Application: 21-06-021
(U 39 M)
Exhibit No.: (PG&E-4)
Date: February 25, 2022
Witness(es): Various

PACIFIC GAS AND ELECTRIC COMPANY

2023 GENERAL RATE CASE

EXHIBIT (PG&E-4)

ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING CHAPTERS 2-13

VOLUME 1 OF 2

[INCLUDES ERRATA THROUGH FEBRUARY 25, 2022 AND FEBRUARY 25, 2022 SUPPLEMENTAL WORKPAPERS]

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
EXHIBIT (PG&E-4)
ELECTRIC DISTRIBUTION

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2023 GENERAL RATE CASE
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[1] New witness from the June 30, 2021 submission.

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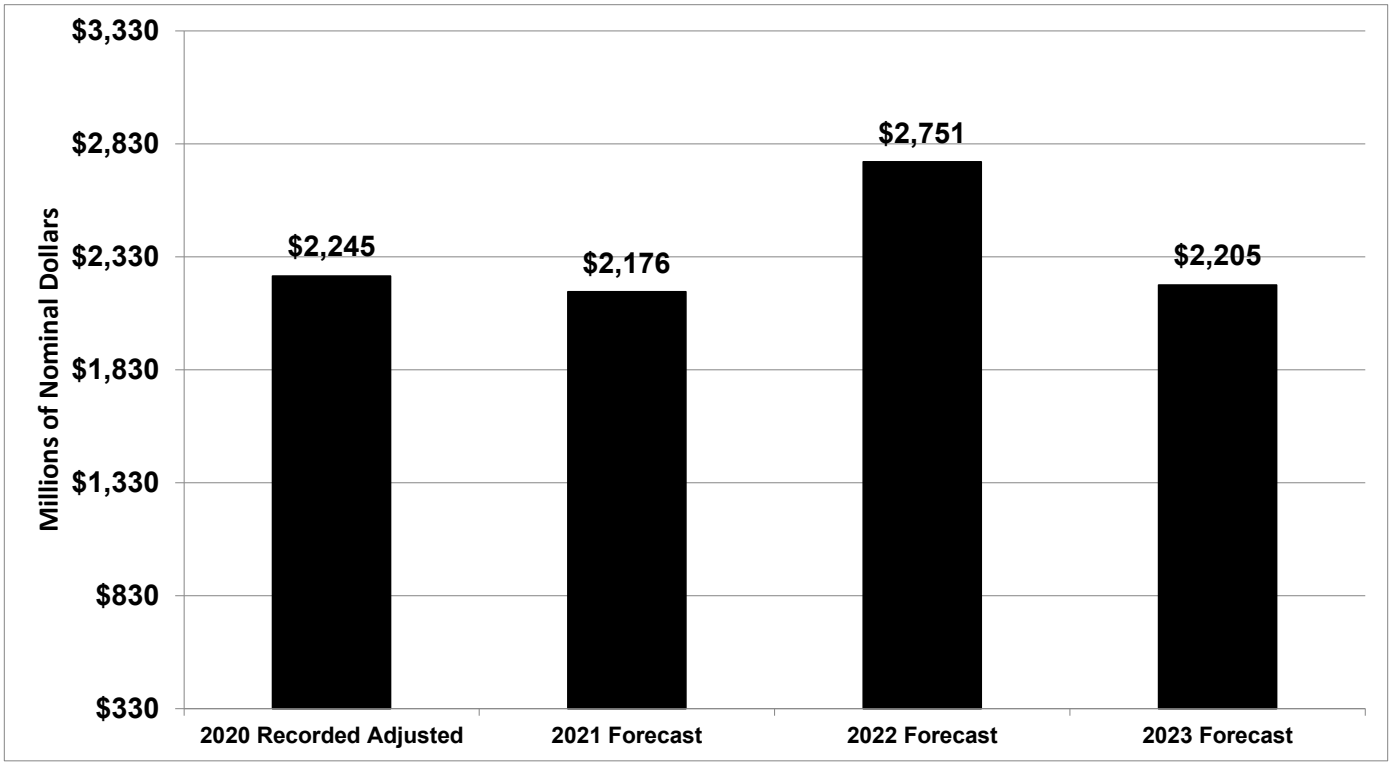
Workpaper Table 2-1
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Expenses
(Millions of Nominal Dollars)

	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	Workpaper Reference	Notes
Electric Distribution Expenses	2,245	2,176	2,751	2,205	WP 2-10, Line 130	(1)

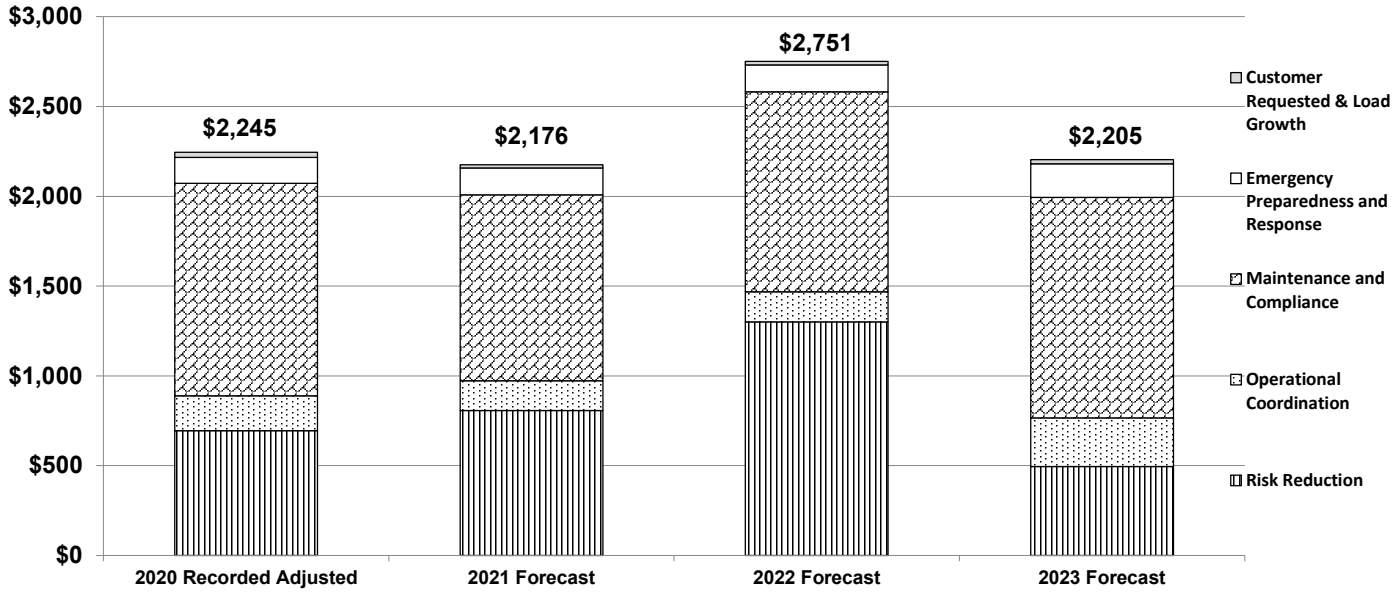


Notes

(1) Expense amounts for 2020-2022 in this chapter include work tracked in memorandum accounts and other separately funded programs which will be rolled into the GRC starting in 2023, shown for trending purposes. Forecast amounts exclude the confidential forecasts for the Elkhorn energy storage project shown in Appendix A.

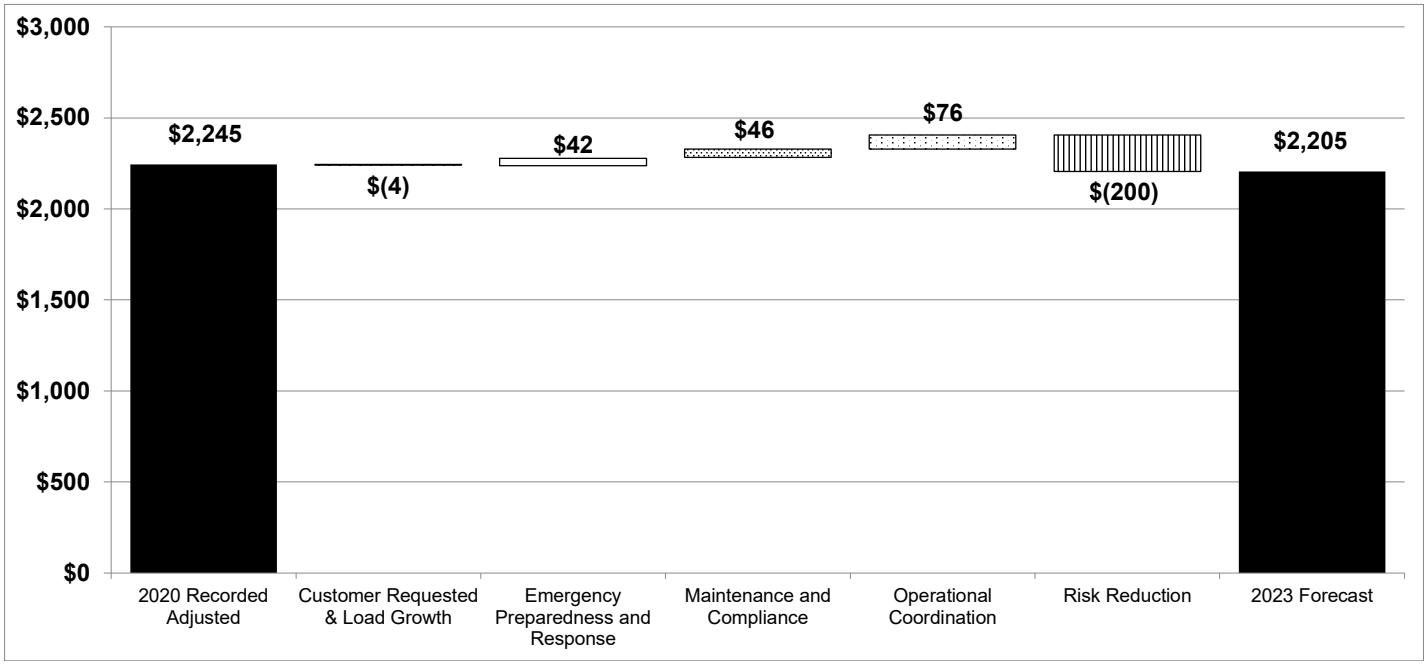
Workpaper Table 2-2
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Expense Forecast by Program Area
(Millions of Nominal Dollars)

	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	Workpaper Reference
Customer Requested & Load Growth	$28	$19	$19	$24	WP 2-10, Line 24
Emergency Preparedness and Response	$144	$149	$149	$187	WP 2-10, Line 36
Maintenance and Compliance	$1,182	$1,035	$1,114	$1,228	WP 2-10, Line 61
Operational Coordination	$194	$166	$168	$270	WP 2-10, Line 90
Risk Reduction	$696	$807	$1,301	$496	WP 2-10, Line 129
Total	$2,245	$2,176	$2,751	$2,205	



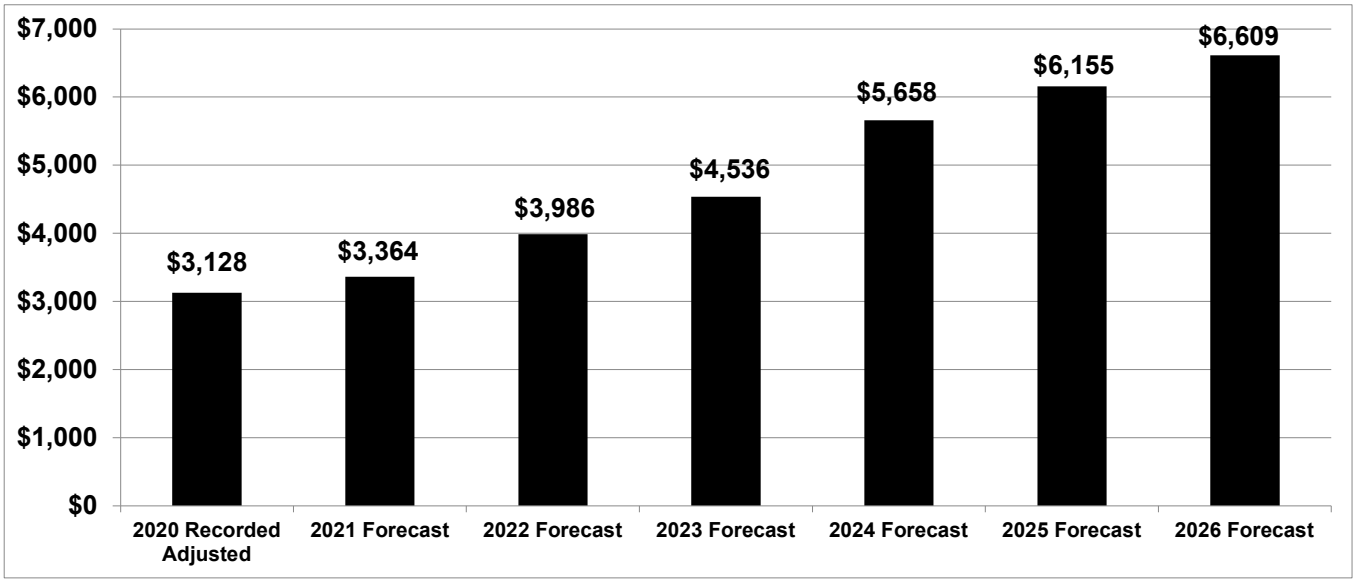
Workpaper Table 2-3
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Expense Walk
(Millions of Nominal Dollars)

		2020-2023 Change	Workpaper Reference
Total 2020 Recorded Adjusted Expenses	2,245		WP 2-10, Line 130
Customer Requested & Load Growth		(4)	WP 2-10, Line 24
Emergency Preparedness and Response		42	WP 2-10, Line 36
Maintenance and Compliance		46	WP 2-10, Line 61
Operational Coordination		76	WP 2-10, Line 90
Risk Reduction		(200)	WP 2-10, Line 129
Total 2023 Forecast Expenses	2,205		WP 2-10, Line 130



Workpaper Table 2-4
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Capital Expenditures
(Millions of Nominal Dollars)

	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Workpaper Reference
Electric Operations Capital Expenditures	3,128	3,364	3,986	4,536	5,658	6,155	6,609	WP 2-10, Line 130

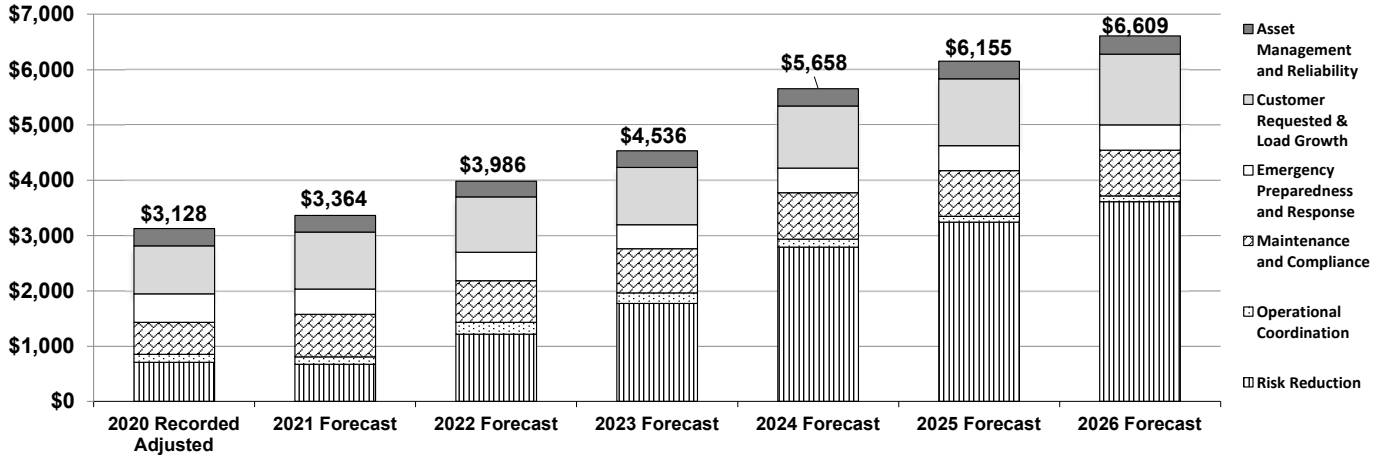


Notes

(1) Capital amounts for 2020-2022 in this chapter include work tracked in memorandum accounts and other separately funded programs which will be rolled into the GRC starting in 2023, shown for trending purposes. Forecast amounts exclude the confidential forecasts for the Elkhorn energy storage project shown in Appendix A.

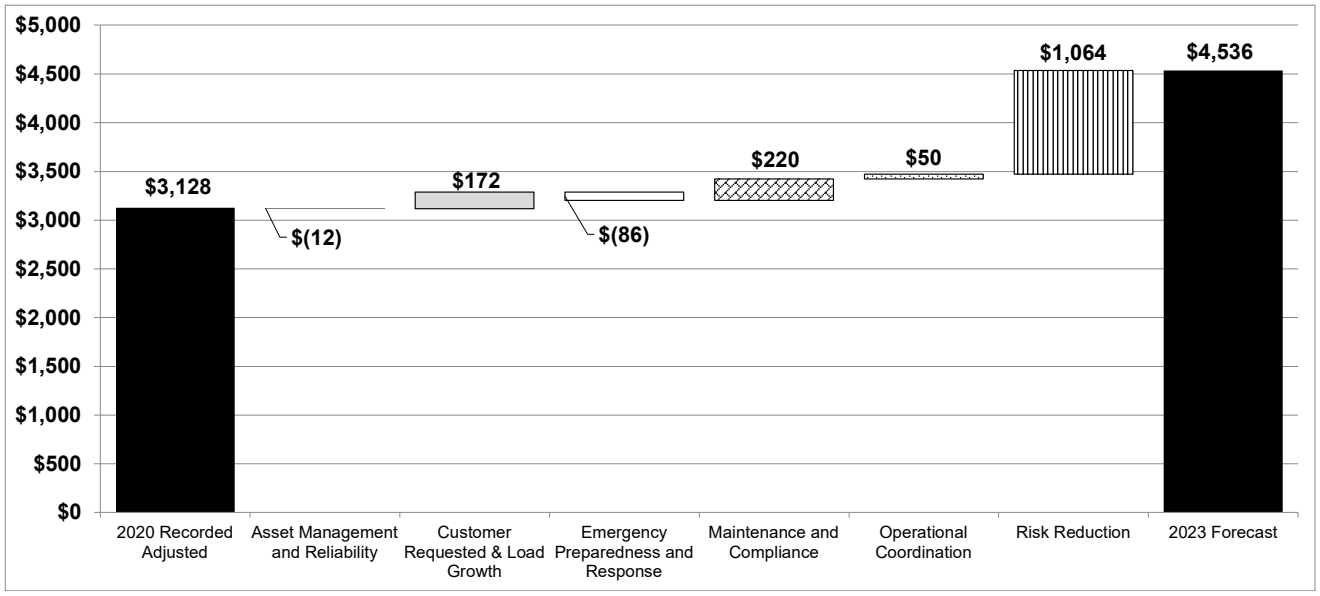
Workpaper Table 2-5
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Capital Forecast by Program Area
(Millions of Nominal Dollars)

	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Workpaper Reference
Asset Management and Reliability	$314	$301	$286	$302	$312	$320	$329	WP 2-10, Line 14
Customer Requested & Load Growth	$864	$1,027	$1,001	$1,035	$1,127	$1,209	$1,278	WP 2-10, Line 24
Emergency Preparedness and Response	$519	$459	$513	$433	$441	$448	$457	WP 2-10, Line 36
Maintenance and Compliance	$579	$769	$755	$799	$839	$831	$828	WP 2-10, Line 61
Operational Coordination	$141	$133	$213	$191	$146	$100	$105	WP 2-10, Line 90
Risk Reduction	$712	$675	$1,218	$1,776	$2,793	$3,246	$3,613	WP 2-10, Line 129
Total	**$3,128**	**$3,364**	**$3,986**	**$4,536**	**$5,658**	**$6,155**	**$6,609**	



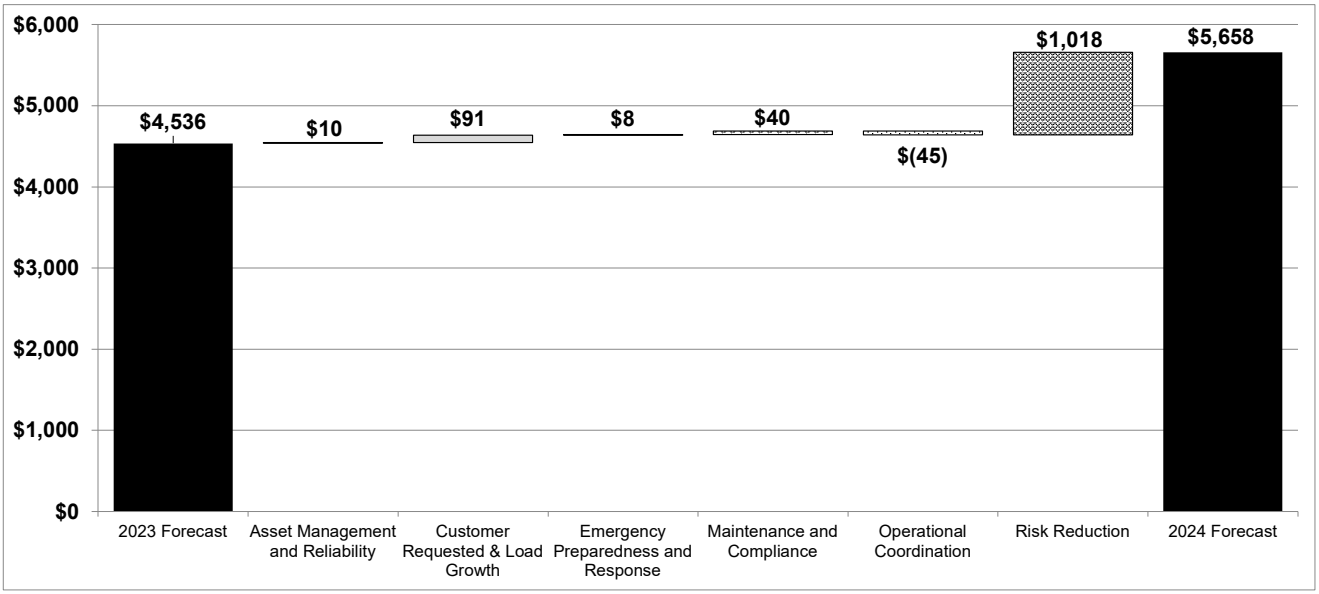
Workpaper Table 2-6
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Capital Expenditures 2020 to 2023 Walk
(Millions of Nominal Dollars)

		2020-2023 Change	Workpaper Reference
Total 2020 Recorded Adjusted Capital	3,128		WP 2-10, Line 130
Asset Management and Reliability		(12)	WP 2-10, Line 14
Customer Requested & Load Growth		172	WP 2-10, Line 24
Emergency Preparedness and Response		(86)	WP 2-10, Line 36
Maintenance and Compliance		220	WP 2-10, Line 61
Operational Coordination		50	WP 2-10, Line 90
Risk Reduction		1064	WP 2-10, Line 129
Total 2023 Forecast Capital	4,536		WP 2-10, Line 130



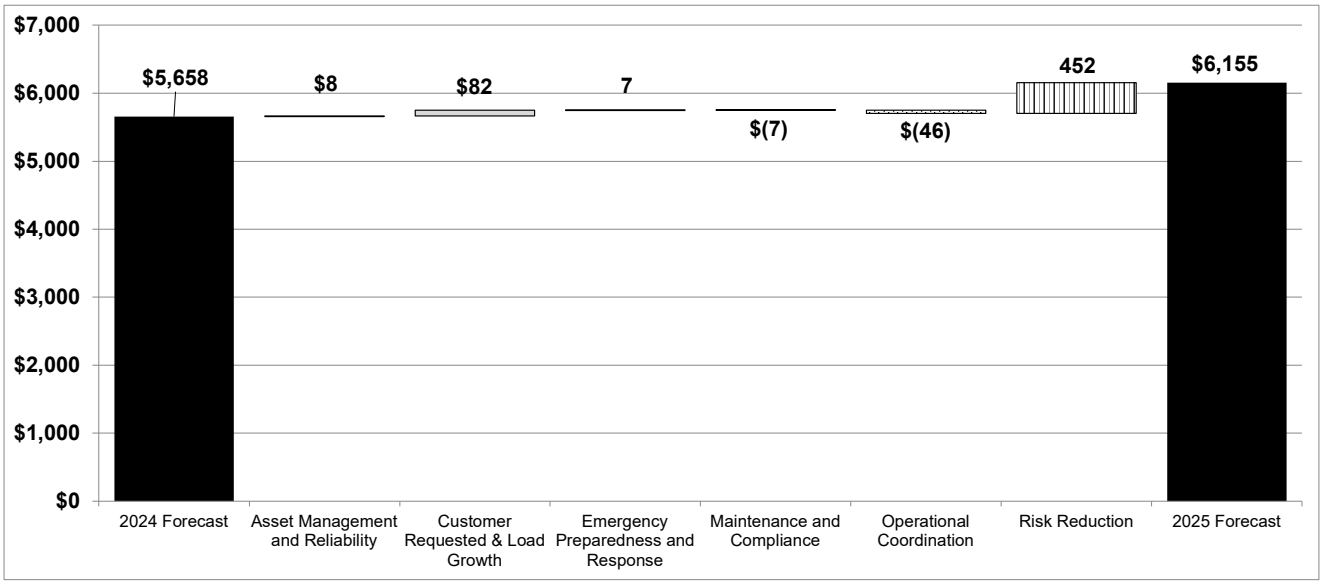
Workpaper Table 2-7
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Capital Expenditures 2023 to 2024 Walk
(Millions of Nominal Dollars)

		2023-2024 Change	Workpaper Reference
Total 2023 Forecast Capital	4,536		WP 2-10, Line 130
Asset Management and Reliability		10	WP 2-10, Line 14
Customer Requested & Load Growth		91	WP 2-10, Line 24
Emergency Preparedness and Response		8	WP 2-10, Line 36
Maintenance and Compliance		40	WP 2-10, Line 61
Operational Coordination		(45)	WP 2-10, Line 90
Risk Reduction		1018	WP 2-10, Line 129
Total 2024 Forecast Capital	5,658		WP 2-10, Line 130



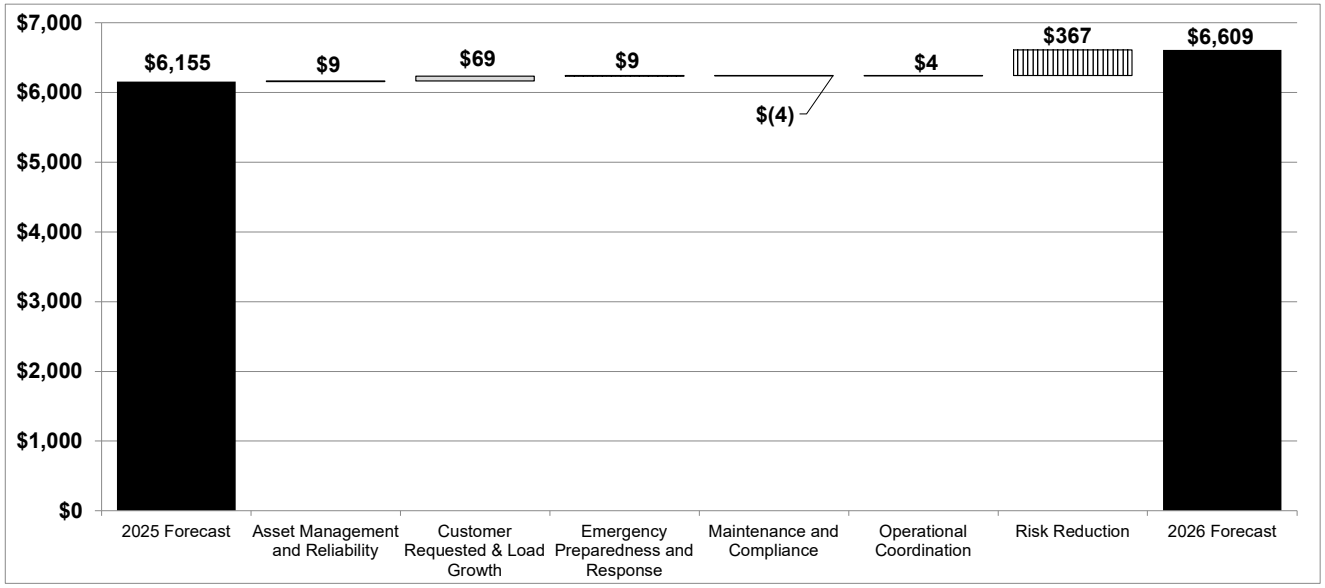
Workpaper Table 2-8
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Capital Expenditures 2024 to 2025 Walk
(Millions of Nominal Dollars)

		2024-2025 Change	Workpaper Reference
Total 2024 Forecast Capital	5,658		WP 2-10, Line 130
Asset Management and Reliability		8	WP 2-10, Line 14
Customer Requested & Load Growth		82	WP 2-10, Line 24
Emergency Preparedness and Response		7	WP 2-10, Line 36
Maintenance and Compliance		(7)	WP 2-10, Line 61
Operational Coordination		(46)	WP 2-10, Line 90
Risk Reduction		452	WP 2-10, Line 129
Total 2025 Forecast Capital	6,155		WP 2-10, Line 130



Workpaper Table 2-9
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Capital Expenditures 2025 to 2026 Walk
(Millions of Nominal Dollars)

		2025-2026 Change	Workpaper Reference
Total 2025 Forecast Capital	6,155		WP 2-10, Line 130
Asset Management and Reliability		9	WP 2-10, Line 14
Customer Requested & Load Growth		69	WP 2-10, Line 24
Emergency Preparedness and Response		9	WP 2-10, Line 36
Maintenance and Compliance		(4)	WP 2-10, Line 61
Operational Coordination		4	WP 2-10, Line 90
Risk Reduction		367	WP 2-10, Line 129
Total 2026 Forecast Capital	6,609		WP 2-10, Line 130



Workpaper Table 2-10
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
2020-2023 Expense and 2020-2026 Capital Forecasts
(Thousands of Nominal Dollars)

Line No				2020 Recorded Adjusted		2021 Forecast		2022 Forecast		2023 Forecast		2024 Forecast	2025 Forecast	2026 Forecast	
				Expense	Capital	Expense	Capital	Expense	Capital	Expense	Capital	Capital	Capital	Capital	Notes
1	**Asset Management and Reliability**	**MWC**	**Chapter**												
2	E Dist Replace OH Asset	08	13		16,059		41,180		32,688		43,036	44,486	45,701	46,934	
3	E Dist Replace UG Asset-Gen	56	13		57,995		90,160		85,382		91,317	93,066	94,845	96,660	
4	E Dist Automation & Protection	09	13		(1)		0		0		0	0	0	0	
5	Build IT Apps & Infra	2F	13		0		0		0		0	0	0	0	
6	E Dist Reliability Ckt/Zone	49	13		20,156		20,921		19,992		22,871	22,566	22,883	25,369	
7	E Dist Inst/Repl Network	2C	14		201		300		3,171		1,312	2,796	2,622	2,467	
8	E Dist Replace UG Asset-Gen	56	14		21,929		25,199		25,199		24,361	25,033	25,722	26,430	
9	E Dist Subst Repl Other Equip	48	15		76,676		76,087		95,800		94,971	87,218	84,078	77,723	
10	E Dist Subst Repl Transformer	54	15		31,907		40,766		22,077		16,014	23,991	28,472	31,329	
11	E Dist Repl Substation Safety	58	15		3,369		5,980		1,738		8,232	12,882	15,743	22,218	
12	Energy Storage Capital	3R	21		86,080		0		0		0	0	0	0	
13	TO-EGI/WRO/SI	82	21		41		121		0		0	0	0	0	
14	**Subtotal**			**0**	**314,412**	**0**	**300,713**	**0**	**286,046**	**0**	**302,113**	**312,039**	**320,065**	**329,130**	
15	**Customer Requested & Load Growth**														
16	E Dist Line Capacity	06	17		107,255		233,720		150,476		137,655	163,173	176,314	187,492	
17	E Dist Subst Capacity	46	17		36,270		78,880		65,191		58,082	68,061	71,985	74,728	
18	E Dist Customer Connects	16	18		536,190		511,868		600,122		666,795	714,625	767,943	796,132	
19	E Dist WRO General	10	18		145,630		155,690		145,048		132,769	139,842	150,827	176,341	
20	E Dist WRO Rule 20A	30	19		38,273		47,288		39,954		39,876	40,957	42,060	43,204	
21	E TD WRO	EW	18	15,521		8,106		8,118		10,283					
22	Manage Service Inquiries	EV	18	12,986		10,879		10,894		13,878					
23	Manage Var Bal Acct Processes	IG	19	(65)		0		0		0					
24	**Subtotal**			**28,443**	**863,617**	**18,985**	**1,027,447**	**19,013**	**1,000,790**	**24,161**	**1,035,178**	**1,126,658**	**1,209,129**	**1,277,895**	
25	**Emergency Preparedness and Response**														
26	EP&R Capital	21	5		0		0		0		3,359	3,334	3,364	3,465	
27	E Dist Major Emergency	95	6		64,253		76,351		78,014		79,996	82,287	84,639	87,058	
28	E Dist Routine Emergency	17	6		247,499		193,244		233,354		239,188	246,137	253,271	260,615	
29	E Dist Subst Emergency Repl	59	15		119,133		101,935		77,872		82,323	84,550	86,831	89,175	
30	Community Rebuild Capital	95	23		88,100		87,513		124,132		28,139	24,585	20,281	16,940	
31	EP&R Expense	AB	5	7,431		10,097		2,314		22,275					
32	E Dist Major Emergency	IF	6	30,973		60,202		60,898		62,788					
33	E Dist Routine Emergency	BH	6	67,075		59,274		59,361		73,678					
34	E Dist Subst O&M	GC	15	9,825		7,586		11,501		14,069					
35	E Dist Major Emergency	IF	23	29,194		12,071		15,138		13,781					
36	**Subtotal**			**144,499**	**518,986**	**149,230**	**459,043**	**149,213**	**513,372**	**186,591**	**433,006**	**440,893**	**448,386**	**457,254**	
37	**Maintenance and Compliance**														
38	Install New Electric Meters	25	8		24,205		27,535		28,700		30,101	31,378	32,713	34,096	
39	Install New Gas Meters	74	8		18,192		53,573		57,511		74,355	83,911	62,855	42,319	
40	E Dist Inst/Repl OH General	2A	11		239,575		318,236		244,519		254,440	261,383	268,318	280,585	
41	E Dist Inst/Repl UG	2B	11		47,590		57,340		60,873		63,731	65,459	70,281	72,170	
42	Poles - Misc Capital	21	12		2,656		0		0		0	0	0	0	
43	E Dist Inst/Repl OH Poles	07	12		246,582		311,884		363,150		376,218	396,715	397,280	398,565	
44	E Dist Inst/Repl Network	2C	14		0		0		0		0	0	0	0	
45	Change/Maint Used Elec Meter	EY	8	6,809		5,079		5,101		7,734					
46	Change/Maint Used Gas Meters	HY	8	1,552		590		610		685					
47	Collect Revenue	IU	8	1,499		1,500		1,570		2,250					
48	Provide Field Service	DD	8	400		411		422		480					
49	Read & Investigate Meters	AR	8	10,096		10,686		10,589		10,425					
50	E Dist Tree Trim Bal Acct	HN	9	693,149		668,123		711,007		871,220					
51	E Dist Tree Trim Bal Acct	IG	9	93,070		67,978		144,000		69,830					
52	E T&D Patrol/Insp	BF	10	160,684		119,647		89,625		89,464					
53	E Dist Maint OH General	KA	11	117,745		62,508		60,713		74,135					
54	E Dist Maint UG	KB	11	13,147		15,079		15,101		18,938					
55	Maint Other Equip	BK	11	1,851		1,619		1,621		1,912					
56	E T&D Maint OH Poles	GA	12	35,496		46,516		40,749		39,340					
57	Manage Var Bal Acct Processes	IG	12	0		0		0		0					
58	Misc Expense - Poles	AB	12	61		21		0		0					
59	E Dist Maint Network	KC	14	4,891		4,198		4,204		5,021					
60	E Dist Subst O&M	GC	15	41,356		31,181		28,230		36,871					
61	**Subtotal**			**1,181,806**	**578,800**	**1,035,135**	**768,568**	**1,113,544**	**754,754**	**1,228,306**	**798,844**	**838,847**	**831,447**	**827,734**	
62	**Operational Coordination**														
63	E T&D Control System/ Facility	63	7		1,117		4,129		4,219		4,333	2,225	2,285	2,347	
64	Build IT Apps & Infra	2F	13		0		0		0		0	0	0	0	
65	E Dist Automation & Protection	09	13		0		0		0		0	0	0	0	
66	E Dist Automation & Protection	09	16		37,437		25,483		26,371		27,003	27,745	28,540	29,281	
67	Build IT Apps & Infra	2F	20		22,788		17,696		21,997		17,987	16,597	16,499	18,506	
68	Data Management and Analytics	21	20		3		0		1,608		1,712	1,825	1,949	2,085	
69	Grid Modernization Capital	21	21		395		2,882		3,083		2,237	1,852	1,902	0	
70	Build IT Apps & Infra	2F	21		26,724		19,540		17,900		20,369	19,086	19,695	17,000	
71	E T&D Control System/ Facility	63	21		44,373		81,885		126,880		109,049	68,042	20,565	26,438	
72	Applied Technology Services	21	22		1,276		(23,542)		1,496		1,493	1,496	1,499	1,502	
73	Tools & Equipment	05	22		6,711		5,203		9,167		6,901	7,079	7,263	7,455	
74	Provide Field Service	DD	7	23,204		18,620		18,685		23,776					
75	E Dist Operate System	BA	7	30,017		23,055		23,089		29,478					
76	Elec Trans Ops Engr & Tech	HG	7	2,074		4,385		7,638		5,392					

Workpaper Table 2-10
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
2020-2023 Expense and 2020-2026 Capital Forecasts
(Thousands of Nominal Dollars)

Line No				2020 Recorded Adjusted		2021 Forecast		2022 Forecast		2023 Forecast		2024 Forecast	2025 Forecast	2026 Forecast	
				Expense	Capital	Expense	Capital	Expense	Capital	Expense	Capital	Capital	Capital	Capital	Notes
77	E T&D Automation & Protection	HX	16	2,344		2,412		2,416		3,008					
78	E Dist Planning & Ops Engineer	FZ	17	15,158		15,447		16,155		19,943					
79	Maintain IT Apps & Infra	JV	20	2,810		3,777		3,333		4,501					
80	E Dist Mapping	GE	20	8,845		15,888		14,108		21,524					
81	Elec Trans Ops Engr & Tech	HG	21	5,154		5,424		2,287		15,541					
82	Maintain IT Apps & Infra	JV	21	1,429		1,345		2,500		3,309					
83	Manage Var Bal Acct Processes	IG	21	686		4,013		5,596		3,026					
84	Grid Modernization Expense	AB	21	3,320		3,926		4,135		10,015					
85	Research & Development	AT	21	0		0		0		2,056					
86	Bill Customers	IS	22	709		862		864		1,641					
87	Electric Distribution Support	AB	22	47,137		6,365		6,412		46,700					
88	Operational Management	OM	22	(4,204)		14,401		14,422		19,513					
89	Operational Support	OS	22	55,555		45,894		45,961		60,931					
90	**Subtotal**			**194,237**	**140,824**	**165,815**	**133,275**	**167,601**	**212,721**	**270,355**	**191,084**	**145,947**	**100,197**	**104,614**	
91	**Risk Reduction**														
92	Situational Awareness and Forecasting	21	4.1		11,649		9,451		9,375		4,601	3,290	3,341	3,446	
93	Public Safety Power Shutoff Operations	21	4.2		2,397		3,084		3,237		262	269	277	284	
94	E Dist Inst/Repl OH General	2A	4.3		7,847		15,125		15,388		15,752	16,257	16,777	17,314	
95	Meter-Based Sensors	21	4.3		(30)		0		0		10,507	0	0	0	
96	E Dist Reliability Ckt/Zone	49	4.3		91,685		89,226		77,153		54,857	54,853	56,803	59,508	
97	E Dist Replace OH Asset	08	4.3		484,916		415,654		1,030,125		1,512,026	2,541,346	3,018,650	3,423,762	
98	Misc Capital	21	4.4		0		0		0		0	0	0	0	
99	Build IT Apps & Infra	2F	4.5		22,658		25,300		25,300		25,300	25,300	25,300	25,300	
100	Emergency Preparedness and Response	21	5		518		2,046		1,966		2,143	2,075	2,093	2,160	
101	E Dist Inst/Repl OH General	2A	11		66,280		97,959		22,636		26,067	43,897	42,273	43,268	
102	E Dist Inst/Repl OH Poles	07	12		0		0		3,303		3,296	3,500	3,709	3,924	
103	E Dist Reliability Ckt/Zone	49	13		19		535		6,731		6,239	6,408	6,695	6,876	
104	E Dist Replace OH Asset	08	13		536		925		949		975	1,001	1,028	1,056	
105	E Dist Replace UG Asset-Gen	56	14		0		0		0		6,510	6,673	6,840	7,011	
106	E Dist Inst/Repl Network	2C	14		22,365		15,568		15,568		12,240	10,809	11,082	11,361	
107	E Dist Subst Repl Other Equip	48	15		701		514		787		1,360	0	0	0	
108	E Dist Subst Repl Transformer	54	15		0		0		5,893		5,229	6,303	6,947	7,392	
109	Community Rebuild Capital	95	23		0		0		0		88,450	71,511	44,087	0	
110	Situational Awareness and Forecasting	AB	4.1	34,022		59,348		54,559		43,416					
111	Public Safety Power Shutoff Operations	AB	4.2	141,178		127,920		119,254		115,266					
112	Meter-Based Sensors	AB	4.3	2,881		1,528		3,486		7,204					
113	E Dist Planning & Ops Engineer	FZ	4.3	1,487		3,256		2,576		3,437					
114	Elec Trans Ops Engr & Tech	HG	4.3	10		134		0		0					
115	E Dist Maint OH General	KA	4.3	0		0		617		953					
116	Develop Generation Balancing Account	IG	4.3	3,494		3,031		0		0					
117	Community Wildfire Safety Program Balancing Account	IG	4.4	119		0		0		0					
118	Community Wildfire Safety Program	AB	4.4	34,144		27,802		14,994		13,460					
119	Information Technology for Wildfire Mitigations	AB	4.5	5,500		0		0		0					
120	Information Technology for Wildfire Mitigations Balancing	IG	4.5	21,358		35,700		35,700		35,700					
121	E Dist Operate System	BA	4.6	0		2,998		2,152		2,219					(1)
122	E Dist Planning & Ops Engineer	BH	4.6	0		12,658		109,095		112,510					(1)
123	E Dist Subst O&M	FZ	4.6	0		2,046		7,169		2,063					(1)
124	E Dist Routine Emergency	GC	4.6	0		0		808		833					(1)
125	Manage Var Bal Acct Processes	IG	4.6	0		502		29,697		33,504					(1)
126	Emergency Preparedness and Response	AB	5	125		(5,888)		1,894		4,176					
127	Vegetation Management Balancing Account	IG	9	451,390		535,952		916,600		118,022					
128	Wildfire Distribution Risk Model Improvements	AB	22	0		0		2,742		2,810					
129	**Subtotal**			**695,709**	**711,540**	**806,985**	**675,387**	**1,301,344**	**1,218,412**	**495,573**	**1,775,815**	**2,793,492**	**3,245,901**	**3,612,663**	
130	**Total**			**2,244,694**	**3,128,179**	**2,176,151**	**3,364,432**	**2,750,714**	**3,986,096**	**2,204,986**	**4,536,041**	**5,657,875**	**6,155,126**	**6,609,290**	

(1) "2021 Forecast" values for Chapter 4.6 represent recorded costs rather than forecast costs

Workpaper Table 2-11
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Expense Forecast by Chapter
(Thousands of Nominal Dollars)

Line No.	Ch.	Chapter Title	Programs	MWC	2020 Recorded Total	2021 Forecast Total	2022 Forecast Total	2023 Forecast Total	Notes
1	4.1	Situational Awareness and Forecasting	Misc Expense	AB	$ 34,022	$ 59,348	$ 54,559	$ 43,416	
2					**$ 34,022**	**$ 59,348**	**$ 54,559**	**$ 43,416**	
3	4.2	PSPS Operations	Misc Expense	AB	$ 141,178	$ 127,920	$ 119,254	$ 115,266	
4					**$ 141,178**	**$ 127,920**	**$ 119,254**	**$ 115,266**	
5	4.3	System Hardening, Enhanced Automation and PSPS Impact Mitigations	E Dist Planning & Ops Engineer	FZ	$ 1,487	$ 3,256	$ 2,576	$ 3,437	
6			Elec Trans Ops Engr & Tech	HG	$ 10	$ 134	$ -	$ -	
7			E Dist Maint OH General	KA	$ -	$ -	$ 617	$ 953	
8			Manage Var Bal Acct Processes	IG	$ 3,494	$ 3,031	$ -	$ -	
9			Misc Expense	AB	$ 2,881	$ 1,528	$ 3,486	$ 7,204	
10					**$ 7,872**	**$ 7,949**	**$ 6,679**	**$ 11,595**	
11	4.4	Community Wildfire Safety Program PMO	Misc Expense	AB	$ 34,144	$ 27,802	$ 14,994	$ 13,460	
12			Manage Var Bal Acct Processes	IG	$ 119	$ -	$ -	$ -	
13					**$ 34,263**	**$ 27,802**	**$ 14,994**	**$ 13,460**	
14	4.5	Information Technology for Wildfire Mitigations	Manage Var Bal Acct Processes	IG	$ 21,358	$ 35,700	$ 35,700	$ 35,700	
15			Misc Expense	AB	$ 5,500	$ -	$ -	$ -	
16					**$ 26,858**	**$ 35,700**	**$ 35,700**	**$ 35,700**	
17	4.6	Enhanced Powerline Safety Settings	E Dist Operate System	BA	$ -	$ 2,998	$ 2,152	$ 2,219	(1)
18			E Dist Planning & Ops Engineer	BH	$ -	$ 12,658	$ 109,095	$ 112,510	(1)
19			E Dist Subst O&M	FZ	$ -	$ 2,046	$ 7,169	$ 2,063	(1)
20			E Dist Routine Emergency	GC	$ -	$ -	$ 808	$ 833	(1)
21			Manage Var Bal Acct Processes	IG	$ -	$ 502	$ 29,697	$ 33,504	(1)
22					**$ -**	**$ 18,203**	**$ 148,921**	**$ 151,129**	
23	5	Emergency Preparedness and Response	Misc Expense	AB	$ 7,556	$ 4,209	$ 4,208	$ 26,451	
24					**$ 7,556**	**$ 4,209**	**$ 4,208**	**$ 26,451**	
25	6	Electric Emergency Recovery	E Dist Major Emergency	IF	$ 30,973	$ 60,202	$ 60,898	$ 62,788	
26			E Dist Routine Emergency	BH	$ 67,075	$ 59,274	$ 59,361	$ 73,678	
27					**$ 98,049**	**$ 119,477**	**$ 120,259**	**$ 136,466**	
28	7	Distribution System Operations	E Dist Operate System	BA	$ 30,017	$ 23,055	$ 23,089	$ 29,478	
29			Elec Trans Ops Engr & Tech	HG	$ 2,074	$ 4,385	$ 7,638	$ 5,392	
30			Provide Field Service	DD	$ 23,204	$ 18,620	$ 18,685	$ 23,776	
31					**$ 55,294**	**$ 46,061**	**$ 49,412**	**$ 58,646**	
32	8	Field Metering	Change/Maint Used Elec Meter	EY	$ 6,809	$ 5,079	$ 5,101	$ 7,734	
33			Change/Maint Used Gas Meters	HY	$ 1,552	$ 590	$ 610	$ 685	
34			Collect Revenue	IU	$ 1,499	$ 1,500	$ 1,570	$ 2,250	
35			Provide Field Service	DD	$ 400	$ 411	$ 422	$ 480	
36			Read & Investigate Meters	AR	$ 10,096	$ 10,686	$ 10,589	$ 10,425	
37					**$ 20,355**	**$ 18,266**	**$ 18,292**	**$ 21,574**	
38	9	Vegetation Management	E Dist Tree Trim Bal Acct	HN	$ 693,149	$ 668,123	$ 711,007	$ 871,220	
39			Manage Var Bal Acct Processes	IG	$ 544,461	$ 603,930	$ 1,060,600	$ 187,853	
40					**$ 1,237,610**	**$ 1,272,053**	**$ 1,771,608**	**$ 1,059,072**	
41	10	Overhead and Underground Electric Asset Inspections	E T&D Patrol/Insp	BF	$ 160,684	$ 119,647	$ 89,625	$ 89,464	
42					**$ 160,684**	**$ 119,647**	**$ 89,625**	**$ 89,464**	
43	11	Overhead and Underground Electric Distribution Maintenance	E Dist Maint OH General	KA	$ 117,745	$ 62,508	$ 60,713	$ 74,135	
44			E Dist Maint UG	KB	$ 13,147	$ 15,079	$ 15,101	$ 18,938	
45			Maint Other Equip	BK	$ 1,851	$ 1,619	$ 1,621	$ 1,912	
46					**$ 132,744**	**$ 79,206**	**$ 77,436**	**$ 94,985**	
47	12	Pole Asset Management	E T&D Maint OH Poles	GA	$ 35,496	$ 46,516	$ 40,749	$ 39,340	
48			Manage Var Bal Acct Processes	IG	$ 0	$ -	$ -	$ -	
49			Misc Expense	AB	$ 61	$ 21	$ -	$ -	
50					**$ 35,557**	**$ 46,537**	**$ 40,749**	**$ 39,340**	
51	14	Network Asset Management	E Dist Maint Network	KC	$ 4,891	$ 4,198	$ 4,204	$ 5,021	
52					**$ 4,891**	**$ 4,198**	**$ 4,204**	**$ 5,021**	
53	15	Substation Asset Management	E Dist Subst O&M	GC	$ 51,181	$ 38,767	$ 39,731	$ 50,940	
54					**$ 51,181**	**$ 38,767**	**$ 39,731**	**$ 50,940**	
55	16	Distribution System Automation and Protection	E T&D Automation & Protection	HX	$ 2,344	$ 2,412	$ 2,416	$ 3,008	
56					**$ 2,344**	**$ 2,412**	**$ 2,416**	**$ 3,008**	
57	17	Electric Distribution Capacity, Engineering and Planning	E Dist Planning & Ops Engineer	FZ	$ 15,158	$ 15,447	$ 16,155	$ 19,943	
58					**$ 15,158**	**$ 15,447**	**$ 16,155**	**$ 19,943**	
59	18	New Business and Work at the Request of Others	E TD WRO	EW	$ 15,521	$ 8,106	$ 8,118	$ 10,283	
60			Manage Service Inquiries	EV	$ 12,986	$ 10,879	$ 10,894	$ 13,878	
61					**$ 28,507**	**$ 18,985**	**$ 19,013**	**$ 24,161**	
62	19	Rule 20A	Manage Var Bal Acct Processes	IG	$ (65)	$ -	$ -	$ -	
63					**$ (65)**	**$ -**	**$ -**	**$ -**	
64	20	Electric Distribution Data Management and Technology	E Dist Mapping	GE	$ 8,845	$ 15,888	$ 14,108	$ 21,524	
65			Maintain IT Apps & Infra	JV	$ 2,810	$ 3,777	$ 3,333	$ 4,501	
66					**$ 11,655**	**$ 19,665**	**$ 17,441**	**$ 26,026**	
67	21	Integrated Grid Platform and Grid Modernization Plan	Elec Trans Ops Engr & Tech	HG	$ 5,154	$ 5,424	$ 2,287	$ 15,541	
68			Maintain IT Apps & Infra	JV	$ 1,429	$ 1,345	$ 2,500	$ 3,309	
69			Manage Var Bal Acct Processes	IG	$ 686	$ 4,013	$ 5,596	$ 3,026	
70			Misc Expense	AB	$ 3,320	$ 3,926	$ 4,135	$ 10,015	
71			Research & Development	AT	$ -	$ -	$ -	$ 2,056	
72					**$ 10,589**	**$ 14,708**	**$ 14,518**	**$ 33,947**	
73	22	Electric Distribution Support Activities	Bill Customers	IS	$ 709	$ 862	$ 864	$ 1,641	
74			Misc Expense	AB	$ 47,137	$ 6,365	$ 9,155	$ 49,510	
75			Operational Management	OM	$ (4,204)	$ 14,401	$ 14,422	$ 19,513	
76			Operational Support	OS	$ 55,555	$ 45,894	$ 45,961	$ 60,931	
77					**$ 99,196**	**$ 67,522**	**$ 70,401**	**$ 131,594**	
78	23	Community Rebuild Program	Community Rebuild Expense	IF	$ 29,194	$ 12,071	$ 15,138	$ 13,781	
79					**$ 29,194**	**$ 12,071**	**$ 15,138**	**$ 13,781**	
80			**Total Expense**		**$ 2,244,694**	**$ 2,176,151**	**$ 2,750,714**	**$ 2,204,986**	

(1) "2021 Forecast" values for Chapter 4.6 represent recorded costs rather than forecast costs

Workpaper Table 2-12
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Capital Forecast by Chapter
(Thousands of Nominal Dollars)

Line No.	Ch.	Chapter Title	Programs	MWC	2020 Recorded Total	2021 Forecast Total	2022 Forecast Total	2023 Forecast Total	2024 Forecast Total	2025 Forecast Total	2026 Forecast Total
1	4.1	Situational Awareness and Forecasting	Misc Capital	21	$ 11,649	$ 9,451	$ 9,375	$ 4,601	$ 3,290	$ 3,341	$ 3,446
2					**$ 11,649**	**$ 9,451**	**$ 9,375**	**$ 4,601**	**$ 3,290**	**$ 3,341**	**$ 3,446**
3	4.2	PSPS Operations	Misc Capital	21	$ 2,397	$ 3,084	$ 3,237	$ 262	$ 269	$ 277	$ 284
4					**$ 2,397**	**$ 3,084**	**$ 3,237**	**$ 262**	**$ 269**	**$ 277**	**$ 284**
5	4.3	System Hardening, Enhanced Automation and PSPS Impact Mitigations	E Dist Replace OH Asset	08	$ 484,916	$ 415,654	$ 1,030,125	$ 1,512,026	$ 2,541,346	$ 3,018,650	$ 3,423,762
6			E Dist Inst/Repl OH General	2A	$ 7,847	$ 15,125	$ 15,388	$ 15,752	$ 16,257	$ 16,777	$ 17,314
7			E Dist Reliability Ckt/Zone	49	$ 91,685	$ 89,226	$ 77,153	$ 54,857	$ 54,853	$ 56,803	$ 59,508
8			Misc Capital	21	$ (30)	$ -	$ -	$ 10,507	$ -	$ -	$ -
9					**$ 584,417**	**$ 520,005**	**$ 1,122,667**	**$ 1,593,142**	**$ 2,612,456**	**$ 3,092,230**	**$ 3,500,584**
10	4.4	Community Wildfire Safety Program PMO	Misc Capital	21	$ 0	$ -	$ -	$ -	$ -	$ -	$ -
11					**$ 0**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
12	4.5	Information Technology for Wildfire Mitigations	Build IT Apps & Infra	2F	$ 22,658	$ 25,300	$ 25,300	$ 25,300	$ 25,300	$ 25,300	$ 25,300
13					**$ 22,658**	**$ 25,300**	**$ 25,300**	**$ 25,300**	**$ 25,300**	**$ 25,300**	**$ 25,300**
14	5	Emergency Preparedness and Response	Misc Capital	21	$ 518	$ 2,046	$ 1,966	$ 5,502	$ 5,409	$ 5,457	$ 5,626
15					**$ 518**	**$ 2,046**	**$ 1,966**	**$ 5,502**	**$ 5,409**	**$ 5,457**	**$ 5,626**
16	6	Electric Emergency Recovery	E Dist Major Emergency	95	$ 64,253	$ 76,351	$ 78,014	$ 79,996	$ 82,287	$ 84,639	$ 87,058
17			E Dist Routine Emergency	17	$ 247,499	$ 193,244	$ 233,354	$ 239,188	$ 246,137	$ 253,271	$ 260,615
18					**$ 311,753**	**$ 269,595**	**$ 311,368**	**$ 319,184**	**$ 328,424**	**$ 337,910**	**$ 347,674**
19	7	Distribution System Operations	E T&D Control System/ Facility	63	$ 1,117	$ 4,129	$ 4,219	$ 4,333	$ 2,225	$ 2,285	$ 2,347
20					**$ 1,117**	**$ 4,129**	**$ 4,219**	**$ 4,333**	**$ 2,225**	**$ 2,285**	**$ 2,347**
21	8	Field Metering	Install New Electric Meters	25	$ 24,205	$ 27,535	$ 28,700	$ 30,101	$ 31,378	$ 32,713	$ 34,096
22			Install New Gas Meters	74	$ 18,192	$ 53,573	$ 57,511	$ 74,355	$ 83,911	$ 62,855	$ 42,319
23					**$ 42,397**	**$ 81,108**	**$ 86,211**	**$ 104,455**	**$ 115,290**	**$ 95,568**	**$ 76,414**
24	11	Overhead and Underground Electric Distribution Maintenance	E Dist Inst/Repl UG	2B	$ 47,590	$ 57,340	$ 60,873	$ 63,731	$ 65,459	$ 70,281	$ 72,170
25			E Dist Inst/Repl OH General	2A	$ 305,856	$ 416,195	$ 267,155	$ 280,507	$ 305,280	$ 310,591	$ 323,852
26					**$ 353,446**	**$ 473,535**	**$ 328,029**	**$ 344,238**	**$ 370,739**	**$ 380,872**	**$ 396,023**
27	12	Pole Asset Management	Misc Capital	21	$ 2,656	$ -	$ -	$ -	$ -	$ -	$ -
28			E Dist Inst/Repl OH Poles	07	$ 246,582	$ 311,884	$ 366,453	$ 379,514	$ 400,215	$ 400,989	$ 402,489
29					**$ 249,238**	**$ 311,884**	**$ 366,453**	**$ 379,514**	**$ 400,215**	**$ 400,989**	**$ 402,489**
30	13	Overhead and Underground Asset Management	E Dist Replace UG Asset-Gen	56	$ 57,995	$ 90,160	$ 85,382	$ 91,317	$ 93,066	$ 94,845	$ 96,660
31			Build IT Apps & Infra	2F	$ 0	$ -	$ -	$ -	$ -	$ -	$ -
32			E Dist Automation & Protection	09	$ (1)	$ -	$ -	$ -	$ -	$ -	$ -
33			E Dist Reliability Ckt/Zone	49	$ 20,175	$ 21,455	$ 26,722	$ 29,110	$ 28,974	$ 29,578	$ 32,245
34			E Dist Replace OH Asset	08	$ 16,595	$ 42,105	$ 33,637	$ 44,011	$ 45,487	$ 46,729	$ 47,990
35					**$ 94,764**	**$ 153,720**	**$ 145,742**	**$ 164,438**	**$ 167,528**	**$ 171,152**	**$ 176,895**
36	14	Network Asset Management	E Dist Inst/Repl Network	2C	$ 22,566	$ 15,868	$ 18,739	$ 13,552	$ 13,605	$ 13,704	$ 13,828
37			E Dist Replace UG Asset-Gen	56	$ 21,929	$ 25,199	$ 25,199	$ 30,871	$ 31,706	$ 32,562	$ 33,441
38					**$ 44,495**	**$ 41,067**	**$ 43,938**	**$ 44,423**	**$ 45,312**	**$ 46,265**	**$ 47,269**
39	15	Substation Asset Management	E Dist Repl Substation Safety	58	$ 3,369	$ 5,980	$ 1,738	$ 8,232	$ 12,882	$ 15,743	$ 22,218
40			E Dist Subst Emergency Repl	59	$ 119,133	$ 101,935	$ 77,872	$ 82,323	$ 84,550	$ 86,831	$ 89,175
41			E Dist Subst Repl Other Equip	48	$ 77,377	$ 76,601	$ 96,588	$ 96,331	$ 87,218	$ 84,078	$ 77,723
42			E Dist Subst Repl Transformer	54	$ 31,907	$ 40,766	$ 27,970	$ 21,243	$ 30,294	$ 35,418	$ 38,721
43					**$ 231,786**	**$ 225,282**	**$ 204,167**	**$ 208,129**	**$ 214,944**	**$ 222,071**	**$ 227,837**
44	16	Distribution System Automation and Protection	E Dist Automation & Protection	09	$ 37,437	$ 25,483	$ 26,371	$ 27,003	$ 27,745	$ 28,540	$ 29,281
45					**$ 37,437**	**$ 25,483**	**$ 26,371**	**$ 27,003**	**$ 27,745**	**$ 28,540**	**$ 29,281**
46	17	Electric Distribution Capacity, Engineering and Planning	E Dist Line Capacity	06	$ 107,255	$ 233,720	$ 150,476	$ 137,655	$ 163,173	$ 176,314	$ 187,492
47			E Dist Subst Capacity	46	$ 36,270	$ 78,880	$ 65,191	$ 58,082	$ 68,061	$ 71,985	$ 74,728
48					**$ 143,525**	**$ 312,600**	**$ 215,667**	**$ 195,738**	**$ 231,234**	**$ 248,299**	**$ 262,219**
49	18	New Business and Work at the Request of Others	E Dist Customer Connects	16	$ 536,190	$ 511,868	$ 600,122	$ 666,795	$ 714,625	$ 767,943	$ 796,132
50			E Dist WRO General	10	$ 145,630	$ 155,690	$ 145,048	$ 132,769	$ 139,842	$ 150,827	$ 176,341
51					**$ 681,819**	**$ 667,558**	**$ 745,170**	**$ 799,564**	**$ 854,467**	**$ 918,770**	**$ 972,473**
52	19	Rule 20A	E Dist WRO Rule 20A	30	$ 38,273	$ 47,288	$ 39,954	$ 39,876	$ 40,957	$ 42,060	$ 43,204
53					**$ 38,273**	**$ 47,288**	**$ 39,954**	**$ 39,876**	**$ 40,957**	**$ 42,060**	**$ 43,204**
54	20	Electric Distribution Data Management and Technology	Build IT Apps & Infra	2F	$ 22,788	$ 17,696	$ 21,997	$ 17,987	$ 16,597	$ 16,499	$ 18,506
55			Misc Capital	21	$ 3	$ -	$ 1,608	$ 1,712	$ 1,825	$ 1,949	$ 2,085
56					**$ 22,791**	**$ 17,696**	**$ 23,605**	**$ 19,700**	**$ 18,421**	**$ 18,448**	**$ 20,591**
57	21	Integrated Grid Platform and Grid Modernization Plan	TO-EGI/WRO/SI	82	$ 41	$ 121	$ -	$ -	$ -	$ -	$ -
58			Build IT Apps & Infra	2F	$ 26,724	$ 19,540	$ 17,900	$ 20,369	$ 19,086	$ 19,695	$ 17,000
59			E T&D Control System/ Facility	63	$ 44,373	$ 81,885	$ 126,880	$ 109,049	$ 68,042	$ 20,565	$ 26,438
60			Energy Storage Capital	3R	$ 86,080	$ -	$ -	$ -	$ -	$ -	$ -
61			Misc Capital	21	$ 395	$ 2,882	$ 3,083	$ 2,237	$ 1,852	$ 1,902	$ -
62					**$ 157,613**	**$ 104,428**	**$ 147,863**	**$ 131,655**	**$ 88,981**	**$ 42,163**	**$ 43,438**
63	22	Electric Distribution Support Activities	Misc Capital	21	$ 1,276	$ (23,542)	$ 1,496	$ 1,493	$ 1,496	$ 1,499	$ 1,502

Workpaper Table 2-12
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Capital Forecast by Chapter
(Thousands of Nominal Dollars)

Line No.	Ch.	Chapter Title	Programs	MWC	2020 Recorded Total	2021 Forecast Total	2022 Forecast Total	2023 Forecast Total	2024 Forecast Total	2025 Forecast Total	2026 Forecast Total
64			Tools & Equipment	05	$ 6,711	$ 5,203	$ 9,167	$ 6,901	$ 7,079	$ 7,263	$ 7,455
65					**$ 7,987**	**$ (18,340)**	**$ 10,663**	**$ 8,394**	**$ 8,575**	**$ 8,762**	**$ 8,956**
66	23	Community Rebuild Program	Community Rebuild Capital	95	$ 88,100	$ 87,513	$ 124,132	$ 116,590	$ 96,095	$ 64,368	$ 16,940
67					**$ 88,100**	**$ 87,513**	**$ 124,132**	**$ 116,590**	**$ 96,095**	**$ 64,368**	**$ 16,940**
68			**Total Capital**		**$ 3,128,179**	**$ 3,364,432**	**$ 3,986,096**	**$ 4,536,041**	**$ 5,657,875**	**$ 6,155,126**	**$ 6,609,290**

(1) "2021 Forecast" values for Chapter 4.6 represent recorded costs rather than forecast costs

Workpaper Table 2-13
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 2
Deferred Work Analysis Summary

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Line	2023 GRC Chapter	Type	MWC	MAT CODE	Description	Check 1	Check 2		Check 3	Deferred Work	Explanation	Units Comparison			Dollar Comparison ($000s)		
							Check 2a	*Check 2b*				2020 Rec. Adj. Units + 2021 to 2022 Forecast (A)	2020 to 2022 Imputed Units (B)	Units Difference (A-B)	2020 Rec. Adj. + 2021 to 2022 $$ Forecast (C)	2020 to 2022 Imputed $$ (D)	$$ Difference (C-D)
1	4	Capital	08	08W	System Hardening Wildfire Resiliency projects	Yes	Yes	No	No	No	No deferred work. PG&E expects to spend less than imputed amounts, but will return excess amounts to customers per the terms of the Wildfire Mitigation Balancing Account.	1,044	1,021	23	$ 1,930,694	$ 2,360,449	$ (429,755)
2	4	Capital	21	N/A	Emergency Preparedness and Response Wildfire Mitigation projects	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 39,163	$ 25,235	$ 13,928
3	4	Capital	2A	2AP	Expulsion Fuse Replacement	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units and spend more than the imputed adopted amount.	3,033	1,875	1,158	$ 38,360	$ 16,280	$ 22,079
4	4	Capital	2F	N/A	IT Wildfire Support	Yes	No	No	No	No	No deferred work. Work not unitized, and was not included in the 2020 GRC forecast.	0	0	0	$ 73,258	$ -	$ 73,258
5	4	Capital	49	49A	Automation and Protection	Yes	No	No	No	No	No deferred work. Work not unitized. PG&E added SCADA operability on additional reclosers for wildfire mitigation.	0	0	0	$ 8,446	$ -	$ 8,446
6	4	Capital	49	49H	PSPS Sect Device Install/Replace	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	922	224	698	$ 133,250	$ 16,280	$ 116,970
7	4	Capital	49	49I	Distribution Grid Sensors	Yes	Yes	No	No	No	No deferred work. This work was not included in the 2020 GRC forecast.	2,672	0	2,672	$ 37,677	$ -	$ 37,677
8	4	Capital	49	49M	Temporary Distribution Microgrids (Pre-Interconnection Hubs)	Yes	Yes	Yes	No	No	No deferred work. PG&E expects to develop fewer microgrid locations than forecast in the 2020 GRC, but expects to spend more than the imputed adopted amount. No additional locations are forecast in the 2023 GRC.	20	31	(11)	$ 43,725	$ 34,054	$ 9,671
9	4	Capital	49	49R	Rapid Earth Fault Current Limiter	Yes	No	No	No	No	No deferred work. This work was not included in the 2020 GRC forecast.	0	0	0	$ 29,898	$ -	$ 29,898
10	4	Capital	49	49T	Automation and Protection - FuseSaver	Yes	Yes	Yes	Yes	No	No deferred work. PG&E focused resources on the Rapid Earth Fault Current Limiter pilot in 2020, and will resume installations in 2021. This work is subject to balancing account treatment, so any underspend in the 2020 GRC timeframe will be returned to customers.	143	316	(173)	$ 5,069	$ 6,646	$ (1,577)
11	4	Expense	AB	N/A	PSPS and Situational Awareness and Forecasting mitigations	Yes	No	No	No	No	No deferred work. Work not unitized. PG&E forecasts to spend more than imputed adopted amounts due to PSPS operations costs not forecast in the 2020 GRC.	0	0	0	$ 626,615	$ 131,644	$ 494,971
12	4	Expense	BA	BAF	Genl Operate	Yes	No	No	No	No	No deferred work. This work was not included in the 2020 GRC forecast.	0	0	0	$ 4,694	$ -	$ 4,694

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13	4	Expense	BA	BAH	FLISR Maintenance	Yes	No	No	No	No	No deferred work. This work was not included in the 2020 GRC forecast.	0	0	0	$ 456	$ -	$ 456
14	4	Expense	BH	BHE	FAS Emergency Resp - OH Elect	Yes	No	No	No	No	No deferred work. This work was not included in the 2020 GRC forecast.	0	0	0	$ 121,753	$ -	$ 121,753
15	4	Expense	FZ	FZ#, FZA	Asset Performance Center	Yes	No	No	No	No	No deferred work. Work not unitized. Imputed adopted amounts for Asset Performance Center are included in the Ch 17 MAT FZA amounts.	0	0	0	$ 14,903	$ -	$ 14,903
16	4	Expense	FZ	FZE	Troublemen Field Work	Yes	No	No	No	No	No deferred work. This work was not included in the 2020 GRC forecast.	0	0	0	$ 1,631	$ -	$ 1,631
17	4	Expense	GC	GC2	Troublemen Field Work	Yes	No	No	No	No	No deferred work. This work was not included in the 2020 GRC forecast.	0	0	0	$ 808	$ -	$ 808
18	4	Expense	HG	HG#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 144	$ 1,089	$ (945)
19	4	Expense	IG	IG#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized. Technology to support wildfire mitigations was not included in the 2020 GRC forecast.	0	0	0	$ 129,601	$ -	$ 129,601
20	4	Expense	JV	JV#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ -	$ -	$ -
21	4	Expense	KA	KAT	Not assigned	No	No	No	No	No	No deferred work. Work not unitized, and was not included in the 2020 GRC forecast.	0	0	0	$ 617	$ -	$ 617
22	5	Capital	21	21A	EP&R Capital	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 4,530	$ 3,642	$ 888
23	5	Expense	AB	AB6	EP&R Expense	Yes	No	No	No	No	No deferred work. Work not unitized. Underspend is attributed to cost saving initiatives incorporated into forecast.	0	0	0	$ 15,973	$ 19,804	$ (3,831)
24	6	Capital	17	N/A	ED Routine Emergency	Yes	No	No	No	No	No deferred work. Work is demand driven and not unitized. PG&E expects to spend more than imputed adopted amounts.	0	0	0	$ 674,097	$ 565,406	$ 108,691
25	6	Capital	95	N/A	ED Major Emergency	Yes	No	No	No	No	No deferred work. Work is demand driven and not unitized. PG&E expects to spend more than imputed adopted amounts.	0	0	0	$ 218,619	$ 169,717	$ 48,902
26	6	Expense	BH	N/A	ED Routine Emergency	Yes	No	No	No	No	No deferred work. Work is demand driven and not unitized. PG&E expects to spend more than imputed adopted amounts.	0	0	0	$ 185,710	$ 175,353	$ 10,357
27	6	Expense	IF	N/A	ED Major Emergency	Yes	No	No	No	No	No deferred work. Work is demand driven and not unitized. PG&E expects to spend more than imputed adopted amounts.	0	0	0	$ 152,074	$ 103,232	$ 48,842
28	7	Capital	63	63C/63D	Distribution Operational Tech	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 9,465	$ 1,001	$ 8,464
29	7	Expense	BA	BA#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (5,127)	$ -	$ (5,127)
30	7	Expense	BA	BAF	General Operations	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 72,855	$ 65,342	$ 7,513

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31	7	Expense	BA	BAH	FLISR Maintenance	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 8,433	$ -	$ 8,433
32	7	Expense	DD	DD#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 14,013	$ 17,753	$ (3,740)
33	7	Expense	DD	DDH	Electric Trouble Customer Equipment	Yes	Yes	Yes	Yes	No	No deferred work. Work is demand-driven.	32,876	141,246	(108,370)	$ 16,902	$ 17,655	$ (753)
34	7	Expense	DD	DDJ	Swing Service, Disconnects/Reconnects	Yes	Yes	Yes	Yes	No	No deferred work. Work is demand-driven.	76,496	240,144	(163,648)	$ 29,594	$ 26,984	$ 2,609
35	7	Expense	HG	HG#/HGD	Distribution Operational Technology	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 14,097	$ 4,040	$ 10,057
36	8	Capital	25	N/A	Install New Electric Meters	Yes	No	No	No	No	No deferred work. Work not unitized. See Customer Care Deferred Work Analysis for Imputed Adopted dollars reflecting transfer of this program from Customer Care to Electric Distribution in 2018.	0	0	0	$ 80,440	$ -	$ 80,440
37	8	Capital	74	N/A	Install New Gas Meters	Yes	No	No	No	No	No deferred work. Work not unitized. See Customer Care Deferred Work Analysis for Imputed Adopted dollars reflecting transfer of this program from Customer Care to Electric Distribution in 2018.	0	0	0	$ 129,276	$ -	$ 129,276
38	8	Expense	AR	N/A	Read & Investigate Meters	Yes	No	No	No	No	No deferred work. Work not unitized. See Customer Care Deferred Work Analysis for Imputed Adopted dollars reflecting transfer of this program from Customer Care to Electric Distribution in 2018.	0	0	0	$ 31,370	$ -	$ 31,370
39	8	Expense	DD	DDC	Electric Start/Stop	Yes	No	No	No	No	No deferred work. Work not unitized. See Customer Care Deferred Work Analysis for Imputed Adopted dollars reflecting transfer of this program from Customer Care to Electric Distribution in 2018.	0	0	0	$ 1,233	$ -	$ 1,233
40	8	Expense	EY	N/A	Change/Maintenance Used Electric Meter	Yes	No	No	No	No	No deferred work. Work not unitized. See Customer Care Deferred Work Analysis for Imputed Adopted dollars reflecting transfer of this program from Customer Care to Electric Distribution in 2018.	0	0	0	$ 16,989	$ -	$ 16,989
41	8	Expense	HY	N/A	Perform Gas Meter Maintenance	Yes	No	No	No	No	No deferred work. Work not unitized. See Customer Care Deferred Work Analysis for Imputed Adopted dollars reflecting transfer of this program from Customer Care to Electric Distribution in 2018.	0	0	0	$ 2,752	$ -	$ 2,752
42	8	Expense	IU	N/A	Collect Revenue	Yes	No	No	No	No	No deferred work. Work not unitized. See Customer Care Deferred Work Analysis for Imputed Adopted dollars reflecting transfer of this program from Customer Care to Electric Distribution in 2018.	0	0	0	$ 4,569	$ -	$ 4,569
43	9	Expense	HN	N/A	VMBA - Routine Vegetation Management	Yes	No	No	No	No	No deferred work. Work not unitized. PG&E forecasts to spend more than imputed amounts due to higher contractor costs.	0	0	0	$ 2,072,279	$ 758,885	$ 1,313,395

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44	9	Expense	IG	IGI	Dead and Dying Trees	Yes	No	No	No	No	No deferred work. Work not unitized. This work was not forecast in the 2020 GRC, so has no imputed amounts.	0	0	0	$ 305,048	$ -	$ 305,048
45	9	Expense	IG	IGJ	Enhanced Vegetation Management	Yes	No	No	No	No	No deferred work. Work not unitized. PG&E forecasts to spend more than imputed amounts due to higher contractor costs.	0	0	0	$ 1,903,942	$ 1,055,037	$ 848,905
46	10	Expense	BF	BF3	UG BART Cable Test/Insp	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 91	$ 122	$ (31)
47	10	Expense	BF	BF4	UG Auto Transfer Switch Test/Insp	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 309	$ 299	$ 9
48	10	Expense	BF	BFA	OH Poles Patrolled	Yes	Yes	Yes	Yes	No	No deferred work. PG&E expects to perform fewer than imputed patrols due to 1) more frequent inspection cycles in 2021 and 2022, requiring fewer patrols; and 2) moving of patrol and inspection of padmount facilities back to underground patrols and inspections.	4,018,838	4,476,868	(458,030)	$ 14,271	$ 14,693	$ (421)
49	10	Expense	BF	BFB	OH Poles Inspected	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units due to increased inspections in the HFTD areas.	2,489,056	1,470,640	1,018,416	$ 248,918	$ 40,633	$ 208,285
50	10	Expense	BF	BFC	OH Infrared Inspections	Yes	No	No	No	No	No deferred work. Work is not unitized. PG&E expects to spend less than the imputed adopted amount due to contractor availability in 2020 impacting implementation schedule.	0	0	0	$ 6,205	$ 6,702	$ (498)
51	10	Expense	BF	BFD	UG Enclosures Patrolled	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units due to padmount facilities moving back to underground patrols and inspections.	781,208	548,522	232,686	$ 6,925	$ 3,015	$ 3,909
52	10	Expense	BF	BFE	UG Infrared Inspections	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	441,519	181,613	259,906	$ 37,127	$ 16,028	$ 21,099
53	10	Expense	BF	BFF	UG Line Equipment Insp/Test	Yes	Yes	Yes	Yes	No	No deferred work. PG&E expects to perform fewer units than imputed, but intends to do all inspections to meet PG&E utility standards.	4,364	7,195	(2,831)	$ 1,540	$ 1,710	$ (170)
54	10	Expense	BF	BFG	OH Line Equipment Insp/Test	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units due to a variation in the inspection cycle of SCADA units.	77,926	72,364	5,562	$ 7,642	$ 8,390	$ (748)
55	10	Expense	BF	BFH	Inspection Projects	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 46,451	$ 8,335	$ 38,116
56	10	Expense	BF	BFJ	OH Patrol ORT Post Outage	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 477	$ 1,287	$ (811)
57	10	Expense	BF	BFL	SB WF Patrols	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 0	$ -	$ 0
58	11	Capital	2A	2A#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (1,153)	$ -	$ (1,153)

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59	11	Capital	2A	2AA	OH General Replace	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units and spend more than the imputed adopted amount due to corrective actions required by the WSIP conducted in 2019.	58,065	36,069	21,996	$ 614,257	$ 178,642	$ 435,615
60	11	Capital	2A	2AB	Bird Safe Install/Replacement	Yes	Yes	Yes	Yes	No	No deferred work. Work is demand driven and fewer units of work than imputed are required.	2,072	3,627	(1,555)	$ 8,479	$ 9,503	$ (1,024)
61	11	Capital	2A	2AC	Bird Safe Install/Replace Annual	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	3,007	2,966	41	$ 13,061	$ 7,791	$ 5,270
62	11	Capital	2A	2AE	OH COE Replace	Yes	Yes	Yes	Yes	No	No deferred work. Work is demand-driven. PG&E expects to perform fewer than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	3,635	4,388	(753)	$ 127,022	$ 96,154	$ 30,868
63	11	Capital	2A	2AF	OH Idle Facility Remove	Yes	Yes	Yes	Yes	Yes	Deferred work. PG&E expects to perform fewer than imputed adopted units but spend more than the imputed adopted amount due to increase in unit costs. Facilities removal in the HFTD is being prioritized in 2021. See discussion in Exhibit (PG&E-4), Chapter 11.	3,563	5,346	(1,783)	$ 28,198	$ 24,124	$ 4,073
64	11	Capital	2A	2AG	SF Series Streetlights	Yes	No	No	No	No	No deferred work. Work not unitized. PG&E forecast to complete this work in 2019 so there are no imputed amounts.	0	0	0	$ 5,170	$ -	$ 5,170
65	11	Capital	2A	2AH	LED Streetlights	Yes	Yes	No	No	No	No deferred work. PG&E forecast to complete this work in 2019, so there are no imputed amounts.	13,334	0	13,334	$ 5,664	$ -	$ 5,664
66	11	Capital	2A	2AI	SF Historical Streetlights	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 445	$ -	$ 445
67	11	Capital	2A	2AP	OH Capital Projects	Yes	Yes	No	No	No	No deferred work. No imputed adopted units. 2020 GRC included forecast for Ceramic Post Insulators in MAT 2AP. This work has moved to new MAT 2AQ.	0	0	0	$ 4,667	$ 25,247	$ (20,580)
68	11	Capital	2A	2AQ	Ceramic Post Insulators	Yes	Yes	No	No	No	No deferred work. No imputed adopted units. This work was forecast in MAT 2AP in the 2020 GRC.	3,653	0	3,653	$ 12,545	$ -	$ 12,545
69	11	Capital	2A	2AR	Surge Arrester Replacement	Yes	Yes	Yes	Yes	No	No deferred work. PG&E is completing replacements in the HFTD areas by 2021, and is slowing the pace of remaining replacements starting in 2022. As this work is balancing account funded, there is no deferred work as funding for the units not completed is returned to customers.	39,040	58,019	(18,979)	$ 169,161	$ 226,363	$ (57,202)

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70	11	Capital	2A	2AS	FAS Overhead Capital	Yes	Yes	Yes	Yes	No	Work is demand driven. Tags are generated in the field by troubleman and work is completed as it is discovered in the field.	6,102	6,973	(871)	$ 1,691	$ 2,271	$ (579)
71	11	Capital	2B	2B#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (701)	$ 9,281	$ (9,982)
72	11	Capital	2B	2BA	UG General Replace	Yes	Yes	Yes	Yes	Yes	Deferred work. PG&E expects to perform fewer than imputed adopted units. PG&E expects to spend less than the imputed adopted amount. See discussion in Exhibit (PG&E-4), Chapter 11.	5,044	7,676	(2,632)	$ 130,936	$ 139,851	$ (8,916)
73	11	Capital	2B	2BB	Fault Indicator Replacements	Yes	Yes	Yes	Yes	No	No deferred work. This is demand driven work which is identified by inspectors and typically fixed on the spot (find and fix).	9,261	11,370	(2,109)	$ 2,234	$ 3,515	$ (1,281)
74	11	Capital	2B	2BD	UG COE Replace	Yes	Yes	Yes	Yes	No	No deferred work. Work is demand-driven. PG&E expects to perform fewer than imputed adopted units. PG&E expects to spend more than the imputed adopted amount due to higher unit costs.	388	436	(48)	$ 20,506	$ 17,750	$ 2,756
75	11	Capital	2B	2BF	UG Idle Facility Remove	Yes	Yes	Yes	Yes	Yes	Deferred work. PG&E expects to perform fewer than imputed adopted units. PG&E expects to spend less than the imputed adopted amount. See discussion in Exhibit (PG&E-4), Chapter 11.	14	51	(37)	$ 230	$ 583	$ (352)
76	11	Capital	2B	2BP	UG Capital Projects	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 12,598	$ 7,770	$ 4,828
77	11	Expense	BK	BK#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (360)	$ -	$ (360)
78	11	Expense	BK	BKA	Line Equipment Overhauls (Emeryville)	Yes	Yes	Yes	Yes	No	No deferred work. PG&E expects to perform fewer line equipment overhauls due to shift in work to field repairs and scrapping caused by storm and wildfire recovery activities.	1,786	3,501	(1,715)	$ 5,148	$ 3,681	$ 1,466
79	11	Expense	BK	BKJ	Line Equipment Overhauls (Division Up/Down Labor) (Emeryville)	Yes	Yes	Yes	Yes	No	No deferred work. PG&E expects to perform fewer line equipment overhauls due to shift in work to field repairs and scrapping caused by storm and wildfire recovery activities.	112	265	(153)	$ 205	$ 1,216	$ (1,012)
80	11	Expense	BK	BKK	Equip Warranty Repair (Emeryville)	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 100	$ 188	$ (88)
81	11	Expense	KA	KA#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (6,346)	$ 2,212	$ (8,558)
82	11	Expense	KA	KAA	OH General CM Tag	Yes	Yes	Yes	Yes	Yes	Deferred work. PG&E expects to perform fewer than imputed adopted units. PG&E expects to spend more than the imputed adopted amount. See discussion in Exhibit (PG&E-4), Chapter 11.	82,057	93,674	(11,617)	$ 196,945	$ 56,886	$ 140,059
83	11	Expense	KA	KAC	Bird Safe Retrofit	Yes	Yes	Yes	Yes	No	No deferred work. forecast has been updated based on recent historical actual performance.	1,682	3,021	(1,339)	$ 2,619	$ 2,262	$ 357
84	11	Expense	KA	KAD	Bird Safe Retrofit Annual	Yes	Yes	Yes	Yes	No	No deferred work. PG&E is completing some retrofits under other programs outside of MAT KAD to count towards program commitments.	2,307	2,982	(675)	$ 2,921	$ 2,233	$ 688
85	11	Expense	KA	KAF	OH COE CM Tag	Yes	Yes	Yes	Yes	No	No deferred work. the mix of work between COE Capital and Expense was different than previously forecasted.	3,924	4,232	(308)	$ 18,724	$ 21,912	$ (3,188)
86	11	Expense	KA	KAH	Streetlights Replace Burnouts	Yes	Yes	Yes	Yes	No	No deferred work. There have been greater savings as a result of LED conversion project than previously forecasted.	30,886	43,843	(12,957)	$ 5,355	$ 6,658	$ (1,303)
87	11	Expense	KA	KAK	RTVI Invest/Repair	Yes	Yes	Yes	Yes	No	No deferred work. Work is demand-driven. PG&E expects to perform fewer than imputed adopted units. PG&E expects to spend less than the imputed adopted amount.	103	429	(326)	$ 263	$ 325	$ (62)
88	11	Expense	KA	KAM	Insulators Washing	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 474	$ 631	$ (157)
89	11	Expense	KA	KAO	Idle Facilities Invest - Svc Planning	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 2,082	$ 548	$ 1,534

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Line	2023 GRC Chapter	Type	MWC	MAT CODE	Description	Check 1	Check 2		Check 3	Deferred Work	Explanation	Units Comparison			Dollar Comparison ($000s)		
							Check 2a	*Check 2b*				2020 Rec. Adj. Units + 2021 to 2022 Forecast (A)	2020 to 2022 Imputed Units (B)	Units Difference (A-B)	2020 Rec. Adj. + 2021 to 2022 $$ Forecast (C)	2020 to 2022 Imputed $$ (D)	$$ Difference (C-D)
90	11	Expense	KA	KAP	OH Expense Projects	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 13,121	$ -	$ 13,121
91	11	Expense	KA	KAQ	Wood Pole Bridge Bonding	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 21	$ 83	$ (62)
92	11	Expense	KA	KAS	FAS Overhead Expense	Yes	Yes	Yes	Yes	No	Work is demand driven. Tags are generated in the field by troubleman and work is completed as it is discovered in the field.	29,818	30,814	(996)	$ 4,786	$ 5,499	$ (713)
93	11	Expense	KB	KB#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (3,020)	$ 1,971	$ (4,991)
94	11	Expense	KB	KBA	UG General Corrective Maintenance (CM) Tag	Yes	Yes	Yes	Yes	Yes	Deferred work. PG&E expects to perform fewer than imputed adopted units. PG&E expects to spend more than the imputed adopted amount. See discussion in Exhibit (PG&E-4), Chapter 11.	13,239	18,479	(5,240)	$ 41,092	$ 33,027	$ 8,064
95	11	Expense	KB	KBC	UG COE CM Tag	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	8,091	741	7,350	$ 3,644	$ 2,612	$ 1,032
96	11	Expense	KB	KBD	Nitrogen Cylinders CM	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 91	$ 66	$ 26
97	11	Expense	KB	KBE	BART Cable Repair	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 133	$ 183	$ (50)
98	11	Expense	KB	KBP	UG Expense Projects	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 1,388	$ 475	$ 912
99	11	Expense	KB	KBQ	Elbows/Splices Replace	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 0	$ -	$ 0
100	12	Capital	07	07#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (3,451)	$ -	$ (3,451)
101	12	Capital	07	07C	Special Criteria Pole Replace	Yes	Yes	No	No	No	No deferred work. No imputed units.	278	0	278	$ 3,390	$ -	$ 3,390
102	12	Capital	07	07D	Pole Replacement	Yes	Yes	No	No	No	No deferred work. Work is demand-driven. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	39,154	23,467	15,687	$ 895,019	$ 329,683	$ 565,336
103	12	Capital	07	07G	Pole Joint Util Telco Reimb	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (4)	$ -	$ (4)
104	12	Capital	07	07L	Steel Lattice Structures	Yes	Yes	No	No	No	No deferred work. No imputed units.	0	0	0	$ 121	$ -	$ 121
105	12	Capital	07	07O	Overloaded Pole Replacements	Yes	Yes	No	No	No	No deferred work. No imputed adopted units. Overloaded poles were forecast in MAT 07D in the 2020 GRC, so there is no imputed amount for MAT 07O.	940	0	940	$ 29,844	$ -	$ 29,844
106	12	Capital	21	21A	EP&R Capital	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 2,656	$ -	$ 2,656
107	12	Expense	AB	AB#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 82	$ -	$ 82
108	12	Expense	GA	GA#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (11,572)	$ (12,866)	$ 1,293
109	12	Expense	GA	GAA	Intrusive Inspection Program	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	808,253	737,656	70,597	$ 59,932	$ 38,203	$ 21,728
110	12	Expense	GA	GAB	Pole Joint Util Maint Reimbursement	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 471	$ -	$ 471
111	12	Expense	GA	GAC	Pole Analyze Loading	Yes	No	No	No	No	No deferred work. Work not unitized. Forecast overspend is attributed to development of NEW Pole Loading Program (not forecast in 2020 GRC), which includes Light Detection and Ranging data acquisition and analysis.	0	0	0	$ 60,901	$ -	$ 60,901
112	12	Expense	GA	GAD	Pole Restoration Program	Yes	Yes	Yes	Yes	No	No deferred work. Work is demand-driven. PG&E expects to perform less than the identified imputed adopted units. PG&E expects to spend less than the imputed adopted amount.	8,602	16,368	(7,766)	$ 11,705	$ 15,059	$ (3,355)
113	12	Expense	GA	GAE	Pole Review Engineer Non-Reim	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 18	$ -	$ 18
114	12	Expense	GA	GAF	Telco Engr Review Non-Reimbursed	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 264	$ 501	$ (237)
115	12	Expense	GA	GAH	Pole Joint Util Maint Non-Reim	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 1,042	$ 835	$ 207
116	12	Expense	IG	IG#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 0	$ -	$ 0
117	13	Capital	08	08#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (541)	$ -	$ (541)
118	13	Capital	08	08F	Do Not Use - Cornerstone	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 10	$ -	$ 10
119	13	Capital	08	08J	Overhead Conductor Replacement Program	Yes	Yes	Yes	Yes	Yes	Deferred work. Some work was deferred in 2020 due to work deferrals associated with COVID-19, and shifting of resources to support higher priority work. PG&E forecasts to complete fewer units than imputed adopted amounts in the 2020 GRC period. See discussion in Exhibit (PG&E-4), Chapter 13.	161	289	(128)	$ 90,459	$ 157,550	$ (67,092)

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Line	2023 GRC Chapter	Type	MWC	MAT CODE	Description	Check 1	Check 2		Check 3	Deferred Work	Explanation	Units Comparison			Dollar Comparison ($000s)		
							Check 2a	*Check 2b*				2020 Rec. Adj. Units + 2021 to 2022 Forecast (A)	2020 to 2022 Imputed Units (B)	Units Difference (A-B)	2020 Rec. Adj. + 2021 to 2022 $$ Forecast (C)	2020 to 2022 Imputed $$ (D)	$$ Difference (C-D)
120	13	Capital	08	08S	Grasshopper / OH Switch Program	Yes	Yes	Yes	Yes	Yes	Deferred work. Some work was deferred in 2020 due to work deferrals associated with COVID-19, and shifting of resources to support higher priority work. PG&E forecasts to complete fewer units than imputed adopted amounts in the 2020 GRC period. See discussion in Exhibit (PG&E-4), Chapter 13.	64	90	(26)	$ 2,410	$ 3,372	$ (962)
121	13	Capital	2F	2FK	ISvcs: Rep/Upgr SCADA	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 0	$ -	$ 0
122	13	Capital	09	09A	ED Line SCADA Install/Replace	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (1)	$ -	$ (1)
123	13	Capital	49	49#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 38,688	$ 13,297	$ 25,392
124	13	Capital	49	49A	Distribution Line Automation	Yes	No	No	No	No	No deferred work. Work not unitized. Forecast underspend due to change of scope of program.	0	0	0	$ 6,220	$ 17,000	$ (10,779)
125	13	Capital	49	49B	Recl Ctrls Install/Replace	Yes	Yes	No	No	No	No deferred work. No imputed units.	10	0	10	$ 1,063	$ -	$ 1,063
126	13	Capital	49	49C	OH Fuses Install/Replace	Yes	Yes	Yes	Yes	Yes	Deferred work. Some work was deferred in 2020 due to shifting of resources to support higher priority work. PG&E forecasts to complete fewer units than imputed adopted amounts in the 2020 GRC period. See discussion in Exhibit (PG&E-4), Chapter 13.	231	297	(66)	$ 2,713	$ 3,285	$ (572)
127	13	Capital	49	49D	OH Recl/Sect/Swch Install/Replace	Yes	Yes	No	No	No	No deferred work. No imputed units.	1	0	1	$ 851	$ -	$ 851
128	13	Capital	49	49E	General Install/Replace Circuit/Zone	Yes	Yes	No	No	No	No deferred work. No imputed units.	1	0	1	$ (2,837)	$ -	$ (2,837)
129	13	Capital	49	49F	UG Fuses Install/Replace	Yes	Yes	No	No	No	No deferred work. No imputed units.	0	0	0	$ (4)	$ -	$ (4)
130	13	Capital	49	49G	UG Recl/Sect/Swch Install/Replace	Yes	Yes	No	No	No	No deferred work. No imputed units.	0	0	0	$ 1,509	$ -	$ 1,509
131	13	Capital	49	49I	Distribution Grid Sensors	Yes	Yes	No	No	No	No deferred work. No imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	0	0	0	$ 318	$ -	$ 318
132	13	Capital	49	49S	Elect Reliability Inst FLISR	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	36	24	12	$ 8,721	$ 6,551	$ 2,170
133	13	Capital	49	49T	Trip Savers / Fusesavers	Yes	Yes	Yes	Yes	Yes	Deferred work. PG&E expects to perform fewer than imputed adopted units. PG&E expects to spend less than the imputed adopted amount. See discussion in Exhibit (PG&E-4), Chapter 13.	147	239	(92)	$ 2,403	$ 3,290	$ (887)
134	13	Capital	49	49X	Emerging Dist Rel Improvements	Yes	No	No	No	No	No deferred work. Work not unitized. Forecast underspend due to shift of priorities.	0	0	0	$ 8,707	$ 18,467	$ (9,760)
135	13	Capital	56	56#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (2,860)	$ -	$ (2,860)
136	13	Capital	56	56A	UG Cable Other Replace	Yes	Yes	Yes	Yes	Yes	Deferred work. Some work was deferred in 2020 due to work deferrals associated with COVID-19, and shifting of resources to support higher priority work such as TGRAM/TGRAL replacements, LBOR switch replacements, and installing temperature indicators on underground equipment. PG&E forecasts to complete fewer units than imputed adopted amounts in the 2020 GRC period. See discussion in Exhibit (PG&E-4), Chapter 13.	55	60	(5)	$ 95,556	$ 100,539	$ (4,983)

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							Check 2a	*Check 2b*				2020 Rec. Adj. Units + 2021 to 2022 Forecast (A)	2020 to 2022 Imputed Units (B)	Units Difference (A-B)	2020 Rec. Adj. + 2021 to 2022 $$ Forecast (C)	2020 to 2022 Imputed $$ (D)	$$ Difference (C-D)
137	13	Capital	56	56B	UG Cable Inject	Yes	No	No	No	No	No deferred work. Work not unitized. Forecast u underspend reflects directing resources to complete cable replacement projects.	0	0	0	$ 2,114	$ 9,940	$ (7,826)
138	13	Capital	56	56C	UG Cable COE Replace	Yes	Yes	Yes	Yes	Yes	Deferred work. Some work was deferred in 2020 due to work deferrals associated with COVID-19, and shifting of resources to support higher priority work such as TGRAM/TGRAL replacements, LBOR switch replacements, and installing temperature indicators on underground equipment. PG&E forecasts to complete fewer units than imputed adopted amounts in the 2020 GRC period. See discussion in Exhibit (PG&E-4), Chapter 13.	498	662	(164)	$ 88,331	$ 100,250	$ (11,919)
139	13	Capital	56	56D	TGRAM/TGRAL Switch Replacement	Yes	Yes	No	No	No	No deferred work. PG&E is replacing TGRAM/TGRAL switches as found. This work was not forecast in the 2020 GRC.	6	0	6	$ 5,182	$ -	$ 5,182
140	13	Capital	56	56S	Replace Obsolete UG Switches	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	237	192	45	$ 24,159	$ 19,986	$ 4,174
141	13	Capital	56	56T	Install Temperature Indicator	Yes	Yes	No	No	No	No deferred work. This is a new program not included in the 2020 GRC to install temperature indicators on underground equipment.	3,404	0	3,404	$ 21,054	$ -	$ 21,054
142	14	Capital	2C	2C#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (191)	$ -	$ (191)
143	14	Capital	2C	2CA	NP Relay Replacement	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	109	61	48	$ 983	$ 695	$ 288
144	14	Capital	2C	2CB	Fiber/SCADA Communication Replace	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 25	$ 451	$ (426)
145	14	Capital	2C	2CC	Network Transformer & Protector Replace	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	88	66	22	$ 18,110	$ 13,738	$ 4,372
146	14	Capital	2C	2CD	Venting Manhole Covers Replace	Yes	Yes	Yes	Yes	No	No deferred work. Work in MAT 2CD now reflects only replacements in PG&E's network distribution system. The work forecast in the 2020 GRC also included non-network locations, which have moved to MAT 2BP PG&E expects to complete all network locations by the end of 2022.	886	1,779	(893)	$ 8,135	$ 16,715	$ (8,580)
147	14	Capital	2C	2CE	SCADA Communications Upgrd	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 30,111	$ 26,191	$ 3,920
148	14	Capital	56	56N	Network Cable Replacement	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 72,327	$ 73,529	$ (1,202)
149	14	Expense	KC	KC#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (1,278)	$ -	$ (1,278)
150	14	Expense	KC	KCA	Network Equip CM Notifications	Yes	Yes	Yes	Yes	No	No deferred work. Work is demand-driven. PG&E expects to perform fewer than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	121	224	(103)	$ 498	$ 470	$ 27
151	14	Expense	KC	KCB	Network Oil Repl & 60Day F/U	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	519	80	439	$ 213	$ 96	$ 117

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							Check 2a	*Check 2b*				2020 Rec. Adj. Units + 2021 to 2022 Forecast (A)	2020 to 2022 Imputed Units (B)	Units Difference (A-B)	2020 Rec. Adj. + 2021 to 2022 $$ Forecast (C)	2020 to 2022 Imputed $$ (D)	$$ Difference (C-D)
152	14	Expense	KC	KCC	Network Vault CM Notifications	Yes	Yes	Unknown (A	Unknown (A	No	No deferred work. Work is demand-driven. This MAT is treated as non-unitized in this rate case because of data issues and the large variability in project costs. PG&E expects to spend less than the imputed adopted amount.	10	235	(225)	$ 270	$ 489	$ (218)
153	14	Expense	KC	KCD	Network Xfmr Preventive Maintenance/Restore	Yes	Yes	Yes	Yes	No	No deferred work. Work is demand-driven. This MAT is treated as non-unitized in this rate case because of data issues and the large variability in project costs. PG&E expects to spend more than the imputed adopted amount.	10,742	10,784	(42)	$ 8,772	$ 7,589	$ 1,184
154	14	Expense	KC	KCE	Network Protector Preventive Maintenance	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	1,407	1,162	245	$ 2,292	$ 1,874	$ 418
155	14	Expense	KC	KCF	Fiber/SCADA Comm Repair	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 2,525	$ 1,795	$ 730
156	15	Capital	48	48A	Replace ED Substation Other Equipment	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 18,890	$ 20,495	$ (1,606)
157	15	Capital	48	48B	Replace ED Substation Regulators	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 3	$ -	$ 3
158	15	Capital	48	48C	Replace ED Substation Batteries	Yes	Yes	Yes	Yes	Yes	Deferred work. PG&E expects to perform fewer than imputed adopted units. PG&E expects to spend less than the imputed adopted amount. See discussion in Exhibit (PG&E-4), Chapter 15.	13	30	(17)	$ 3,488	$ 6,779	$ (3,291)
159	15	Capital	48	48D	Replace ED Substation Breakers	Yes	Yes	No	No	No	No deferred work. Work not unitized.	53	0	53	$ 50,059	$ 26,334	$ 23,725
160	15	Capital	48	48E	Replace ED Substation Switches	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 6,941	$ 3,160	$ 3,781
161	15	Capital	48	48F	Replace ED Substation Switchgear	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 103,437	$ 62,262	$ 41,174
162	15	Capital	48	48H	Replace ED Substation Civil Structures	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 4,819	$ 6,138	$ (1,318)
163	15	Capital	48	48L	Dist Line Work Support Substation	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 46,884	$ 21,336	$ 25,548
164	15	Capital	48	48N	ED Substation Insulators	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 1,150	$ 6,770	$ (5,620)
165	15	Capital	48	48R	ED Substation Reactors	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (1)	$ -	$ (1)
166	15	Capital	48	48X	ED Substation Animal Abatement	Yes	Yes	Yes	Yes	No	No Deferred work. PG&E expects to perform fewer than imputed adopted units in MAT 48X, but did additional animal abatement projects in MWC 59 for wildfire mitigation. PG&E also expects to spend more than the imputed adopted amount due to animal abatement projects re-initiated from prior years.	26	30	(4)	$ 14,898	$ 7,159	$ 7,739
167	15	Capital	54	54#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (113)	$ -	$ (113)

Workpaper Table 2-13
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Line	2023 GRC Chapter	Type	MWC	MAT CODE	Description	Check 1	Check 2		Check 3	Deferred Work	Explanation	Units Comparison			Dollar Comparison ($000s)		
							Check 2a	*Check 2b*				2020 Rec. Adj. Units + 2021 to 2022 Forecast (A)	2020 to 2022 Imputed Units (B)	Units Difference (A-B)	2020 Rec. Adj. + 2021 to 2022 $$ Forecast (C)	2020 to 2022 Imputed $$ (D)	$$ Difference (C-D)
168	15	Capital	54	54A	ED Substation Replace Transformer	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 97,592	$ 16,985	$ 80,607
169	15	Capital	54	54L	ED Substation - Life Extension Transformer	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 3,164	$ -	$ 3,164
170	15	Capital	58	58A	ED Substation Safety&Envir&Fire Protect	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 4,268	$ 6,857	$ (2,589)
171	15	Capital	58	58B	Replace Dist Sub Civil	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 1,324	$ -	$ 1,324
172	15	Capital	58	58C	Replace Dist Sub Misc Equip	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 37	$ -	$ 37
173	15	Capital	58	58S	ED Substation Security Upgrades	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 5,458	$ 7,345	$ (1,887)
174	15	Capital	59	N/A	ED Substation Emergency Replacement	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 298,940	$ 192,904	$ 106,036
175	15	Expense	GC	GC#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (10,061)	$ -	$ (10,061)
176	15	Expense	GC	GC1	ED Substation Engineering Maintenance Support	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 15,142	$ 13,742	$ 1,400
177	15	Expense	GC	GC2	ED Substation Major Emergency Corrective Maintenance	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 25,794	$ 14,382	$ 11,412
178	15	Expense	GC	GC5	Dist Sub enhanced inspections	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 8,636	$ -	$ 8,636
179	15	Expense	GC	GCA	ED Substation: TXfmr - preventive maintenance	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	13,576	12,849	727	$ 2,971	$ 2,687	$ 285
180	15	Expense	GC	GCB	ED Substation: Breaker - preventive maintenance	Yes	Yes	Yes	Yes	No	No deferred work. PG&E expects to perform fewer than imputed adopted units, due to fewer breaker units requiring preventive maintenance. PG&E expects to spend less than the imputed adopted amount.	5,076	5,338	(262)	$ 2,042	$ 2,270	$ (228)
181	15	Expense	GC	GCC	ED Substation: Relay - preventive maintenance	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units, and to spend less than the imputed adopted amount.	4,214	3,508	706	$ 5,141	$ 6,620	$ (1,479)
182	15	Expense	GC	GCD	ED Substation: Inspections	Yes	Yes	Yes	Yes	No	No deferred work. Substation Inspections are compliance-driven work. PG&E performed less units than imputed because fewer sites required inspection. PG&E expects to spend more than the imputed adopted amount.	20,502	23,850	(3,348)	$ 10,539	$ 7,822	$ 2,717
183	15	Expense	GC	GCE	ED Substation: General station preventive maintenance	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	3,508	3,022	486	$ 1,363	$ 1,337	$ 26
184	15	Expense	GC	GCF	ED Substation: Batteries - preventive maintenance	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	3,614	1,925	1,689	$ 1,365	$ 912	$ 453
185	15	Expense	GC	GCG	ED Substation Vegetation Management	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 24,510	$ 4,525	$ 19,986
186	15	Expense	GC	GCH	ED Substation Building Maintenance	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 3,618	$ 2,909	$ 708
187	15	Expense	GC	GCI	ED Substation: Switches preventive maintenance	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	325	271	54	$ 258	$ 187	$ 70

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							Check 2					Units Comparison			Dollar Comparison ($000s)		
Line	2023 GRC Chapter	Type	MWC	MAT CODE	Description	Check 1	*Check 2a*	*Check 2b*	Check 3	Deferred Work	Explanation	2020 Rec. Adj. Units + 2021 to 2022 Forecast (A)	2020 to 2022 Imputed Units (B)	Units Difference (A-B)	2020 Rec. Adj. + 2021 to 2022 $$ Forecast (C)	2020 to 2022 Imputed $$ (D)	$$ Difference (C-D)
188	15	Expense	GC	GCJ	ED Substation: Corrective (T80)	Yes	Yes	Yes	Yes	No	No deferred work. PG&E expects to perform fewer than imputed adopted units due to fewer issues identified than planned in substations, reduction attributed to the overlap from the WSIP identified issues corrected in 2019, and overall variability in corrective work. PG&E expects to spend more than the imputed adopted amount.	13,781	22,261	(8,480)	$ 29,269	$ 22,821	$ 6,448
189	15	Expense	GC	GCM	ED Substation Breaker Mechanism Services	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	2,153	1,314	839	$ 4,372	$ 2,516	$ 1,856
190	15	Expense	GC	GCO	ED Substation Transformer Overhaul Inspections	Yes	Yes	Yes	Yes	No	No deferred work. PG&E expects to perform fewer than imputed adopted units due to fewer Load Tap Change (LTC) overhaul inspections required in 2020. The volume of LTCs exceeding their thresholds based on make and model is now forecast to be less than the volume forecast in the 2020 GRC.	347	477	(130)	$ 2,839	$ 4,539	$ (1,699)
191	15	Expense	GC	GCS	ED Substation CKSW MOAS Mechanism Services	Yes	Yes	No	No	No	No deferred work. PG&E expects to perform more than imputed adopted units. PG&E expects to spend more than the imputed adopted amount.	252	146	106	$ 576	$ 355	$ 221
192	15	Expense	GC	GCV	ED Substation Breaker Overhauls	Yes	Yes	Yes	Yes	No	No deferred work. PG&E expects to perform fewer than imputed adopted units, due to fewer breaker units requiring overhauls. PG&E expects to spend less than the imputed adopted amount.	25	51	(26)	$ 109	$ 254	$ (145)
193	15	Expense	GC	GCW	ED Substation Station Washes	Yes	Yes	Yes	Yes	No	No deferred work. Substation washes are compliance-driven work. PG&E performed less than imputed because fewer sites required washing.	1,270	1,323	(53)	$ 1,195	$ 1,217	$ (21)
194	16	Capital	09	09B	ED Sub SCADA/RTU Replace	Yes	No	No	No	No	No deferred work. Work not unitized. PG&E expects to spend less than imputed adopted amounts for proactive SCADA replacements in order to fund new substation installations and emergency replacements.	0	0	0	$ 33,937	$ 60,565	$ (26,628)
195	16	Capital	09	09D	ED Sub SCADA/RTU Install	Yes	No	No	No	No	No deferred work. Work not unitized. PG&E expects to spend more than imputed adopted amounts to add install SCADA at additional substations.	0	0	0	$ 27,477	$ 13,508	$ 13,969
196	16	Capital	09	09E	ED Sub Protect Relay Install/Replace	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 8,519	$ 10,874	$ (2,355)
197	16	Capital	09	09F	ED Sub SCADA Emergency Replace	Yes	No	No	No	No	No deferred work. Work not unitized. PG&E expects to spend more than imputed adopted amounts to address equipment emergency replacements.	0	0	0	$ 19,357	$ 3,579	$ 15,779
198	16	Expense	HX	N/A	Distribution Automation & Protection Support	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 7,172	$ 6,265	$ 907
199	17	Capital	06	06#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 29,683	$ 21,608	$ 8,074
200	17	Capital	06	06A	Fdr Prj Assoc w/Subst Capacity	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 76,879	$ 21,390	$ 55,490
201	17	Capital	06	06B	Transformer Repl Overloaded	Yes	Yes	Unknown (A	Unknown (A	No	No deferred work. This MAT is treated as non-unitized in this rate case because of cost of each unit is highly variable depending on the location of the work. PG&E expects to spend more than the imputed adopted amount.	17	148	(131)	$ 10,622	$ 2,046	$ 8,576
202	17	Capital	06	06D	Circuits Reinforce-DP Managed	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 6,616	$ 10,542	$ (3,926)
203	17	Capital	06	06E	Circuits Reinforce-PS Managed	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 65,643	$ 56,760	$ 8,884
204	17	Capital	06	06F	Voltage Correct Primary	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (11)	$ -	$ (11)
205	17	Capital	06	06G	Voltage Correct Secondary	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 8,125	$ 9,887	$ (1,762)
206	17	Capital	06	06H	Dist Line New Business Performance	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 275,959	$ 136,602	$ 139,357
207	17	Capital	06	06I	Operational Capacity Proj	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 15,603	$ 10,728	$ 4,875
208	17	Capital	06	06J	OH Power Factor Inst	No	No	No	No	No	No deferred work. Work was not characterized as needed for safe and reliable service in the 2020 GRC.	0	0	0	$ (1)	$ -	$ (1)
209	17	Capital	06	06K	Power Factor Management	No	No	No	No	No	No deferred work. Work was not characterized as needed for safe and reliable service in the 2020 GRC.	0	0	0	$ 661	$ 3,389	$ (2,728)

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Line	2023 GRC Chapter	Type	MWC	MAT CODE	Description	Check 1	Check 2		Check 3	Deferred Work	Explanation	Units Comparison			Dollar Comparison ($000s)		
							Check 2a	*Check 2b*				2020 Rec. Adj. Units + 2021 to 2022 Forecast (A)	2020 to 2022 Imputed Units (B)	Units Difference (A-B)	2020 Rec. Adj. + 2021 to 2022 $$ Forecast (C)	2020 to 2022 Imputed $$ (D)	$$ Difference (C-D)
210	17	Capital	06	06P	Enable DG Dist Line	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 1,672	$ 4,073	$ (2,401)
211	17	Capital	10	10#	Not assigned	No	No	No	No	No	No deferred work. Work was not characterized as needed for safe and reliable service in the 2020 GRC.	0	0	0	$ -	$ -	$ -
212	17	Capital	46	46#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 696	$ -	$ 696
213	17	Capital	46	46A	ED Substation General install/Replace	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 70,095	$ 41,917	$ 28,178
214	17	Capital	46	46F	ED Substatino Emergency and Operational Capacity	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 38,484	$ 24,951	$ 13,533
215	17	Capital	46	46H	ED Substation New Bus Related Capacity	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 70,990	$ 46,723	$ 24,267
216	17	Capital	46	46N	ED Substation Land Purchase New Sub	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 76	$ 4,187	$ (4,112)
217	17	Capital	46	46T	ED Substation Support Transmission or Substation Related work	Yes	Yes	No	No	No	No deferred work. No imputed adopted units. PG&E expects to spend less than the imputed adopted amount.	0	0	0	$ -	$ 4,859	$ (4,859)
218	17	Expense	FZ	FZ#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (3,246)	$ -	$ (3,246)
219	17	Expense	FZ	FZA	General Engineering	Yes	No	No	No	No	No deferred work. Work not unitized. Recorded and forecast costs for Asset Performance Center reflected in Chapter 4.	0	0	0	$ 40,817	$ 44,107	$ (3,290)
220	17	Expense	FZ	FZB	Voltage Complaints Investigations	Yes	No	No	No	No	No deferred work. Work is demand-driven. Work not unitized.	0	0	0	$ 2,343	$ 1,804	$ 538
221	17	Expense	FZ	FZC	Transformer Reports Manage	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 263	$ 43	$ 220
222	17	Expense	FZ	FZD	Field Work Plan	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 2,065	$ 1,757	$ 307
223	17	Expense	FZ	FZE	Troublemen Field Work	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 4,519	$ 4,244	$ 275
224	18	Capital	10	N/A	ED Work Requested by Others (WRO) General	No	No	No	No	No	No deferred work. Work was not characterized as needed for safe and reliable service in the 2020 GRC.	0	0	0	$ 446,368	$ 404,100	$ 42,268
225	18	Capital	16	N/A	ED Customer Connects	No	No	No	No	No	No deferred work. Work was not characterized as needed for safe and reliable service in the 2020 GRC.	0	0	0	$ 1,648,180	$ 1,393,897	$ 254,283
226	18	Expense	EV	EV#	Not assigned	No	No	No	No	No	No deferred work. Work was not characterized as needed for safe and reliable service in the 2020 GRC.	0	0	0	$ (601)	$ -	$ (601)
227	18	Expense	EV	EVA	Service Inquiry	No	No	No	No	No	No deferred work. Work was not characterized as needed for safe and reliable service in the 2020 GRC.	0	0	0	$ 10,221	$ 9,074	$ 1,147
228	18	Expense	EV	EVB	OK to Serve	No	No	No	No	No	No deferred work. Work was not characterized as needed for safe and reliable service in the 2020 GRC.	0	0	0	$ 25,139	$ 29,626	$ (4,487)
229	18	Expense	EW	N/A	Electric Operations Work Requested by Others (WRO)	No	No	No	No	No	No deferred work. Work was not characterized as needed for safe and reliable service in the 2020 GRC.	0	0	0	$ 31,746	$ 27,828	$ 3,918
230	19	Capital	30	N/A	ED WRO Rule 20A	No	No	No	No	No	No deferred work. Work was not characterized as needed for safe and reliable service in the 2020 GRC.	0	0	0	$ 125,514	$ 102,965	$ 22,549
231	19	Expense	IG	IG#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (65)	$ -	$ (65)
232	20	Capital	21	21#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 1,611	$ -	$ 1,611
233	20	Capital	2F	N/A	Build IT Applications & Infrastructure	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 62,481	$ 37,702	$ 24,779
234	20	Expense	GE	GE#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ (4,289)	$ -	$ (4,289)
235	20	Expense	GE	GEO	Mapping	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 32,478	$ 18,032	$ 14,446
236	20	Expense	GE	GEP	Records Management	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 10,652	$ -	$ 10,652
237	20	Expense	JV	N/A	Maintain IT Applications & Infrastructure	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 9,919	$ 13,281	$ (3,361)
238	21	Capital	21	21#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 6,360	$ -	$ 6,360

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239	21	Capital	2F	2F#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 26,724	$ -	$ 26,724
240	21	Capital	2F	2FA	ASvcs: Development	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 37,440	$ 15,031	$ 22,409
241	21	Capital	3R	N/A	Energy Storage Capital	Yes	No	No	No	No	No deferred work. Work not unitized. Work was not forecast in the 2020 GRC.	0	0	0	$ 86,080	$ -	$ 86,080
242	21	Capital	63	63C	Dist Ctrl Sys/Fac Install/Replace	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 253,138	$ 101,055	$ 152,083
243	21	Capital	82	82Y	TSub - EGI Direct Assignment	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 162	$ -	$ 162
244	21	Expense	AB	AB#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized. Work was not forecast in the 2020 GRC.	0	0	0	$ 11,380	$ -	$ 11,380
245	21	Expense	AT	AT#	Not assigned	No	No	No	No	No	No deferred work. Work not unitized. Work is funded in EPIC program through 2022.	0	0	0	$ -	$ -	$ -
246	21	Expense	HG	HG#/ HGC	ADMS Development	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 12,865	$ 28,334	$ (15,469)
247	21	Expense	IG	IG#	Not assigned	Yes	No	No	No	No	No deferred work. Work not unitized. Work was not forecast in the 2020 GRC.	0	0	0	$ 10,296	$ -	$ 10,296
248	21	Expense	JV	JVA	ISvcs: Wrkplce End User SW Ste	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 5,274	$ 2,754	$ 2,520
249	22	Capital	05	N/A	Tools & Equipment	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 21,081	$ 23,454	$ (2,373)
250	22	Capital	21	21#	Miscellaneous Capital	No	No	No	No	No	No deferred work. Work was not characterized as needed for safe and reliable service in the 2020 GRC.	0	0	0	$ (20,771)	$ (113,254)	$ 92,484
251	22	Expense	AB	AB#	ED Support	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 62,656	$ 54,679	$ 7,977
252	22	Expense	IS	N/A	Streetlight Support	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 2,435	$ 3,322	$ (887)
253	22	Expense	OM	N/A	Operational Management	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 24,619	$ 22,090	$ 2,529
254	22	Expense	OS	N/A	Operational Support	Yes	No	No	No	No	No deferred work. Work not unitized.	0	0	0	$ 147,409	$ 68,265	$ 79,144
255	23	Expense	IF	IF#	Not assigned	No	No	No	No	No	No deferred work. Work not unitized. Not forecast in 2020 GRC, captured in CEMA.	0	0	0	$ 32,591	$ -	$ 32,591
256	23	Expense	IF	IFC	CEMA Expense	No	No	No	No	No	No deferred work. Work not unitized. Not forecast in 2020 GRC, captured in CEMA.	0	0	0	$ -	$ -	$ -
257	23	Expense	IF	IFF	Wildfire Rebuild Work - Exp	No	No	No	No	No	No deferred work. Work not unitized. Not forecast in 2020 GRC, captured in CEMA.	0	0	0	$ 23,812	$ -	$ 23,812
258	23	Capital	95	95F	Wildfire Rebuild Work	No	No	No	No	No	No deferred work. Work not unitized. Not forecast in 2020 GRC, captured in CEMA.	0	0	0	$ 299,745	$ -	$ 299,745

NOTES:

(A) This work changed from unitized in 2020 to non-unitized in 2023. PG&E represents this work is not deferred, see explanation above.

(B) Official Imputed Adopted dollars are in MWC HN.

(C) As stated in Exhibit (PG&E-1), Chapter 2, Section E.2: "[W]ith limited exceptions, PG&E had to freeze the inputs to its forecast for the period 2021 through 2026 as of March 5, 2021. The reasonableness of PG&E's forecast should thus be judged based on the information available to the Company as of this date." The same qualification applies to the deferred work analysis presented in this Exhibit. However, in managing the work portfolio, Electric Operations regularly reevaluates the planned execution of work to take into account changing circumstances and other factors, resulting in changes to unit and spending forecasts.

Workpaper Table 2-14
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Capital Imputed and Recorded/Forecast Costs 2020-2022
(Thousands of Nominal Dollars)

Line No.	Ch.	Chapter Title	Programs	MWC	2023 GRC (2020 Rec Adj + 2021 to 2022 Forecast)	2020 GRC (2020 to 2022 Imputed $$)	Difference
1	4	Wildfire Risk Mitigations	System Hardening Wildfire Resiliency projects	08	$ 1,930,695	$ 2,360,449	$ (429,754)
2	4	Wildfire Risk Mitigations	Emergency Preparedness and Response Wildfire Mitigation projects	21	$ 39,163	$ 25,235	$ 13,928
3	4	Wildfire Risk Mitigations	Expulsion Fuse Replacement	2A	$ 38,360	$ 16,280	$ 22,079
4	4	Wildfire Risk Mitigations	IT Wildfire Support	2F	$ 73,258	$ -	$ 73,258
5	4	Wildfire Risk Mitigations	Automation and Protection,PSPS Sectionalizing, Line Sensors	49	$ 258,064	$ 56,980	$ 201,084
6	5	Emergency Preparedness and Response	Miscellaneous Capital and Emergency Preparedness & Response	21	$ 4,530	$ 3,642	$ 888
7	6	Electric Emergency Recovery	ED Routine Emergency	17	$ 674,097	$ 565,406	$ 108,691
8	6	Electric Emergency Recovery	ED Major Emergency	95	$ 218,619	$ 169,717	$ 48,902
9	7	Distribution System Operations	Electric Operations Control Center Facility and Operations Technology	63	$ 9,465	$ 1,001	$ 8,464
10	8	Field Metering	Install New Electric Meters	25	$ 80,440	$ -	$ 80,440
11	8	Field Metering	Install New Gas Meters	74	$ 129,276	$ -	$ 129,276
12	11	OH and UG ED Maintenance	ED Install/Replace Overhead	2A	$ 989,206	$ 570,095	$ 419,111
13	11	OH and UG ED Maintenance	ED Install/Replace Underground	2B	$ 165,803	$ 178,751	$ (12,948)
14	12	Pole Asset Management	ED Install/Replace Overhead Poles	07	$ 924,919	$ 329,683	$ 595,236
15	12	Pole Asset Management	Miscellaneous Capital and Emergency Preparedness & Response	21	$ 2,656	$ -	$ 2,656
16	13	OH and UG Asset Management and Reliability	ED Overhead Asset Replacement	08	$ 92,338	$ 160,923	$ (68,585)
17	13	OH and UG Asset Management and Reliability	ED Automation & Protection	09	$ (1)	$ -	$ (1)
18	13	OH and UG Asset Management and Reliability	ED Reliability Circuit/Zone	49	$ 68,352	$ 61,888	$ 6,464
19	13	OH and UG Asset Management and Reliability	ED Underground (UG) Asset Replacements	56	$ 233,537	$ 230,715	$ 2,822
20	14	Network Asset Management	ED Install/Replace Network	2C	$ 57,173	$ 57,789	$ (617)
21	14	Network Asset Management	ED Underground (UG) Asset Replacements	56	$ 72,327	$ 73,529	$ (1,202)
22	15	Substation Asset Management	ED Substation Replace Other Equipment	48	$ 250,566	$ 160,433	$ 90,133
23	15	Substation Asset Management	ED Substation Transformer Replacements	54	$ 100,643	$ 16,985	$ 83,658
24	15	Substation Asset Management	ED Substation Safety and Security	58	$ 11,086	$ 14,202	$ (3,116)
25	15	Substation Asset Management	ED Substation Emergency Replacement	59	$ 298,940	$ 192,904	$ 106,036
26	16	Distribution System Automation & Protection	ED Automation & Protection	09	$ 89,291	$ 88,526	$ 765
27	17	ED Capacity, Engineering and Planning	ED Line and Equipment Capacity	06	$ 491,451	$ 277,025	$ 214,427
28	17	ED Capacity, Engineering and Planning	ED Substation Capacity	46	$ 180,341	$ 122,638	$ 57,703
29	18	New Business and Work at the Request of Others	ED Work Requested by Others (WRO) General	10	$ 446,368	$ 404,100	$ 42,268
30	18	New Business and Work at the Request of Others	ED Customer Connects	16	$ 1,648,180	$ 1,393,897	$ 254,283
31	19	Rule 20A	ED WRO Rule 20A	30	$ 125,514	$ 102,965	$ 22,549
32	20	ED Data Management and Technology	Miscellaneous Capital and Emergency Preparedness & Response	21	$ 1,611	$ -	$ 1,611
33	20	ED Data Management and Technology	Build IT Applications & Infrastructure	2F	$ 62,481	$ 37,702	$ 24,779
34	21	Integrated Grid Platform and Grid Modernization Plan	Miscellaneous Capital and Emergency Preparedness & Response	21	$ 6,360	$ -	$ 6,360
35	21	Integrated Grid Platform and Grid Modernization Plan	Build IT Applications & Infrastructure	2F	$ 64,164	$ 15,031	$ 49,133
36	21	Integrated Grid Platform and Grid Modernization Plan	Energy Storage Capital	3R	$ 86,080	$ -	$ 86,080
37	21	Integrated Grid Platform and Grid Modernization Plan	Electric Operations Control Center Facility and Operations Technology	63	$ 253,138	$ 101,055	$ 152,083
38	21	Integrated Grid Platform and Grid Modernization Plan	TO-EGI/WRO/SI	82	$ 162	$ -	$ 162
39	22	ED Support Activities	Tools & Equipment	05	$ 21,081	$ 23,454	$ (2,373)
40	22	ED Support Activities	Miscellaneous Capital	21	$ (20,771)	$ (113,254)	$ 92,484
41	23	Community Rebuild Program	Community Rebuild Capital	95	$ 299,745	$ -	$ 299,745
42			**Total Capital**		**$ 10,478,707**	**$ 7,699,746**	**$ 2,778,961**

Workpaper Table 2-15
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Expense Imputed and Recorded/Forecast Costs 2020-2022
(Thousands of Nominal Dollars)

Line No.	Ch.	Chapter Title	Programs	MWC	2023 GRC (2020 Rec Adj + 2021 to 2022 Forecast)	2020 GRC (2020 to 2022 Imputed $$)	Difference
1	4	Wildfire Risk Mitigations	Wildfire Mitigation Expense	AB	$ 626,615	$ 131,644	$ 494,971
2	4	Wildfire Risk Mitigations	Wildfire Mitigation Expense	BA	$ 5,150	$ -	$ 5,150
3	4	Wildfire Risk Mitigations	Wildfire Mitigation Expense	BH	$ 121,753	$ -	$ 121,753
4	4	Wildfire Risk Mitigations	Asset Performance Center	FZ	$ 16,534	$ -	$ 16,534
5	4	Wildfire Risk Mitigations	Asset Performance Center	GC	$ 808	$ -	$ 808
6	4	Wildfire Risk Mitigations	ED Operational Technology	HG	$ 144	$ 1,089	$ (945)
7	4	Wildfire Risk Mitigations	Wildfire Mitigation Expense	IG	$ 129,601	$ -	$ 129,601
8	4	Wildfire Risk Mitigations	Wildfire Mitigation Expense	JV	$ -	$ -	$ -
9	4	Wildfire Risk Mitigations	Preventive Maintenance and Equipment Repair, Overhead (OH)	KA	$ 617	$ -	$ 617
10	5	Emergency Preparedness and Response	Support and Emergency Preparedness and Response	AB	$ 15,973	$ 19,804	$ (3,831)
11	6	Electric Emergency Recovery	ED Routine Emergency	BH	$ 185,710	$ 175,353	$ 10,357
12	6	Electric Emergency Recovery	ED Major Emergency	IF	$ 152,074	$ 103,232	$ 48,842
13	7	Distribution System Operations	ED Operation Activities	BA	$ 76,161	$ 65,342	$ 10,820
14	7	Distribution System Operations	Customer Field Service Work	DD	$ 60,509	$ 62,392	$ (1,883)
15	7	Distribution System Operations	ED Operational Technology	HG	$ 14,097	$ 4,040	$ 10,057
16	8	Field Metering	Read & Investigate Meters	AR	$ 31,370	$ -	$ 31,370
17	8	Field Metering	Customer Field Service Work	DD	$ 1,233	$ -	$ 1,233
18	8	Field Metering	Change/Maintenance Used Electric Meter	EY	$ 16,989	$ -	$ 16,989
19	8	Field Metering	Perform Gas Meter Maintenance	HY	$ 2,752	$ -	$ 2,752
20	8	Field Metering	Collect Revenue	IU	$ 4,569	$ -	$ 4,569
21	9	Vegetation Management	VMBA - Routine Vegetation Management	HN	$ 2,072,279	$ 758,885	$ 1,313,395
22	9	Vegetation Management	VMBA - Enhanced VM and Dead and Dying Trees	IG	$ 2,208,990	$ 1,055,037	$ 1,153,953
23	10	OH and UG Electric Asset Inspections	ED Patrols and Inspections	BF	$ 369,956	$ 101,215	$ 268,741
24	11	OH and UG ED Maintenance	Maintenance of Other Equip	BK	$ 5,092	$ 5,086	$ 6
25	11	OH and UG ED Maintenance	Preventive Maintenance and Equipment Repair, Overhead (OH)	KA	$ 240,966	$ 99,249	$ 141,717
26	11	OH and UG ED Maintenance	Preventive Maintenance and Equipment Repair, Underground (UG)	KB	$ 43,328	$ 38,334	$ 4,994
27	12	Pole Asset Management	Support and Emergency Preparedness and Response	AB	$ 82	$ -	$ 82
28	12	Pole Asset Management	Poles – Intrusive Inspection/Test and Treat Program	GA	$ 122,761	$ 41,733	$ 81,028
29	12	Pole Asset Management	Miscellaneous Balancing and Memorandum Account	IG	$ 0	$ -	$ 0
30	14	Network Asset Management	Preventive Maintenance and Equipment Repair, Network	KC	$ 13,292	$ 12,313	$ 979
31	15	Substation Asset Management	Operate and Maintain Substations	GC	$ 129,679	$ 89,093	$ 40,586
32	16	Distribution System Automation & Protection	Distribution Automation & Protection Support	HX	$ 7,172	$ 6,265	$ 907
33	17	ED Capacity, Engineering and Planning	ED Engineering and Planning	FZ	$ 46,760	$ 51,956	$ (5,195)
34	18	New Business and Work at the Request of Others	Manage Service Inquiries	EV	$ 34,759	$ 38,700	$ (3,941)
35	18	New Business and Work at the Request of Others	Electric Operations Work Requested by Others (WRO)	EW	$ 31,746	$ 27,828	$ 3,918
36	19	Rule 20A	Rule 20A Expense	IG	$ (65)	$ -	$ (65)
37	20	ED Data Management and Technology	ED Mapping	GE	$ 38,841	$ 18,032	$ 20,809
38	20	ED Data Management and Technology	Maintain IT Applications & Infrastructure	JV	$ 9,919	$ 13,281	$ (3,361)
39	21	Integrated Grid Platform and Grid Modernization Plan	Support and Emergency Preparedness and Response	AB	$ 11,380	$ -	$ 11,380
40	21	Integrated Grid Platform and Grid Modernization Plan	Research & Development	AT	$ -	$ -	$ -
41	21	Integrated Grid Platform and Grid Modernization Plan	ED Operational Technology	HG	$ 12,865	$ 28,334	$ (15,469)
42	21	Integrated Grid Platform and Grid Modernization Plan	Miscellaneous Balancing and Memorandum Account	IG	$ 10,296	$ -	$ 10,296
43	21	Integrated Grid Platform and Grid Modernization Plan	Maintain IT Applications & Infrastructure	JV	$ 5,274	$ 2,754	$ 2,520
44	22	ED Support Activities	Support and Emergency Preparedness and Response	AB	$ 62,656	$ 54,679	$ 7,977
45	22	ED Support Activities	Streetlight Support	IS	$ 2,435	$ 3,322	$ (887)
46	22	ED Support Activities	Operational Management	OM	$ 24,619	$ 22,090	$ 2,529
47	22	ED Support Activities	Operational Support	OS	$ 147,409	$ 68,265	$ 79,144
48	23	Community Rebuild Program	Community Rebuild Expense	IF	$ 56,403	$ -	$ 56,403
49			**Total Expense**		**$ 7,171,558**	**$ 3,099,347**	**$ 4,072,212**

Workpaper Table 2-16
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution 2023 Expense Forecast by Program Area
(Thousands of Nominal Dollars)

Line No.	Ch.	Chapter Title	Programs	MWC	Asset Management and Reliability	Customer Requested & Load Growth	Emergency Preparedness and Response	Maintenance and Compliance	Operational Coordination	Risk Reduction	2023 Forecast Total	Notes
1	4.1	Situational Awareness and Forecasting	Misc Expense	AB	$ -	$ -	$ -	$ -	$ -	$ 43,416	$ 43,416	
2					**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 43,416**	**$ 43,416**	
3	4.2	PSPS Operations	Misc Expense	AB	$ -	$ -	$ -	$ -	$ -	$ 115,266	$ 115,266	
4					**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 115,266**	**$ 115,266**	
5	4.3	System Hardening, Enhanced Automation, and PSPS Impact Mitigations	E Dist Planning & Ops Engineer	FZ	$ -	$ -	$ -	$ -	$ -	$ 3,437	$ 3,437	
6			Misc Expense	AB	$ -	$ -	$ -	$ -	$ -	$ 7,204	$ 7,204	
7			E Dist Maint OH General	KA	$ -	$ -	$ -	$ -	$ -	$ 953	$ 953	
8					**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 11,595**	**$ 11,595**	
9	4.4	Community Wildfire Safety Program PMO	Misc Expense	AB	$ -	$ -	$ -	$ -	$ -	$ 13,460	$ 13,460	
10					**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 13,460**	**$ 13,460**	
11	4.5	Information Technology for Wildfire Mitigations	Manage Var Bal Acct Processes	IG	$ -	$ -	$ -	$ -	$ -	$ 35,700	$ 35,700	
12					**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 35,700**	**$ 35,700**	
13	4.6	Enhanced Powerline Safety Settings	E Dist Operate System	BA	$ -	$ -	$ -	$ -	$ -	$ 2,219	$ 2,219	(1)
14			E Dist Planning & Ops Engineer	BH	$ -	$ -	$ -	$ -	$ -	$ 112,510	$ 112,510	(1)
15			E Dist Subst O&M	FZ	$ -	$ -	$ -	$ -	$ -	$ 2,063	$ 2,063	(1)
16			E Dist Routine Emergency	GC	$ -	$ -	$ -	$ -	$ -	$ 833	$ 833	(1)
17			Manage Var Bal Acct Processes	IG	$ -	$ -	$ -	$ -	$ -	$ 33,504	$ 33,504	(1)
18					**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 151,129**	**$ 151,129**	
19	5	Emergency Preparedness and Response	Misc Expense	AB	$ -	$ -	$ 22,275	$ -	$ -	$ 4,176	$ 26,451	
20					**$ -**	**$ -**	**$ 22,275**	**$ -**	**$ -**	**$ 4,176**	**$ 26,451**	
21	6	Electric Emergency Recovery	E Dist Major Emergency	IF	$ -	$ -	$ 62,788	$ -	$ -	$ -	$ 62,788	
22			E Dist Routine Emergency	BH	$ -	$ -	$ 73,678	$ -	$ -	$ -	$ 73,678	
23					**$ -**	**$ -**	**$ 136,466**	**$ -**	**$ -**	**$ -**	**$ 136,466**	
24	7	Distribution System Operations	E Dist Operate System	BA	$ -	$ -	$ -	$ -	$ 29,478	$ -	$ 29,478	
25			Elec Trans Ops Engr & Tech	HG	$ -	$ -	$ -	$ -	$ 5,392	$ -	$ 5,392	
26			Provide Field Service	DD	$ -	$ -	$ -	$ -	$ 23,776	$ -	$ 23,776	
27					**$ -**	**$ -**	**$ -**	**$ -**	**$ 58,646**	**$ -**	**$ 58,646**	
28	8	Field Metering	Change/Maint Used Elec Meter	EY	$ -	$ -	$ -	$ 7,734	$ -	$ -	$ 7,734	
29			Change/Maint Used Gas Meters	HY	$ -	$ -	$ -	$ 685	$ -	$ -	$ 685	
30			Collect Revenue	IU	$ -	$ -	$ -	$ 2,250	$ -	$ -	$ 2,250	
31			Provide Field Service	DD	$ -	$ -	$ -	$ 480	$ -	$ -	$ 480	
32			Read & Investigate Meters	AR	$ -	$ -	$ -	$ 10,425	$ -	$ -	$ 10,425	
33					**$ -**	**$ -**	**$ -**	**$ 21,574**	**$ -**	**$ -**	**$ 21,574**	
34	9	Vegetation Management	E Dist Tree Trim Bal Acct	HN	$ -	$ -	$ -	$ 871,220	$ -	$ -	$ 871,220	
35			Manage Var Bal Acct Processes	IG	$ -	$ -	$ -	$ 69,830	$ -	$ 118,022	$ 187,853	
36					**$ -**	**$ -**	**$ -**	**$ 941,050**	**$ -**	**$ 118,022**	**$ 1,059,072**	
37	10	Overhead and Underground Electric Asset Inspections	E T&D Patrol/Insp	BF	$ -	$ -	$ -	$ 89,464	$ -	$ -	$ 89,464	
38					**$ -**	**$ -**	**$ -**	**$ 89,464**	**$ -**	**$ -**	**$ 89,464**	
39	11	Overhead and Underground Electric Distribution Maintenance	E Dist Maint OH General	KA	$ -	$ -	$ -	$ 74,135	$ -	$ -	$ 74,135	

Workpaper Table 2-16
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution 2023 Expense Forecast by Program Area
(Thousands of Nominal Dollars)

Line No.	Ch.	Chapter Title	Programs	MWC	Asset Management and Reliability	Customer Requested & Load Growth	Emergency Preparedness and Response	Maintenance and Compliance	Operational Coordination	Risk Reduction	2023 Forecast Total	Notes
40			E Dist Maint UG	KB	$ -	$ -	$ -	$ 18,938	$ -	$ -	$ 18,938	
41			Maint Other Equip	BK	$ -	$ -	$ -	$ 1,912	$ -	$ -	$ 1,912	
42					**$ -**	**$ -**	**$ -**	**$ 94,985**	**$ -**	**$ -**	**$ 94,985**	
43	12	Pole Asset Management	E T&D Maint OH Poles	GA	$ -	$ -	$ -	$ 39,340	$ -	$ -	$ 39,340	
44					**$ -**	**$ -**	**$ -**	**$ 39,340**	**$ -**	**$ -**	**$ 39,340**	
45	14	Network Asset Management	E Dist Maint Network	KC	$ -	$ -	$ -	$ 5,021	$ -	$ -	$ 5,021	
46					**$ -**	**$ -**	**$ -**	**$ 5,021**	**$ -**	**$ -**	**$ 5,021**	
47	15	Substation Asset Management	E Dist Subst O&M	GC	$ -	$ -	$ 14,069	$ 36,871	$ -	$ -	$ 50,940	
48					**$ -**	**$ -**	**$ 14,069**	**$ 36,871**	**$ -**	**$ -**	**$ 50,940**	
49	16	Distribution System Automation and Protection	E T&D Automation & Protection	HX	$ -	$ -	$ -	$ -	$ 3,008	$ -	$ 3,008	
50					**$ -**	**$ -**	**$ -**	**$ -**	**$ 3,008**	**$ -**	**$ 3,008**	
51	17	Electric Distribution Capacity, Engineering and Planning	E Dist Planning & Ops Engineer	FZ	$ -	$ -	$ -	$ -	$ 19,943	$ -	$ 19,943	
52					**$ -**	**$ -**	**$ -**	**$ -**	**$ 19,943**	**$ -**	**$ 19,943**	
53	18	New Business and Work at the Request of Others	E TD WRO	EW	$ -	$ 10,283	$ -	$ -	$ -	$ -	$ 10,283	
54			Manage Service Inquiries	EV	$ -	$ 13,878	$ -	$ -	$ -	$ -	$ 13,878	
55					**$ -**	**$ 24,161**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 24,161**	
56	20	Electric Distribution Data Management and Technology	E Dist Mapping	GE	$ -	$ -	$ -	$ -	$ 21,524	$ -	$ 21,524	
57			Maintain IT Apps & Infra	JV	$ -	$ -	$ -	$ -	$ 4,501	$ -	$ 4,501	
58					**$ -**	**$ -**	**$ -**	**$ -**	**$ 26,026**	**$ -**	**$ 26,026**	
59	21	Integrated Grid Platform and Grid Modernization Plan	Elec Trans Ops Engr & Tech	HG	$ -	$ -	$ -	$ -	$ 15,541	$ -	$ 15,541	
60			Maintain IT Apps & Infra	JV	$ -	$ -	$ -	$ -	$ 3,309	$ -	$ 3,309	
61			Manage Var Bal Acct Processes	IG	$ -	$ -	$ -	$ -	$ 3,026	$ -	$ 3,026	
62			Misc Expense	AB	$ -	$ -	$ -	$ -	$ 10,015	$ -	$ 10,015	
63			Research & Development	AT	$ -	$ -	$ -	$ -	$ 2,056	$ -	$ 2,056	
64					**$ -**	**$ -**	**$ -**	**$ -**	**$ 33,947**	**$ -**	**$ 33,947**	
65	22	Electric Distribution Support Activities	Bill Customers	IS	$ -	$ -	$ -	$ -	$ 1,641	$ -	$ 1,641	
66			Misc Expense	AB	$ -	$ -	$ -	$ -	$ 46,700	$ 2,810	$ 49,510	
67			Operational Management	OM	$ -	$ -	$ -	$ -	$ 19,513	$ -	$ 19,513	
68			Operational Support	OS	$ -	$ -	$ -	$ -	$ 60,931	$ -	$ 60,931	
69					**$ -**	**$ -**	**$ -**	**$ -**	**$ 128,784**	**$ 2,810**	**$ 131,594**	
70	23	Community Rebuild Program	Community Rebuild Expense	IF	$ -	$ -	$ 13,781	$ -	$ -	$ -	$ 13,781	
71					**$ -**	**$ -**	**$ 13,781**	**$ -**	**$ -**	**$ -**	**$ 13,781**	
72			**Total Expense**		**$ -**	**$ 24,161**	**$ 186,591**	**$ 1,228,306**	**$ 270,355**	**$ 495,573**	**$ 2,204,986**	

(1) "2021 Forecast" values for Chapter 4.6 represent recorded costs rather than forecast costs

Workpaper Table 2-17
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution 2023 Capital Forecast by Program Area
(Thousands of Nominal Dollars)

Line No.	Ch.	Chapter Title	Programs	MWC	Asset Management and Reliability	Customer Requested & Load Growth	Emergency Preparedness and Response	Maintenance and Compliance	Operational Coordination	Risk Reduction	2023 Forecast Total
1	4.1	Situational Awareness and Forecasting	Misc Capital	21	$ -	$ -	$ -	$ -	$ -	$ 4,601	$ 4,601
2					**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 4,601**	**$ 4,601**
3	4.2	PSPS Operations	Misc Capital	21	$ -	$ -	$ -	$ -	$ -	$ 262	$ 262
4					**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 262**	**$ 262**
5	4.3	System Hardening, Enhanced Automation, and PSPS Impact Mitigations	E Dist Replace OH Asset	08	$ -	$ -	$ -	$ -	$ -	$ 1,512,026	$ 1,512,026
6			E Dist Inst/Repl OH General	2A	$ -	$ -	$ -	$ -	$ -	$ 15,752	$ 15,752
7			E Dist Reliability Ckt/Zone	49	$ -	$ -	$ -	$ -	$ -	$ 54,857	$ 54,857
8			Misc Capital	21	$ -	$ -	$ -	$ -	$ -	$ 10,507	$ 10,507
9					**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,593,142**	**$ 1,593,142**
10	4.5	Information Technology for Wildfire Mitigations	Build IT Apps & Infra	2F	$ -	$ -	$ -	$ -	$ -	$ 25,300	$ 25,300
11					**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 25,300**	**$ 25,300**
12	5	Emergency Preparedness and Response	Misc Capital	21	$ -	$ -	$ 3,359	$ -	$ -	$ 2,143	$ 5,502
13					**$ -**	**$ -**	**$ 3,359**	**$ -**	**$ -**	**$ 2,143**	**$ 5,502**
14	6	Electric Emergency Recovery	E Dist Major Emergency	95	$ -	$ -	$ 79,996	$ -	$ -	$ -	$ 79,996
15			E Dist Routine Emergency	17	$ -	$ -	$ 239,188	$ -	$ -	$ -	$ 239,188
16					**$ -**	**$ -**	**$ 319,184**	**$ -**	**$ -**	**$ -**	**$ 319,184**
17	7	Distribution System Operations	E T&D Control System/ Facility	63	$ -	$ -	$ -	$ -	$ 4,333	$ -	$ 4,333
18					**$ -**	**$ -**	**$ -**	**$ -**	**$ 4,333**	**$ -**	**$ 4,333**
19	8	Field Metering	Install New Electric Meters	25	$ -	$ -	$ -	$ 30,101	$ -	$ -	$ 30,101
20			Install New Gas Meters	74	$ -	$ -	$ -	$ 74,355	$ -	$ -	$ 74,355
21					**$ -**	**$ -**	**$ -**	**$ 104,455**	**$ -**	**$ -**	**$ 104,455**
22	11	Overhead and Underground Electric Distribution Maintenance	E Dist Inst/Repl UG	2B	$ -	$ -	$ -	$ 63,731	$ -	$ -	$ 63,731
23			E Dist Inst/Repl OH General	2A	$ -	$ -	$ -	$ 254,440	$ -	$ 26,067	$ 280,507
24					**$ -**	**$ -**	**$ -**	**$ 318,171**	**$ -**	**$ 26,067**	**$ 344,238**
25	12	Pole Asset Management	E Dist Inst/Repl OH Poles	07	$ -	$ -	$ -	$ 376,218	$ -	$ 3,296	$ 379,514
26					**$ -**	**$ -**	**$ -**	**$ 376,218**	**$ -**	**$ 3,296**	**$ 379,514**
27	13	Overhead and Underground Asset Management	E Dist Replace UG Asset-Gen	56	$ 91,317	$ -	$ -	$ -	$ -	$ -	$ 91,317
28			E Dist Reliability Ckt/Zone	49	$ 22,871	$ -	$ -	$ -	$ -	$ 6,239	$ 29,110
29			E Dist Replace OH Asset	08	$ 43,036	$ -	$ -	$ -	$ -	$ 975	$ 44,011
30					**$ 157,223**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 7,214**	**$ 164,438**
31	14	Network Asset Management	E Dist Inst/Repl Network	2C	$ 1,312	$ -	$ -	$ -	$ -	$ 12,240	$ 13,552
32			E Dist Replace UG Asset-Gen	56	$ 24,361	$ -	$ -	$ -	$ -	$ 6,510	$ 30,871
33					**$ 25,673**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 18,750**	**$ 44,423**
34	15	Substation Asset Management	E Dist Repl Substation Safety	58	$ 8,232	$ -	$ -	$ -	$ -	$ -	$ 8,232
35			E Dist Subst Emergency Repl	59	$ -	$ -	$ 82,323	$ -	$ -	$ -	$ 82,323
36			E Dist Subst Repl Other Equip	48	$ 94,971	$ -	$ -	$ -	$ -	$ 1,360	$ 96,331
37			E Dist Subst Repl Transformer	54	$ 16,014	$ -	$ -	$ -	$ -	$ 5,229	$ 21,243
38					**$ 119,217**	**$ -**	**$ 82,323**	**$ -**	**$ -**	**$ 6,589**	**$ 208,129**
39	16	Distribution System Automation and Protection	E Dist Automation & Protection	09	$ -	$ -	$ -	$ -	$ 27,003	$ -	$ 27,003
40					**$ -**	**$ -**	**$ -**	**$ -**	**$ 27,003**	**$ -**	**$ 27,003**
41	17	Electric Distribution Capacity, Engineering and Planning	E Dist Line Capacity	06	$ -	$ 137,655	$ -	$ -	$ -	$ -	$ 137,655
42			E Dist Subst Capacity	46	$ -	$ 58,082	$ -	$ -	$ -	$ -	$ 58,082
43					**$ -**	**$ 195,738**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 195,738**
44	18	New Business and Work at the Request of Others	E Dist Customer Connects	16	$ -	$ 666,795	$ -	$ -	$ -	$ -	$ 666,795
45			E Dist WRO General	10	$ -	$ 132,769	$ -	$ -	$ -	$ -	$ 132,769

Workpaper Table 2-17
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution 2023 Capital Forecast by Program Area
(Thousands of Nominal Dollars)

Line No.	Ch.	Chapter Title	Programs	MWC	Asset Management and Reliability	Customer Requested & Load Growth	Emergency Preparedness and Response	Maintenance and Compliance	Operational Coordination	Risk Reduction	2023 Forecast Total
46					**$ -**	**$ 799,564**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 799,564**
47	19	Rule 20A	E Dist WRO Rule 20A	30	$ -	$ 39,876	$ -	$ -	$ -	$ -	$ 39,876
48					**$ -**	**$ 39,876**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 39,876**
49	20	Electric Distribution Data Management and Technology	Build IT Apps & Infra	2F	$ -	$ -	$ -	$ -	$ 17,987	$ -	$ 17,987
50			Misc Capital	21	$ -	$ -	$ -	$ -	$ 1,712	$ -	$ 1,712
51					**$ -**	**$ -**	**$ -**	**$ -**	**$ 19,700**	**$ -**	**$ 19,700**
52	21	Integrated Grid Platform and Grid Modernization Plan	Build IT Apps & Infra	2F	$ -	$ -	$ -	$ -	$ 20,369	$ -	$ 20,369
53			E T&D Control System/ Facility	63	$ -	$ -	$ -	$ -	$ 109,049	$ -	$ 109,049
54			Misc Capital	21	$ -	$ -	$ -	$ -	$ 2,237	$ -	$ 2,237
55					**$ -**	**$ -**	**$ -**	**$ -**	**$ 131,655**	**$ -**	**$ 131,655**
56	22	Electric Distribution Support Activities	Misc Capital	21	$ -	$ -	$ -	$ -	$ 1,493	$ -	$ 1,493
57			Tools & Equipment	05	$ -	$ -	$ -	$ -	$ 6,901	$ -	$ 6,901
58					**$ -**	**$ -**	**$ -**	**$ -**	**$ 8,394**	**$ -**	**$ 8,394**
59	23	Community Rebuild Program	Community Rebuild Capital	95	$ -	$ -	$ 28,139	$ -	$ -	$ 88,450	$ 116,590
60					**$ -**	**$ -**	**$ 28,139**	**$ -**	**$ -**	**$ 88,450**	**$ 116,590**
61			**Total Capital**		**$ 302,113**	**$ 1,035,178**	**$ 433,006**	**$ 798,844**	**$ 191,084**	**$ 1,775,815**	**$ 4,536,041**

(1) "2021 Forecast" values for Chapter 4.6 represent recorded costs rather than forecast costs

Workpaper Table 2-18
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Imputed and Recorded/Forecast Costs 2020-2022 - Expense
(Thousands of Nominal Dollars)

Line No.	Cost Recovery	Chapter	Chapter Title	Programs	MWC	2020 Recorded Total	2021 Forecast Total	2022 Forecast Total	2020-2022 Total	2020 Imputed Total	2021 Imputed Total	2022 Imputed Total	2020 to 2022 Imputed	Difference from GRC to Imputed	Notes
1	2020 GRC	4	Wildfire Risk Mitigations	E Dist Planning & Ops Engineer	FZ	$ 1,487	$ 3,256	$ 2,576	$ 7,319	$ -	$ -	$ -	$ -	$ 7,319	
2		5	Emergency Preparedness and Response	Misc Expense	AB	$ 7,556	$ 4,209	$ 4,208	$ 15,973	$ 6,463	$ 6,633	$ 6,708	$ 19,804	$ (3,832)	
3		6	Electric Emergency Recovery	E Dist Routine Emergency	BH	$ 66,451	$ 59,274	$ 59,361	$ 185,086	$ 57,276	$ 58,923	$ 59,154	$ 175,353	$ 9,733	
4		7	Distribution System Operations	E Dist Operate System	BA	$ 30,017	$ 23,055	$ 23,089	$ 76,161	$ 21,344	$ 21,993	$ 22,004	$ 65,342	$ 10,820	
5				Provide Field Service	DD	$ 23,204	$ 18,620	$ 18,685	$ 60,509	$ 20,381	$ 20,997	$ 21,014	$ 62,392	$ (1,883)	
6				Elec Trans Ops Engr & Tech	HG	$ 2,074	$ 4,385	$ 7,638	$ 14,097	$ 1,322	$ 1,347	$ 1,370	$ 4,040	$ 10,057	
7		8	Field Metering	Read & Investigate Meters	AR	$ 10,096	$ 10,686	$ 10,589	$ 31,370	$ -	$ -	$ -	$ -	$ 31,370	(1)
8				Provide Field Service	DD	$ 400	$ 411	$ 422	$ 1,233	$ -	$ -	$ -	$ -	$ 1,233	(1)
9				Change/Maint Used Elec Meter	EY	$ 6,809	$ 5,079	$ 5,101	$ 16,989	$ -	$ -	$ -	$ -	$ 16,989	(1)
10				Change/Maint Used Gas Meters	HY	$ 1,552	$ 590	$ 610	$ 2,752	$ -	$ -	$ -	$ -	$ 2,752	(1)
11				Collect Revenue	IU	$ 1,499	$ 1,500	$ 1,570	$ 4,569	$ -	$ -	$ -	$ -	$ 4,569	(1)
12		10	Overhead and Underground Electric Asset Inspections	E T&D Patrol/Insp	BF	$ 74,933	$ 54,994	$ 59,710	$ 189,638	$ 33,084	$ 33,969	$ 34,161	$ 101,215	$ 88,423	
13		11	Overhead and Underground Electric Distribution Maintenance	Maint Other Equip	BK	$ 1,851	$ 1,619	$ 1,621	$ 5,092	$ 1,662	$ 1,707	$ 1,717	$ 5,086	$ 6	
14				E Dist Maint OH General	KA	$ 47,924	$ 27,054	$ 26,476	$ 101,454	$ 32,449	$ 33,279	$ 33,521	$ 99,249	$ 2,206	
15				E Dist Maint UG	KB	$ 13,147	$ 15,079	$ 15,101	$ 43,328	$ 12,537	$ 12,836	$ 12,961	$ 38,334	$ 4,994	
16		12	Pole Asset Management	E T&D Maint OH Poles	GA	$ 21,848	$ 21,095	$ 21,126	$ 64,069	$ 13,585	$ 13,930	$ 14,219	$ 41,733	$ 22,335	
17		14	Network Asset Management	E Dist Maint Network	KC	$ 4,891	$ 4,198	$ 4,204	$ 13,292	$ 4,025	$ 4,131	$ 4,157	$ 12,313	$ 979	
18		15	Substation Asset Management	E Dist Subst O&M	GC	$ 39,748	$ 33,355	$ 31,944	$ 105,047	$ 29,125	$ 29,891	$ 30,078	$ 89,093	$ 15,954	
19		16	Distribution System Automation and Protection	E T&D Automation & Protection	HX	$ 2,344	$ 2,412	$ 2,416	$ 7,172	$ 2,048	$ 2,100	$ 2,116	$ 6,265	$ 907	
20		17	Electric Distribution Capacity, Engineering and Planning	E Dist Planning & Ops Engineer	FZ	$ 15,158	$ 15,447	$ 16,155	$ 46,760	$ 16,974	$ 17,478	$ 17,505	$ 51,956	$ (5,195)	
21		18	New Business and Work at the Request of Others	Manage Service Inquiries	EV	$ 12,986	$ 10,879	$ 10,894	$ 34,759	$ 12,625	$ 13,032	$ 13,043	$ 38,700	$ (3,941)	
22				E TD WRO	EW	$ 15,521	$ 8,106	$ 8,118	$ 31,746	$ 8,859	$ 9,404	$ 9,566	$ 27,828	$ 3,918	
23		20	Electric Distribution Data Management and Technology	E Dist Mapping	GE	$ 5,808	$ 14,088	$ 14,108	$ 34,004	$ 5,899	$ 6,032	$ 6,102	$ 18,032	$ 15,972	
24				Maintain IT Apps & Infra	JV	$ 2,810	$ 3,777	$ 3,333	$ 9,919	$ 4,345	$ 4,440	$ 4,495	$ 13,281	$ (3,361)	
25		21	Integrated Grid Platform and Grid Modernization Plan	Misc Expense	AB	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
26				Elec Trans Ops Engr & Tech	HG	$ 5,154	$ 5,424	$ 2,287	$ 12,865	$ 9,275	$ 9,449	$ 9,610	$ 28,334	$ (15,469)	
27				Maintain IT Apps & Infra	JV	$ 1,429	$ 1,345	$ 2,500	$ 5,274	$ 901	$ 921	$ 932	$ 2,754	$ 2,520	
28		22	Electric Distribution Support Activities	Misc Expense	AB	$ 47,137	$ 6,365	$ 9,155	$ 62,656	$ 17,717	$ 18,213	$ 18,749	$ 54,679	$ 7,977	
29				Bill Customers	IS	$ 709	$ 862	$ 864	$ 2,435	$ 1,088	$ 1,108	$ 1,127	$ 3,322	$ (887)	
30				Operational Management	OM	$ (4,204)	$ 14,401	$ 14,422	$ 24,619	$ 7,217	$ 7,429	$ 7,444	$ 22,090	$ 2,529	
31				Operational Support	OS	$ 55,555	$ 45,894	$ 45,961	$ 147,409	$ 22,305	$ 22,952	$ 23,009	$ 68,265	$ 79,144	
32				**2020 GRC Subtotal:**		**$ 515,893**	**$ 417,461**	**$ 424,243**	**$ 1,357,598**	**$ 342,506**	**$ 352,191**	**$ 354,762**	**$ 1,049,459**	**$ 308,138**	
33	VMBA - Vegetation Mgmt Balancing Account	9	Vegetation Management	E Dist Tree Trim Bal Acct	HN	$ 693,149	$ 668,123	$ 711,007	$ 2,072,279	$ 229,270	$ 252,197	$ 277,417	$ 758,885	$ 1,313,395	
34				Manage Var Bal Acct Processes	IG	$ 544,459	$ 603,930	$ 1,060,600	$ 2,208,989	$ 318,742	$ 350,616	$ 385,678	$ 1,055,037	$ 1,153,952	
35				**VMBA - Vegetation Mgmt Balancing Account Subtotal:**		**$ 1,237,608**	**$ 1,272,053**	**$ 1,771,608**	**$ 4,281,268**	**$ 548,013**	**$ 602,814**	**$ 663,095**	**$ 1,813,922**	**$ 2,467,347**	
36	WMBA Wildfire Mitigation Balancing Acct	4	Wildfire Risk Mitigations	Misc Expense	AB	$ 198,680	$ 204,088	$ 192,293	$ 595,061	$ 42,297	$ 43,819	$ 45,528	$ 131,644	$ 463,417	
37		4	Wildfire Risk Mitigations	Elec Trans Ops Engr & Tech	HG	$ 10	$ 134	$ -	$ 144	$ 350	$ 362	$ 377	$ 1,089	$ (945)	
38		4	Wildfire Risk Mitigations	E Dist Maint OH General	KA	$ -	$ -	$ 617	$ 617	$ -	$ -	$ -	$ -	$ 617	
39		4	Wildfire Risk Mitigations	Manage Var Bal Acct Processes	IG	$ -	$ 35,700	$ 35,700	$ 71,400	$ -	$ -	$ -	$ -	$ 71,400	
40		5	Emergency Preparedness and Response	Misc Expense	AB	$ 1	$ -	$ -	$ 1	$ -	$ -	$ -	$ -	$ 1	
41		10	Emergency Preparedness and Response	E T&D Patrol/Insp	BF	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
42				**WMBA Wildfire Mitigation Balancing Acct Subtotal:**		**$ 198,691**	**$ 239,922**	**$ 228,611**	**$ 667,223**	**$ 42,647**	**$ 44,182**	**$ 45,905**	**$ 132,733**	**$ 534,490**	
43	ED Major Emergency Balancing Account	6	Electric Emergency Recovery	E Dist Major Emergency	IF	$ 30,973	$ 41,465	$ 41,501	$ 113,940	$ 33,743	$ 34,648	$ 34,841	$ 103,232	$ 10,708	
44				**ED Major Emergency Balancing Account Subtotal:**		**$ 30,973**	**$ 41,465**	**$ 41,501**	**$ 113,940**	**$ 33,743**	**$ 34,648**	**$ 34,841**	**$ 103,232**	**$ 10,708**	
45	Fire Risk Mitigation Memo Account	4	Wildfire Risk Mitigations	Misc Expense	AB	$ 19,045	$ 12,509	$ -	$ 31,554	$ -	$ -	$ -	$ -	$ 31,554	
46		4	Wildfire Risk Mitigations	E Dist Operate System	BA	$ -	$ 2,998	$ 2,152	$ 5,150	$ -	$ -	$ -	$ -	$ 5,150	(2)
47		4	Wildfire Risk Mitigations	E Dist Routine Emergency	BH	$ -	$ 12,658	$ 109,095	$ 121,753	$ -	$ -	$ -	$ -	$ 121,753	(2)
48		4	Wildfire Risk Mitigations	E Dist Planning & Ops Engineer	FZ	$ -	$ 2,046	$ 7,169	$ 9,215	$ -	$ -	$ -	$ -	$ 9,215	(2)
49		4	Wildfire Risk Mitigations	E Dist Subst O&M	GC	$ -	$ -	$ 808	$ 808	$ -	$ -	$ -	$ -	$ 808	(2)
50		4	Wildfire Risk Mitigations	Manage Var Bal Acct Processes	IG	$ 24,972	$ 3,533	$ 29,697	$ 58,201	$ -	$ -	$ -	$ -	$ 58,201	
51		6	Electric Emergency Recovery	E Dist Routine Emergency	BH	$ 624	$ -	$ -	$ 624	$ -	$ -	$ -	$ -	$ 624	
52		10	Overhead and Underground Electric Asset Inspections	E T&D Patrol/Insp	BF	$ 85,750	$ 64,652	$ 29,915	$ 180,318	$ -	$ -	$ -	$ -	$ 180,318	
53		11	Overhead and Underground Electric Distribution Maintenance	E Dist Maint OH General	KA	$ 69,820	$ 35,454	$ 34,237	$ 139,512	$ -	$ -	$ -	$ -	$ 139,512	
54		12	Pole Asset Management	Misc Expense	AB	$ 61	$ 21	$ -	$ 82	$ -	$ -	$ -	$ -	$ 82	
55				E T&D Maint OH Poles	GA	$ 13,648	$ 25,421	$ 19,623	$ 58,692	$ -	$ -	$ -	$ -	$ 58,692	
56		15	Substation Asset Management	E Dist Subst O&M	GC	$ 11,432	$ 5,412	$ 7,788	$ 24,632	$ -	$ -	$ -	$ -	$ 24,632	
57		20	Electric Distribution Data Management and Technology	E Dist Mapping	GE	$ 3,037	$ 1,800	$ -	$ 4,837	$ -	$ -	$ -	$ -	$ 4,837	
58				**Fire Risk Mitigation Memo Account Subtotal:**		**$ 228,391**	**$ 166,503**	**$ 240,485**	**$ 635,379**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 635,379**	
59	Rule 20A Balacing Account	19	Rule 20A	Manage Var Bal Acct Processes	IG	$ (65)	$ -	$ -	$ (65)	$ -	$ -	$ -	$ -	$ (65)	
60				**Rule 20A Balancing Account Subtotal:**		**$ (65)**	**$ -**	**$ -**	**$ (65)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ (65)**	
61	FHPMA - Fire Hazard Prevention Memo Acct	9	Vegetation Management	Manage Var Bal Acct Processes	IG	$ 2	$ -	$ -	$ 2	$ -	$ -	$ -	$ -	$ 2	
62		12	Pole Asset Management	Manage Var Bal Acct Processes	IG	$ 0	$ -	$ -	$ 0	$ -	$ -	$ -	$ -	$ 0	
63				**FHPMA - Fire Hazard Prevention Memo Acct Subtotal:**		**$ 2**	**$ -**	**$ -**	**$ 2**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 2**	
64				**Expense (GRC, MEBA, FHPMA, FRMMA, Rule 20A BA, VMBA, WMBA)**		**$ 2,211,493**	**$ 2,137,404**	**$ 2,706,447**	**$ 7,055,345**	**$ 966,909**	**$ 1,033,835**	**$ 1,098,603**	**$ 3,099,347**	**$ 3,955,998**	
65				**Expense (non-GRC)**		**$ 33,200**	**$ 38,747**	**$ 44,266**	**$ 116,214**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 116,214**	
66				**Total Expense**		**$ 2,244,694**	**$ 2,176,151**	**$ 2,750,714**	**$ 7,171,558**	**$ 966,909**	**$ 1,033,835**	**$ 1,098,603**	**$ 3,099,347**	**$ 4,072,212**	

(1) PG&E's Field Metering Chapter was included in Customer Care Exhibit in the 2020 GRC, therefore there are no imputed 2020-2022 amounts for these MWCs.
(2) "2021 Forecast" values for Chapter 4.6 represent recorded costs rather than forecast costs

Workpaper Table 2-19
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Electric Distribution Imputed and Recorded/Forecast Costs 2020-2022 - Capital
(Thousands of Nominal Dollars)

Line No.	Cost Recovery	Chapter	Chapter Title	Programs	MWC	2020 Recorded Total	2021 Forecast Total	2022 Forecast Total	2020-2022 Total	2020 Imputed Total	2021 Imputed Total	2022 Imputed Total	2020 to 2022 Imputed	Difference from GRC to Imputed)	Notes
1	2020 GRC	5	Emergency Preparedness and Response	Misc Capital	21	$ 518	$ 2,046	$ 1,966	$ 4,530	$ 1,187	$ 1,213	$ 1,242	$ 3,642	$ 888	
2		6	Electric Emergency Recovery	E Dist Routine Emergency	17	$ 241,963	$ 193,244	$ 233,354	$ 668,561	$ 183,518	$ 188,416	$ 193,472	$ 565,406	$ 103,155	
3		7	Distribution System Operations	Build IT Apps & Infra	2F	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
4				E T&D Control System/ Facility	63	$ 1,117	$ 4,129	$ 4,219	$ 9,465	$ 325	$ 334	$ 343	$ 1,001	$ 8,464	
5		8	Field Metering	Install New Electric Meters	25	$ 24,205	$ 27,535	$ 28,700	$ 80,440	$ -	$ -	$ -	$ -	$ 80,440	(1)
6				Install New Gas Meters	74	$ 18,192	$ 53,573	$ 57,511	$ 129,276	$ -	$ -	$ -	$ -	$ 129,276	(1)
7		11	Overhead and Underground Electric Distribution Maintenance	E Dist Inst/Repl OH General	2A	$ 139,071	$ 187,929	$ 103,400	$ 430,399	$ 187,219	$ 193,155	$ 189,720	$ 570,095	$ (139,696)	
8				E Dist Inst/Repl UG	2B	$ 47,590	$ 57,340	$ 60,873	$ 165,803	$ 57,229	$ 59,397	$ 62,124	$ 178,751	$ (12,948)	
9		12	Pole Asset Management	E Dist Inst/Repl OH Poles	07	$ 113,193	$ 111,733	$ 139,062	$ 363,988	$ 108,279	$ 109,237	$ 112,168	$ 329,683	$ 34,305	
10		13	Overhead and Underground Asset Management	E Dist Replace OH Asset	08	$ 16,595	$ 42,105	$ 33,637	$ 92,338	$ 51,310	$ 54,081	$ 55,532	$ 160,923	$ (68,585)	
11				E Dist Automation & Protection	09	$ (1)	$ -	$ -	$ (1)	$ -	$ -	$ -	$ -	$ (1)	
12				Build IT Apps & Infra	2F	$ 0	$ -	$ -	$ 0	$ -	$ -	$ -	$ -	$ 0	
13				E Dist Reliability Ckt/Zone	49	$ 20,175	$ 21,455	$ 26,722	$ 68,352	$ 20,831	$ 20,257	$ 20,800	$ 61,888	$ 6,464	
14				E Dist Replace UG Asset-Gen	56	$ 57,995	$ 90,160	$ 85,382	$ 233,537	$ 74,885	$ 76,884	$ 78,947	$ 230,715	$ 2,822	
15		14	Network Asset Management	E Dist Inst/Repl Network	2C	$ 22,566	$ 15,868	$ 18,739	$ 57,173	$ 19,261	$ 20,019	$ 18,509	$ 57,789	$ (617)	
16				E Dist Replace UG Asset-Gen	56	$ 21,929	$ 25,199	$ 25,199	$ 72,327	$ 23,866	$ 24,503	$ 25,160	$ 73,529	$ (1,202)	
17		15	Substation Asset Management	E Dist Subst Repl Other Equip	48	$ 76,868	$ 76,601	$ 96,588	$ 250,056	$ 49,407	$ 53,475	$ 57,551	$ 160,433	$ 89,624	
18				E Dist Subst Repl Transformer	54	$ 31,907	$ 40,766	$ 27,970	$ 100,643	$ 5,513	$ 5,660	$ 5,812	$ 16,985	$ 83,658	
19				E Dist Repl Substation Safety	58	$ 3,369	$ 5,980	$ 1,738	$ 11,086	$ 4,610	$ 4,733	$ 4,859	$ 14,202	$ (3,116)	
20				E Dist Subst Emergency Repl	59	$ 106,553	$ 99,464	$ 77,872	$ 283,888	$ 62,612	$ 64,284	$ 66,008	$ 192,904	$ 90,984	
21		16	Distribution System Automation and Protection	E Dist Automation & Protection	09	$ 37,437	$ 25,483	$ 26,371	$ 89,291	$ 28,327	$ 29,892	$ 30,307	$ 88,526	$ 765	
22		17	Electric Distribution Capacity, Engineering and Planning	E Dist Line Capacity	06	$ 107,255	$ 233,720	$ 150,476	$ 491,451	$ 90,794	$ 91,883	$ 94,348	$ 277,025	$ 214,427	
23				E Dist Subst Capacity	46	$ 36,270	$ 78,880	$ 65,191	$ 180,341	$ 33,678	$ 58,317	$ 30,643	$ 122,638	$ 57,703	
24		18	New Business and Work at the Request of Others	E Dist WRO General	10	$ 145,630	$ 155,690	$ 145,048	$ 446,368	$ 121,507	$ 142,157	$ 140,436	$ 404,100	$ 42,268	
25				E Dist Customer Connects	16	$ 536,190	$ 511,868	$ 600,122	$ 1,648,180	$ 450,570	$ 463,208	$ 480,119	$ 1,393,897	$ 254,283	
26		20	Electric Distribution Data Management and Technology	Misc Capital	21	$ 3	$ -	$ 1,608	$ 1,611	$ -	$ -	$ -	$ -	$ 1,611	
27				Build IT Apps & Infra	2F	$ 22,788	$ 17,696	$ 21,997	$ 62,481	$ 13,515	$ 11,203	$ 12,985	$ 37,702	$ 24,779	
28		21	Integrated Grid Platform and Grid Modernization Plan	Build IT Apps & Infra	2F	$ 26,724	$ 19,540	$ 17,900	$ 64,164	$ 4,056	$ 6,191	$ 4,784	$ 15,031	$ 49,133	
29				E T&D Control System/ Facility	63	$ 44,373	$ 81,885	$ 126,880	$ 253,138	$ 36,590	$ 31,918	$ 32,547	$ 101,055	$ 152,083	
30		22	Electric Distribution Support Activities	Tools & Equipment	05	$ 6,711	$ 5,203	$ 9,167	$ 21,081	$ 7,397	$ 7,816	$ 8,241	$ 23,454	$ (2,373)	
31				Misc Capital	21	$ 1,276	$ (23,542)	$ 1,496	$ (20,771)	$ (36,616)	$ (37,777)	$ (38,861)	$ (113,254)	$ 92,484	
32		23	Community Rebuild Program	Community Rebuild Capital	95	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
33				**2020 GRC Subtotal:**		**$ 1,908,460**	**$ 2,161,549**	**$ 2,189,187**	**$ 6,259,196**	**$ 1,599,869**	**$ 1,680,454**	**$ 1,687,797**	**$ 4,968,120**	**$ 1,291,076**	
34	WMBA Wildfire Mitigation Balancing Acct	4	Wildfire Risk Mitigations	Misc Capital	21	$ 14,046	$ 12,535	$ 12,612	$ 39,193	$ 11,055	$ 7,008	$ 7,173	$ 25,235	$ 13,958	
35				E Dist Replace OH Asset	08	$ 484,916	$ 415,654	$ 1,030,125	$ 1,930,695	$ 493,225	$ 822,166	$ 1,045,058	$ 2,360,449	$ (429,754)	
36				E Dist Inst/Repl OH General	2A	$ 7,847	$ 15,125	$ 15,388	$ 38,360	$ 5,285	$ 5,425	$ 5,570	$ 16,280	$ 22,079	
37				E Dist Reliability Ckt/Zone	49	$ 84,614	$ 68,633	$ 77,153	$ 230,401	$ 20,290	$ 20,827	$ 15,862	$ 56,980	$ 173,421	
38				Build IT Apps & Infra	2F	$ -	$ 25,300	$ 25,300	$ 50,600	$ -	$ -	$ -	$ -	$ 50,600	
39		11	Overhead and Underground Electric Distribution Maintenance	E Dist Inst/Repl OH General	2A	$ 63,497	$ 84,689	$ 16,804	$ 164,990	$ -	$ -	$ -	$ -	$ 164,990	
40		23	Community Rebuild Program	Community Rebuild Capital	95	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
41				**WMBA Wildfire Mitigation Balancing Acct Subtotal:**		**$ 654,920**	**$ 621,936**	**$ 1,177,383**	**$ 2,454,239**	**$ 529,855**	**$ 855,426**	**$ 1,073,663**	**$ 2,458,944**	**$ (4,706)**	
42	ED Major Emergency Balancing Account	6	Electric Emergency Recovery	E Dist Major Emergency	95	$ 64,253	$ 60,810	$ 62,069	$ 187,133	$ 55,086	$ 56,557	$ 58,074	$ 169,717	$ 17,416	
43				**ED Major Emergency Balancing Account Subtotal:**		**$ 64,253**	**$ 60,810**	**$ 62,069**	**$ 187,133**	**$ 55,086**	**$ 56,557**	**$ 58,074**	**$ 169,717**	**$ 17,416**	
44	Fire Risk Mitigation Memo Account	4	Wildfire Risk Mitigations	Misc Capital	21	$ (30)	$ -	$ -	$ (30)	$ -	$ -	$ -	$ -	$ (30)	
45				E Dist Reliability Ckt/Zone	49	$ 7,071	$ 20,593	$ -	$ 27,663	$ -	$ -	$ -	$ -	$ 27,663	
46				Build IT Apps & Infra	2F	$ 22,658	$ -	$ -	$ 22,658	$ -	$ -	$ -	$ -	$ 22,658	
47		6	Electric Emergency Recovery	E Dist Routine Emergency	17	$ 5,536	$ -	$ -	$ 5,536	$ -	$ -	$ -	$ -	$ 5,536	
48		11	Overhead and Underground Electric Distribution Maintenance	E Dist Inst/Repl OH General	2A	$ 103,288	$ 143,578	$ 146,951	$ 393,817	$ -	$ -	$ -	$ -	$ 393,817	
49		12	Pole Asset Management	E Dist Inst/Repl OH Poles	7	$ 133,389	$ 200,151	$ 227,391	$ 560,931	$ -	$ -	$ -	$ -	$ 560,931	
50		15	Substation Asset Management	Misc Capital	21	$ 2,656	$ -	$ -	$ 2,656	$ -	$ -	$ -	$ -	$ 2,656	
51				E Dist Subst Emergency Repl	59	$ 12,581	$ 2,471	$ -	$ 15,052	$ -	$ -	$ -	$ -	$ 15,052	
52				**Fire Risk Mitigation Memo Account Subtotal:**		**$ 287,148**	**$ 366,793**	**$ 374,342**	**$ 1,028,283**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,028,283**	
53	Rule 20A Balacing Account	19	Rule 20A	E Dist WRO Rule 20A	30	$ 38,273	$ 47,288	$ 39,954	$ 125,514	$ 33,420	$ 34,312	$ 35,233	$ 102,965	$ 22,549	
54				**Rule 20A Balancing Account Subtotal:**		**$ 38,273**	**$ 47,288**	**$ 39,954**	**$ 125,514**	**$ 33,420**	**$ 34,312**	**$ 35,233**	**$ 102,965**	**$ 22,549**	
55				**iRC, MEBA, FRMMA, Rule 20A BA, WMBA)**		**$ 2,953,054**	**$ 3,258,376**	**$ 3,842,935**	**$ 10,054,365**	**$ 2,218,231**	**$ 2,626,749**	**$ 2,854,767**	**$ 7,699,746**	**$ 2,354,619**	
56				**Capital (non-GRC)**		**$ 175,125**	**$ 106,057**	**$ 143,160**	**$ 424,343**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 424,343**	
57				**Total Capital**		**$ 3,128,179**	**$ 3,364,432**	**$ 3,986,096**	**$ 10,478,708**	**$ 2,218,231**	**$ 2,626,749**	**$ 2,854,767**	**$ 7,699,746**	**$ 2,778,961**	

(1) PG&E's Field Metering Chapter was included in Customer Care Exhibit in the 2020 GRC, therefore there are no imputed 2020-2022 amounts for these MWCs.
(2) "2021 Forecast" values for Chapter 4.6 represent recorded costs rather than forecast costs

Workpaper Table 2-20
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Explanation of Exhibit 4 Electric Distribution Escalation
(Thousands of Dollars)

Line No.

1 **Step 1 How Escalation is handled in Electric Distribution (Exhibit - 4)**

Overview: Escalation calculated in nominal dollars is described in this exhibit

2 **Step 2 How Escalation is Calculated for Electric Distribution (Exhibit - 4) for Base Expense**

Overview: For the Electric Distribution escalation calculations a blended escalation rate between Labor and Non-Labor was developed and applied to all base costs

A Consistent with other exhibit's of PG&E's GRC, Electric Distribution used annual escalation rates for labor are based on the Labor Agreements PG&E has in place through December 31, 2025 and 2019-2020 United States WorldatWork Salary Budget Survey, which was the most current market data available at the time labor escalation rates were developed and non-labor developed by IHS Global Insight's Power Planner from Q1 2020.

B O&M Labor Escalation Rate by Year

2022	2023
3.52%	3.52%

C O&M Non Labor Escalation Rate by Year

2022	2023
2.20%	2.40%

D A Labor and Non-Labor split was calculated at the exhibit level, using a cost element breakdown of the 2021 expense forecast to assign total costs to Labor and Non-Labor :

Cost Element	2021 forecast-Exp	Labor/Non-Labor Assignment
Labor Internal	625,899	Labor
Labor External	58,887	Labor
Contract	300,958	Non-Labor
Materials	38,938	Non-Labor
Other (incl. Billing Credits and Reimbursements)	31,936	Non-Labor
Total	**1,056,619**	

E To develop the blended Expense escalation rates by year, the Labor and Non-Labor escalation rates shown above were applied separately to the 2021 forecast Labor and Non-Labor totals. The product of those calculations was added together to yield a 2022 total. The 2022 total was compared to the 2021 total to calculate the blended escalation rate.

	2022	2023
Labor	$ 708,891	$ 733,844
Non-Labor	$ 380,014	$ 389,134
Total	$ 1,088,904	$ 1,122,977
Annual Blended Escalation Rate	3.06%	3.13%
Cumulative Blended Escalation Rate	3.06%	6.29%

F The cumulative blended escalation rate was applied to all costs at the MAT code level

3 **Step 3 How Escalation is Calculated for Electric Distribution (Exhibit - 4) for Vegetation Management Expense**

Overview: For the Electric Distribution escalation calculations a blended escalation rate between Labor and Non-Labor was developed and applied to all costs

A Consistent with other exhibit's of PG&E's GRC, Electric Distribution used annual escalation rates for labor are based on the Labor Agreements PG&E has in place through December 31, 2025 and 2019-2020 United States WorldatWork Salary Budget Survey, which was the most current market data available at the time labor escalation rates were developed and non-labor developed by IHS Global Insight's Power Planner from Q1 2020.

B O&M Labor Escalation Rate by Year

2022	2023
3.52%	3.52%

C O&M Non Labor Escalation Rate by Year

2022	2023
2.20%	2.40%

D A Labor and Non-Labor split was calculated at the exhibit level, using a cost element breakdown of the 2021 expense forecast to assign total costs to Labor and Non-Labor :

Cost Element	2021 forecast-Exp	Labor/Non-Labor Assignment
Labor Internal	43,731	Labor
Labor External	13,091	Labor
Contract	1,128,629	Non-Labor
Materials	383	Non-Labor
Other (incl. Billing Credits and Reimbursements)	13,409	Non-Labor
Total	**1,199,245**	

E To develop the blended Expense escalation rates by year, the Labor and Non-Labor escalation rates shown above were applied separately to the 2021 forecast Labor and Non-Labor totals. The product of those calculations was added together to yield a 2022 total. The 2022 total was compared to the 2021 total to calculate the blended escalation rate.

	2022	2023
Labor	$ 58,823	$ 60,893
Non-Labor	$ 1,167,555	$ 1,195,577
Total	$ 1,226,378	$ 1,256,470
Annual Blended Escalation Rate	2.26%	2.45%
Cumulative Blended Escalation Rate	2.26%	4.77%

F The cumulative blended escalation rate was applied to all costs at the MAT code level

4 **Step 4 Exceptions to Standard Escalation Rate Calculation in Electric Distribution**

Overview: For Electric Distribution, the standard escalation was not applied for two types of costs, Emergency Preparedness and Response (EP&R) and Vegetation Management.

EP&R

Overview: Since the work within EP&R is considered A&G work and consists almost entirely of labor costs. Therefore, PG&E used A&G-related escalation rates and calculated a Labor and Non-Labor split specific to the program.

A PG&E used A&G Labor and Non-Labor escalation rates provided by IHS Global Insight's Power Planner from Q1 2020
Consistent with other exhibit's of PG&E's GRC, Electric Distribution used annual escalation rates for labor are based on the Labor Agreements PG&E has in place through December 31, 2025 and 2019-2020 United States WorldatWork Salary Budget Survey, which was the most current market data available at the time labor escalation rates were developed and non-labor developed by IHS Global Insight's Power Planner from Q1 2020.

	2022	2023
A&G Labor Rates	3.28%	3.28%
A&G Non-Labor Rates	1.90%	2.30%

B For Expense, the Labor/Non-Labor split was based on 2018 forecast costs planned (similar to ED).

Workpaper Table 2-20
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 2, Electric Distribution Forecast and Investment Planning
Explanation of Exhibit 4 Electric Distribution Escalation
(Thousands of Dollars)

Line No.

	2021 forecast-Exp
Labor Internal	9,101
Labor External	1,123
Contract	1,768
Other	2,163
Total	**14,155**

C To develop the blended Expense escalation rates by year, the labor and non-labor escalation rates were applied to the 2018 forecast Labor and Non-Labor

	2022	2023
Labor	10,560	10,906
Non-Labor	4,006	4,098
Total	14,565	15,004
Annual Blended Escalation Rate	2.90%	3.01%
Cumulative Blended Escalation Rate	2.90%	5.99%

5 **Step 5 How Escalation is Calculated for Electric Distribution (Exhibit - 4) for Capital**

Overview: For capital, the Electric Distribution escalation rate uses a combined Labor and Non-Labor escalation rate developed by IHS Global Insight's Power Planner from Q1 2020, consistent with other exhibit's of PG&E's GRC.

A Combined Labor & Non-Labor Escalation Rate by Year

	2022	2023	2024	2025	2026
Annual	2.60%	2.70%	2.70%	2.70%	2.70%
Cumulative	2.60%	5.37%	8.22%	11.14%	14.14%

B The cumulative escalation rate was applied to all costs at the MAT code level

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE

Testimony: ☐ **Workpapers:** ☒ **SOQ:** ☐

Exhibit Number: 4 **Chapter Number:** 2

Chapter Title: Electric Distribution Forecast and Investment Planning

Witness Name: Tatjana Rmus

Page No.	Line No.	Item	As Filed	As Corrected
Errata as of November 5, 2021				
WP 2-10, 2-11	30, 109	MWC 95 (Ch 23) Description	Community Rebuild Program E Dist Major Emergency	Community Rebuild Capital Community Rebuild Capital
WP 2-12	72	MWC IF (Ch 23) Description	E Dist Major Emergency	Community Rebuild Expense
WP 2-14	66	MWC 95 (Ch 23) Description	E Dist Major Emergency	Community Rebuild Capital
WP 2-15	1	08W 2020 Rec. Adj. Units + 2021 to 2022 Forecast AND Units Difference	1,032 11	1,046 25
WP 2-16	18	AB6 2020 Rec. Adj. + 2021 to 2022 $$ Forecast AND $$ Difference	$15,980 $(3,825)	$15,973 $(3,832)
WP 2-20	67	2BB 2020 Rec. Adj. + 2021 to 2022 $$ Forecast AND $$ Difference	$2,743 $(771)	$2,234 $(1,281)
WP 2-20	68	2BF 2020 Rec. Adj. + 2021 to 2022 $$ Forecast AND $$ Difference	$263 $(320)	$230 $(352)

Page No.	Line No.	Item	As Filed	As Corrected
WP 2-24	152	48F 2020 Rec. Adj. + 2021 to 2022 $$ Forecast AND $$ Difference	$103,792 $41,530	$103,437 $41,174
WP 2-26	187	09E 2020 Rec. Adj. + 2021 to 2022 $$ Forecast AND $$ Difference	$10,161 $(713)	$8,519 $(2,355)
WP-26	188	09F 2020 Rec. Adj. + 2021 to 2022 $$ Forecast AND $$ Difference	$17,716 $14,137	$19,357 $15,779
WP-27	215	16 2020 Rec. Adj. + 2021 to 2022 $$ Forecast AND $$ Difference	$1,672,211 $278,314	$1,648,180 $254,283
WP 2-32	64	MWC IF (Ch 23) Description	E Dist Major Emergency	Community Rebuild Expense
WP 2-34	59	MWC 95 (Ch 23) Description	E Dist Major Emergency	Community Rebuild Capital
WP 2-26	32, 40	MWC 95 (Ch 23) Description	E Dist Major Emergency E Dist Major Emergency	Community Rebuild Capital Community Rebuild Capital
WP 2-37	Step 2 Line E	2023 Cumulative Blended Escalation Rate	6.28%	6.29%

Page No.	Line No.	Item	As Filed	As Corrected
Errata as of February 25, 2022				
WP 2-6	Workpaper Table 2-6	Asset Management and Reliability	$(10)	$(12)
WP 2-35	41	MWC BF 2020 recorded	$971	$0
		2020-2022 Total, Difference from GRC to Imputed	$971	$0
WP 2-35	48	MWC BF 2020 recorded	$84,779	$85,750
		2020-2022 Total, Difference from GRC to Imputed	$179,347	$180,318

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
EXHIBIT (PG&E-4) ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING
CHAPTER 3, ELECTRIC DISTRIBUTION RISK MANAGEMENT

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PACIFIC GAS AND ELECTRIC COMPANY
2020 GENERAL RATE CASE
EXHIBIT (PG&E-4) ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING
CHAPTER 3, ELECTRIC DISTRIBUTION RISK MANAGEMENT

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(CONTINUED)

Workpaper Table 3-1
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Risk Mitigation and Control Costs - Forecast by Chapter
(Thousands of Nominal Dollars)

Line No.	Ch No.	Chapter (B)	RISK MITIGATIONS EXPENSE: 2023-2026 Forecast by Risk ($000s) (C)						RISK MITIGATIONS CAPITAL: 2023-2026 Forecast by Risk ($000s) (C)					
		Column	A	B	C	D	E	F	G	H	I	J	K	L
			Wildfire	Failure of Electric Distribution (ED) Overhead Assets	Failure of ED Network Assets	Failure of ED Underground Assets	Failure of ED Substation Assets	Emergency Preparedness and Response	Wildfire	Failure of ED Overhead Assets	Failure of ED Network Assets	Failure of ED Underground Assets	Failure of ED Substation Assets	Emergency Preparedness and Response
1	4.1	Situational Awareness and Forecasting	$ 183,815						$ 14,677					
2	4.2	PSPS Operations	$ 480,212						$ 1,092					
3	4.3	System Hardening, Enhanced Automation & PSPS Impact Mitigations	$ 57,522	$ 16,217					$ 10,744,341	$ 10,507,813				
4	4.4	Community Wildfire Safety Program PMO	$ 61,917											
5	4.6	Ehanced Powerline Safety Settings	$ 571,966	$ 571,966										
6	5	Emergency Preparedness and Response						$ 17,469						$ 8,472
7	9	Vegetation Management	$ 449,989	$ 449,989										
8	10	Overhead and Underground Electric Asset Inspections												
9	11	Overhead and Underground Electric Distribution Maintenance							$ -	$ 155,504				
10	12	Pole Asset Management							$ 14,429					
11	13	Overhead and Underground Asset Management and Reliability								$ 30,279				
12	14	Network Asset Management									$ 72,527			
13	15	Substation Asset Management											$ 27,230	
14	16	Distribution System Automation and Protection												
15	17	Electric Distribution Capacity, Engineering and Planning												
16	22	Electric Distribution Support Activities		$ 11,706										
17	23	Community Rebuild Program							$ 293,993					
18		**Total**	**$ 1,805,421**	**$ 1,049,878**	**$ -**	**$ -**	**$ -**	**$ 17,469**	**$ 11,068,533**	**$ 10,693,596**	**$ 72,527**	**$ -**	**$ 27,230**	**$ 8,472**
19														

Ch No.	Chapter	RISK CONTROLS EXPENSE: 2023-2026 Forecast by Risk ($000s) (C)						RISK CONTROLS CAPITAL: 2023-2026 Forecast by Risk ($000s) (C)					
		Wildfire	Failure of ED Overhead Assets	Failure of ED Network Assets	Failure of ED Underground Assets	Failure of ED Substation Assets	Emergency Preparedness and Response	Wildfire	Failure of ED Overhead Assets	Failure of ED Network Assets	Failure of ED Underground Assets	Failure of ED Substation Assets	Emergency Preparedness and Response
4.1	Situational Awareness and Forecasting												
4.2	PSPS Operations												
4.3	System Hardening, Enhanced Automation & PSPS Impact Mitigations												
4.4	Community Wildfire Safety Program PMO												
5	Emergency Preparedness and Response						$ 93,039						$ 13,522
9	Vegetation Management	$ 319,167	$ 3,525,451										
10	Overhead and Underground Electric Asset Inspections	$ 278,276	$ 261,039		$ 63,095								
11	Overhead and Underground Electric Distribution Maintenance	$ 246,460	$ 238,241		$ 75,961			$ 907,142	$ 1,041,225		$ 271,641		
12	Pole Asset Management	$ 91,849	$ 94,461					$ 1,568,778	$ 1,568,778				
13	Overhead and Underground Asset Management and Reliability								$ 211,067		$ 375,888		
14	Network Asset Management			$ 21,256						$ 110,743			
15	Substation Asset Management	$ 50,552				$ 101,624		$ 434,133				$ 502,870	
16	Distribution System Automation and Protection		$ 12,592						$ 112,568				
17	Electric Distribution Capacity, Engineering and Planning		$ 70,534						$ 41,945				
22	Electric Distribution Support Activities												
23	Community Rebuild Program												
	Total	**$ 986,304**	**$ 4,202,317**	**$ 21,256**	**$ 139,056**	**$ 101,624**	**$ 93,039**	**$ 2,910,054**	**$ 2,975,584**	**$ 110,743**	**$ 647,529**	**$ 502,870**	**$ 13,522**

Column A B C D E F G H I J K L

Notes:

(A) Updated to reflect errata (November 5, 2021 and February 25, 2022) and forecast udpates (February 25, 2022)

(B) Only chapters with risk mitigation or risk control forecasts are shown on this table.

(C) The expense and capital forecast by risk represent the amounts included in PG&E's enterprise risk models for calculating a Risk Spend Efficiency (RSE). In certain cases, forecast costs for the same work are included in more than one risk model. For example, the activities and costs to proactively replace batteries in substations appear in two risk controls: Substation Proactive Asset Replacement – Batteries (WLDFR -C10C) and Proactive Asset Replacement – Batteries (SUBSTN-C16C) Even though the forecast amounts are used more than once in the risk models, PG&E is only requesting recovery for these costs one time.

Workpaper Table 3-2
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Wildfire - Recorded and Forecast Control Costs - Capital
(Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE (B)	Reference
1	WLDFR-C008	Equipment Preventive Maintenance and Replacement - Distribution Overhead	11	2AA	$ 179,951,104	$ 232,990,043	$ 201,316,166	$ 205,362,647	$ 212,044,473	$ 218,716,729	$ 230,716,023	$ 1,481,097,185	$ 866,839,872	128.9 (C)	
2	WLDFR-C008	Equipment Preventive Maintenance and Replacement - Distribution Overhead	11	2AF	$ 4,965,509	$ 20,500,353	$ 2,731,666	$ 2,726,352	$ 2,731,798	$ 2,737,080	$ 2,742,402	$ 39,135,160	$ 10,937,632		
3	WLDFR-C011	Animal Abatement	11	2AB	$ 1,974,878	$ 3,023,258	$ 3,480,503	$ 3,473,731	$ 3,480,670	$ 3,487,401	$ 3,494,182	$ 22,414,623	$ 13,935,984	0.5	
4	WLDFR-C011	Animal Abatement	11	2AC	$ 6,002,958	$ 3,431,682	$ 3,626,258	$ 3,614,840	$ 3,926,541	$ 3,937,891	$ 3,949,326	$ 28,489,496	$ 15,428,598		
5	WLDFR-C018	Fire Protection / Suppression Systems	15	58A	$ 2,583,286	$ 1,681,078	$ 3,877	$ 3,249,611	$ 3,337,505	$ 1,142,519	$ 1,173,359	$ 13,171,235	$ 8,902,994	26.6	
6	WLDFR-C10A	Substation Proactive Asset Replacement - Ground Grid	15	48A	$ 2,472,985	$ 4,397,244	$ 11,509,767	$ 4,219,926	$ 2,879,739	$ 2,856,298	$ 2,933,398	$ 31,269,357	$ 12,889,361	0	
7	WLDFR-C10C	Substation Proactive Asset Replacement - Batteries	15	48C	$ 282,048	$ 181,361	$ 3,024,758	$ 3,249,611	$ 3,337,505	$ 3,427,558	$ 3,520,078	$ 17,022,919	$ 13,534,752	0	
8	WLDFR-C10D	Substation Proactive Asset Replacement - Circuit Breakers	15	48D	$ 4,513,366	$ 14,290,160	$ 31,255,215	$ 28,564,458	$ 31,987,261	$ 34,461,619	$ 29,333,980	$ 174,406,059	$ 124,347,318	0.7	
9	WLDFR-C10E	Substation Proactive Asset Replacement - Switches	15	48E	$ 2,538,065	$ 945,304	$ 3,457,206	$ 2,166,407	$ 4,450,006	$ 4,570,077	$ 3,520,078	$ 21,647,143	$ 14,706,568	0.1	
10	WLDFR-C10F	Substation Proactive Asset Replacement - Switchgear	15	48F	$ 45,359,745	$ 26,807,570	$ 31,269,372	$ 32,433,238	$ 16,689,797	$ 16,587,670	$ 15,651,896	$ 184,799,288	$ 81,362,601	0.1	
11	WLDFR-C10H	Substation Proactive Asset Replacement - Line Support Work	15	48L	$ 15,926,097	$ 24,930,547	$ 6,026,869	$ 9,104,860	$ 7,891,927	$ 5,712,596	$ 5,866,796	$ 75,459,692	$ 28,576,179	(D)	
12	WLDFR-C10I	Substation Proactive Asset Replacement - Insulators	15	48N	$ 618,292	$ -	$ 527,364	$ 5,416,018	$ 5,562,508	$ 5,712,596	$ 5,866,796	$ 23,703,574	$ 22,557,918	0.7	
13	WLDFR-C10K	Substation Proactive Asset Replacement - Transformer	15	54A	$ 33,035,943	$ 40,826,938	$ 24,805,657	$ 17,993,020	$ 26,956,020	$ 31,990,537	$ 35,200,776	$ 210,808,891	$ 112,140,353	0.1	
14	WLDFR-C10M	Substation Security Enhancements	15	58S	$ -	$ 677,571	$ 1,687,565	$ 4,982,737	$ 5,562,508	$ 4,570,077	$ -	$ 17,480,458	$ 15,115,322	0	
15	WLDFR-C12C	Pole Replacement	12	07D	$ 238,713,708	$ 301,006,662	$ 355,298,431	$ 368,381,249	$ 388,114,997	$ 387,888,926	$ 388,354,608	$ 2,427,758,581	$ 1,532,739,780	79.5	
16	WLDFR-C12D	Overloaded Pole Replacement	12	07O	$ 11,114,499	$ 10,877,415	$ 7,852,041	$ 7,836,764	$ 8,600,269	$ 9,391,171	$ 10,210,234	$ 65,882,393	$ 36,038,438	70.8	
17		**Total**			**$ 550,052,483**	**$ 686,567,186**	**$ 687,872,715**	**$ 702,775,469**	**$ 727,553,524**	**$ 737,190,745**	**$ 742,533,932**	**$ 4,834,546,054**	**$ 2,910,053,670**		
18															
19		Total Chapter 11			$ 192,894,449	$ 259,945,336	$ 211,154,593	$ 215,177,570	$ 222,183,482	$ 228,879,101	$ 240,901,933	$ 1,571,136,464	$ 907,142,086		WP 3-1, Line 27, Col. G
20		Total Chapter 12			$ 249,828,207	$ 311,884,077	$ 363,150,472	$ 376,218,013	$ 396,715,266	$ 397,280,097	$ 398,564,842	$ 2,493,640,974	$ 1,568,778,218		WP 3-1, Line 28, Col. G
21		Total Chapter 15			$ 107,329,827	$ 114,737,773	$ 113,567,650	$ 111,379,886	$ 108,654,776	$ 111,031,547	$ 103,067,157	$ 769,768,616	$ 434,133,366		WP 3-1, Line 31, Col. G
22		**Total**			**$ 550,052,483**	**$ 686,567,186**	**$ 687,872,715**	**$ 702,775,469**	**$ 727,553,524**	**$ 737,190,745**	**$ 742,533,932**	**$ 4,834,546,054**	**$ 2,910,053,670**		
23															

24 Notes:
25 (A) Updated to include updated forecast costs and RSEs (February 25, 2022) and errata (November 5, 2021 and February 25, 2022).
26 (B) RSEs for mitigation or controls associated with more than one major work category (MWC) or maintenance activity type (MAT) are listed only once, the first time they appear on this schedule.
27 (C) Certain MAT codes that are aligned to this program are considered foundational and are excluded from the RSE calculation.
28 (D) PG&E did not calculate an RSE for this control because it is primarily associated with a non-RAMP risk (Failure of Electric Distribution Substation Assets) and did not meet the Step-3 supplemental analysis threshold for programs requiring an RSE.

Workpaper Table 3-3
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Wildfire - Recorded and Forecast Control Costs - Expense
(Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE (B)	Reference
1	WLDFR-C001	Patrols - Distribution Overhead	10	BFA	$ 6,483,378	$ 3,891,139	$ 3,896,810	$ 4,630,081	$ 4,482,885	$ 4,522,554	$ 4,668,189	$ 32,575,036	$ 18,303,709	136.2	
2	WLDFR-C01A	Inspections - Distribution Overhead	10	BFB	$ 94,061,458	$ 93,350,805	$ 60,534,875	$ 58,807,363	$ 56,937,805	$ 57,441,655	$ 59,291,388	$ 480,425,349	$ 232,478,211	68.6	
3	WLDFR-C01B	Infrared Inspections - Distribution Overhead	10	BFC	$ 1,561,335	$ 2,319,999	$ 2,323,381	$ 2,594,551	$ 2,512,067	$ 2,534,296	$ 2,615,906	$ 16,461,535	$ 10,256,820	41.0	
4	WLDFR-C01E	Insepctions	10	BFH	$ 40,597,884	$ 1,876,482	$ 3,966,389	$ 4,425,040	$ 4,168,883	$ 4,213,902	$ 4,429,538	$ 63,678,118	$ 17,237,363	Foundational	
5	WLDFR-C003	Patrols and Inspections - Substation	15	GCD	$ 4,645,189	$ 2,944,623	$ 2,948,915	$ 3,129,629	$ 3,214,727	$ 3,302,139	$ 3,391,929	$ 23,577,151	$ 13,038,424	914.5	
6	WLDFR-C004	Vegetation Management - Distribution Overhead	9	HN#	$ 53,827,558	$ 209,350,486	$ 711,007,474	$ 871,219,828	$ 844,736,102	$ 800,294,252	$ 727,547,910	$ 4,217,983,610	$ -	4,083.4	
7	WLDFR-C004	Vegetation Management - Distribution Overhead	9	HNA	$ 639,321,408	$ 458,772,476	$ -	$ -	$ -	$ -	$ -	$ 1,098,093,884	$ 37,513,925		
7	WLDFR-C004i	Incremental Routine Vegetation Management (D)	9	HNA								$ -	$ -	4.6	
8	WLDFR-C006	Vegetation Management - Substation	15	GCG	$ 5,737,006	$ 7,803,377	$ 7,851,610	$ 9,904,110	$ 10,900,408	$ 7,720,381	$ 8,989,026	$ 58,905,918	$ 37,513,925	0.4	
9	WLDFR-C007	Vegetation Management - CEMA/Tree Mortality	9	IGI	$ 93,070,479	$ 67,977,674	$ 144,000,050	$ 69,830,227	$ 70,422,901	$ 71,003,348	$ 70,396,338	$ 586,701,018	$ 281,652,814	3,025.6	
10	WLDFR-C008	Equipment Maintenance and Replacement - Distribution Overhead	11	KAA	$ 98,710,568	$ 49,612,461	$ 48,622,465	$ 58,425,421	$ 49,964,533	$ 50,135,573	$ 50,153,933	$ 405,624,954	$ 208,679,460	128.9 (C)	
11	WLDFR-C008	Equipment Maintenance and Replacement - Distribution Overhead	11	KAF	$ 6,259,343	$ 6,227,715	$ 6,236,792	$ 6,619,177	$ 6,799,160	$ 6,984,038	$ 7,173,942	$ 46,300,167	$ 27,576,317		
12	WLDFR-C008	Equipment Maintenance and Replacement - Distribution Overhead	11	KAQ	$ 19,834	$ 984	$ 591	$ 1,077	$ 1,106	$ 1,136	$ 1,167	$ 25,895	$ 4,486	128.9	
13	WLDFR-C011	Animal Abatement	11	KAC	$ 756,186	$ 1,033,123	$ 829,262	$ 1,130,130	$ 1,160,859	$ 1,192,425	$ 1,224,848	$ 7,326,833	$ 4,708,262	0.5	
14	WLDFR-C011	Animal Abatement	11	KAD	$ 438,808	$ 1,240,122	$ 1,241,930	$ 1,318,074	$ 1,353,914	$ 1,390,728	$ 1,428,544	$ 8,412,120	$ 5,491,260		
15	WLDFR-C12A	Pole Programs (also referred to as Intrusive Wood Pole Inspection Program)	12	GAA	$ 17,446,665	$ 21,227,066	$ 21,258,006	$ 19,309,868	$ 18,454,238	$ 18,531,287	$ 19,139,574	$ 135,366,704	$ 75,434,967	359.5	
16	WLDFR-C12B	Pole Analyze Loading	12	GAC	$ 13,651,558	$ 25,421,239	$ 19,622,830	$ -	$ -	$ -	$ -	$ 58,695,627	$ -	Foundational	
16	WLDFR-C12E	Pole Programs - Pole Reinforcements (also referred to as Pole Restoration Program)	12	GAD	$ 4,783,468	$ 3,458,006	$ 3,463,046	$ 3,924,191	$ 4,041,189	$ 4,163,206	$ 4,285,725	$ 28,118,831	$ 16,414,311	1,170.6	
17		**Total**			**$ 1,081,372,124**	**$ 956,507,777**	**$ 1,037,804,426**	**$ 1,115,268,767**	**$ 1,079,150,776**	**$ 1,033,430,921**	**$ 964,737,957**	**$ 7,268,272,748**	**$ 986,304,255**		
18															
19															
20		Total Chapter 9			$ 786,219,445	$ 736,100,636	$ 855,007,524	$ 941,050,055	$ 915,159,002	$ 871,297,601	$ 797,944,248	$ 5,902,778,511	$ 319,166,739		WP 3-1, Line 25, Col. A
21		Total Chapter 10			$ 142,704,055	$ 101,438,425	$ 70,721,455	$ 70,457,035	$ 68,101,640	$ 68,712,407	$ 71,005,021	$ 593,140,038	$ 278,276,103		WP 3-1, Line 26, Col. A
22		Total Chapter 11			$ 106,184,739	$ 58,114,405	$ 56,931,040	$ 67,493,879	$ 59,279,572	$ 59,703,900	$ 59,982,434	$ 467,689,969	$ 246,459,785		WP 3-1, Line 27, Col. A
23		Total Chapter 12			$ 35,881,691	$ 50,106,311	$ 44,343,882	$ 23,234,059	$ 22,495,427	$ 22,694,493	$ 23,425,299	$ 222,181,162	$ 91,849,278		WP 3-1, Line 28, Col. A
24		Total Chapter 15			$ 10,382,195	$ 10,748,000	$ 10,800,525	$ 13,033,739	$ 14,115,135	$ 11,022,520	$ 12,380,955	$ 82,483,069	$ 50,552,349		WP 3-1, Line 31, Col. A
25		**Total**			**$ 1,081,372,124**	**$ 956,507,777**	**$ 1,037,804,426**	**$ 1,115,268,767**	**$ 1,079,150,776**	**$ 1,033,430,921**	**$ 964,737,957**	**$ 7,268,272,748**	**$ 986,304,255**		
26															

27 Notes:
28 (A) Updated to include updated forecast costs and RSEs (February 25, 2022) and errata (November 5, 2021 and February 25, 2022).
29 (B) RSEs for mitigation or controls associated with more than one major work category (MWC) or maintenance activity type (MAT) are listed only once, the first time they appear on this schedule.
30 (C) Certain MAT codes that are aligned to this program are considered foundational and are excluded from the RSE calculation.
31 (D) PG&E calculated an RSE for the Incremental Routine Vegetation Management program in addition to and RSE for the Routine VM program.

Workpaper Table 3-4
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Wildfire - Recorded and Forecast Mitigation Costs - Capital
(Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE (B)	Reference
1	WLDFR-M002	System Hardening	4.3	08W	$ 484,915,413	$ 375,440,297	$ 977,250,000	$ 1,457,954,875	$ 2,497,363,753	$ 2,991,542,807	$ 3,423,761,588	$ 12,208,228,733	$ 10,370,623,023	(B)	
2	WLDFR-M002	System Hardening -Butte County	4.3	08W	$ 40,213,703	$ 52,875,000	$ 54,071,550	$ 43,982,199	$ 27,107,247	$ -	$ -	$ 218,249,700	$ 71,089,447	(C)	
3	WLDFR-M003	Non-Exempt Surge Arrester Replacement	11	2AR	$ 63,497,216	$ 88,859,389	$ 16,804,435	$ -	$ -	$ -	$ -	$ 169,161,040	$ -	0.1	
4	WLDFR-M004	Expulsion Fuse Replacement	4.3	2AP	$ 7,846,531	$ 15,124,923	$ 15,388,477	$ 15,751,717	$ 16,257,250	$ 16,777,228	$ 17,314,355	$ 104,460,481	$ 66,100,550	3.8	
5	WLDFR-M006	PSPS Field Ops Tech Capital	4.2	21A	$ -	$ 1,028,000	$ 994,093	$ -	$ -	$ -	$ -	$ 2,022,093	$ -	(D)	
6	WLDFR-M006	PSPS Reduction Initiatives - PSPS Capital Equipment	4.2	21A	$ 1,376,154	$ 2,056,000	$ 1,987,190	$ -	$ -	$ -	$ -	$ 5,419,344	$ -	(D)	
7	WLDFR-M006	PSPS Reduction Initiatives - Sectionalizer Device Install/Replace	4.3	49H	$ 69,440,765	$ 42,890,115	$ 20,918,670	$ 11,932,627	$ 12,255,375	$ 12,586,050	$ 12,925,785	$ 182,949,387	$ 49,699,837	12.1	
8	WLDFR-M006	PSPS Reduction Initiatives - Temporary Distribution Microgrids	4.3	49M	$ 3,746,459	$ 16,447,871	$ 13,558,896	$ -	$ -	$ -	$ -	$ 33,753,226	$ -	(D)	
9	WLDFR-M006	CRC Preparedness (also referred to as Harden CRC)	4.2	21A	$ 1,020,704	$ -	$ 255,254	$ 261,723	$ 269,226	$ 276,740	$ 284,285	$ 2,367,932	$ 1,091,974		
10	WLDFR-M07A	Situational Awareness and Forecasting Initiatives - Line Sensors	4.3	49I	$ 2,272,431	$ 12,368,708	$ 8,037,499	$ 8,253,730	$ 6,474,382	$ 5,964,393	$ 6,125,139	$ 49,496,282	$ 26,817,644	17.9	
11	WLDFR-M07B	Situational Awareness and Forecasting Initiatives - Weather	4.1	21A	$ 8,314,938	$ 6,398,910	$ 6,377,353	$ 3,270,045	$ 1,121,774	$ 1,154,914	$ 1,189,192	$ 27,827,126	$ 6,735,925	Foundational	
12	WLDFR-M07C	Situational Awareness and Forecasting Initiatives - WSOC	4.1	21A	$ (34,089)	$ 1,542,003	$ 128,624	$ -	$ -	$ -	$ -	$ 1,636,538	$ -	Foundational	
13	WLDFR-M07F	Situational Awareness and Forecasting Initiatives - Sensor IQ	4.3	21A	$ -	$ -	$ -	$ 10,506,738	$ -	$ -	$ -	$ 10,506,738	$ 10,506,738	Foundational	
14	WLDFR-M07G	Situational Awareness and Forecasting Initiatives - Partial	4.1	21A	$ 1,215,572	$ 331,014	$ 627,166	$ -	$ -	$ -	$ -	$ 2,173,752	$ -	291.4	
15	WLDFR-M07I	Situational Awareness and Forecasting Initiatives - Advance Fire	4.1	21A	$ 898,811	$ 1,028,004	$ -	$ -	$ -	$ -	$ -	$ 1,926,815	$ -	Foundational	
16	WLDFR-M07J	Situational Awareness and Forecasting Initiatives - Meteorology	4.1	21A	$ -	$ -	$ 1,055,360	$ 1,082,717	$ 1,889,566	$ 1,905,209	$ 1,966,972	$ 7,899,824	$ 6,844,464	Foundational	
17	WLDFR-M008	Safety and Infrastructure Protection Teams (Capital)	4.1	21A	$ 1,253,924	$ 151,527	$ 1,186,531	$ 247,791	$ 278,200	$ 280,736	$ 290,291	$ 3,689,000	$ 1,097,018	1.0	
18	WLDFR-M10A	Additional System Automation and Protection	4.3	49A	$ 1,455,718	$ 6,990,247	$ -	$ -	$ -	$ -	$ -	$ 8,445,965	$ -		
19	WLDFR-M10B	Additional System Automation and Protection - FuseSaver	4.3	49T	$ -	$ 2,304,747	$ 2,764,442	$ 2,940,000	$ 3,087,000	$ 3,241,000	$ 3,403,000	$ 17,740,189	$ 12,671,000	18.9	
20	WLDFR-M10C	Additional System Automation and Protection - REFCL	4.3	49R	$ 4,798,211	$ 8,223,933	$ 16,875,648	$ 17,331,258	$ 17,800,026	$ 18,280,307	$ 18,773,747	$ 102,083,130	$ 72,185,338	23.1	
21	WLDFR-M011	Situational Awareness and Forecasting Initiatives - EFD	4.3	49I	$ -	$ -	$ 4,647,411	$ 5,434,485	$ 6,234,073	$ 7,485,962	$ 8,785,806	$ 32,587,737	$ 27,940,326	71.5	
22	WLDFR-M012	Situational Awareness and Forecasting Initiatives - DFA	4.3	49I	$ -	$ -	$ 10,350,735	$ 8,965,259	$ 9,002,113	$ 9,245,308	$ 9,494,517	$ 47,057,932	$ 36,707,197	(E)	
23	WLDFR-M013	Pole Programs - Replace Tree Attachments	12	07C	$ 87,434	$ -	$ 3,302,843	$ 3,296,417	$ 3,499,935	$ 3,709,013	$ 3,923,933	$ 17,819,575	$ 14,429,298	0.3	
24	WLDFR-M014	Butte County Rebuild	23	95F	$ 88,100,334	$ 87,513,000	$ 124,132,118	$ 116,589,873	$ 96,095,283	$ 64,367,791	$ 16,939,899	$ 593,738,298	$ 293,992,846	1.0	
25		**Total (F)**			**$ 780,420,229**	**$ 721,573,688**	**$ 1,280,714,295**	**$ 1,707,801,454**	**$ 2,698,735,204**	**$ 3,136,817,459**	**$ 3,525,178,509**	**$ 13,851,240,836**	**$ 11,068,532,625**		
26															
27		Total Chapter 4.1			$ 11,649,156	$ 9,451,458	$ 9,375,034	$ 4,600,553	$ 3,289,540	$ 3,340,859	$ 3,446,455	$ 45,153,055	$ 14,677,407		WP 3-1, Line 1, Col. G
28		Total Chapter 4.2			$ 2,396,858	$ 3,084,000	$ 3,236,537	$ 261,723	$ 269,226	$ 276,740	$ 284,285	$ 9,809,369	$ 1,091,974		WP 3-1, Line 2, Col. G
29		Total Chapter 4.3			$ 614,689,230	$ 532,665,841	$ 1,123,863,328	$ 1,583,052,888	$ 2,595,581,219	$ 3,065,123,055	$ 3,500,583,937	$ 13,015,559,498	$ 10,744,341,100		WP 3-1, Line 3, Col. G
30		Total Chapter 11			$ 63,497,216	$ 88,859,389	$ 16,804,435	$ -	$ -	$ -	$ -	$ 169,161,040	$ -		WP 3-1, Line 9, Col. G
31		Total Chapter 12			$ 87,434	$ -	$ 3,302,843	$ 3,296,417	$ 3,499,935	$ 3,709,013	$ 3,923,933	$ 17,819,575	$ 14,429,298		WP 3-1, Line 10, Col. G
32		Total Chapter 23			$ 88,100,334	$ 87,513,000	$ 124,132,118	$ 116,589,873	$ 96,095,283	$ 64,367,791	$ 16,939,899	$ 593,738,298	$ 293,992,846		WP 3-1, Line 17, Col. G
33		**Total**			**$ 780,420,229**	**$ 721,573,688**	**$ 1,280,714,295**	**$ 1,707,801,454**	**$ 2,698,735,204**	**$ 3,136,817,459**	**$ 3,525,178,509**	**$ 13,851,240,836**	**$ 11,068,532,625**		
34															
35															

36 Notes:
37 (A) Updated to include updated forecast costs and RSEs (February 25, 2022) and errata (November 5, 2021 and February 25, 2022).
38 (B) RSEs for mitigation or controls associated with more than one major work category (MWC) or maintenance activity type (MAT) are listed only once, the first time they appear on this schedule.
39 (C) PG&E calculated two RSEs for System Hardening: System Hardening [Overhead] - the RSE is 5.9; and, System Hardening [Underground] - the RSE is 5.4
40 (D) To comply with guidance from the Safety Policy Division (SPD), PG&E is not calculating an RSE for the Wildfire risk mitigation benefits of PSPS, per Resolution (Res.) WSD 002 (June 11, 2020), Appendix A, p. A 1.
41 (E) The RSE for SA&FI – DFA (WLDFR-M012) is incorporated into the SA&FI – Line Sensors program (WLDFR-M07A) because the two devices work in tandem and the risk reduction is combined.
42 (F) PG&E is proposing an alternative mitigation: WLDFR-M017 Remote Grid. To the extent Remote Grid projects are conducted the capital funding will come from MAT 08W.
43 For the purposes of risk modeling PG&E is assigning estimated capital costs for Remote Grid each year from 2020-2026.

Workpaper Table 3-5
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Wildfire - Recorded and Forecast Mitigation Costs - Expense
(Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE (B)	Reference
1	WLDFR-M001 (WLDFR-M018) (C)	Enhanced Vegetation Management (Modified Enhanced Vegatation Management) (C)	9	IGJ	$ 451,390,239	$ 535,951,926	$ 916,600,000	$ 118,022,400	$ 117,555,234	$ 112,176,917	$ 102,234,120	$ 2,353,930,837	$ 449,988,671	14.5	
2	WLDFR-M005	Public Safety Power Shutoff - PSPS Event (Distribution)	4.2	AB6	$ 80,705,644	$ 82,741,000	$ 70,782,443	$ 72,997,934	$ 74,982,838	$ 77,021,714	$ 79,116,029	$ 538,347,602	$ 304,118,515	(D)	
3	WLDFR-M006	EP&R Field Operations	4.2	AB6	$ 3,690,966	$ 9,973,977	$ -	$ -	$ -	$ -	$ -	$ 13,664,943	$ -	(D)	
4	WLDFR-M006	EP&R Field Ops Tech Expense	4.2	AB6	$ 17,992	$ 102,920	$ 106,069	$ -	$ -	$ -	$ -	$ 226,981	$ -	(D)	
5	WLDFR-M006	Generation Enablement and Deployment PMO	4.3	AB#	$ -	$ -	$ 2,063,003	$ 1,957,478	$ 2,197,337	$ 2,268,549	$ 2,342,075	$ 10,828,442	$ 8,765,439	(D)	
6	WLDFR-M006	Generation Enablement and Deployment PMO	4.3	IG#	$ 3,494,109	$ 3,030,986	$ -	$ -	$ -	$ -	$ -	$ 6,525,095	$ -	(D)	
7	WLDFR-M006	PSPS - EP&R Field Ops Tech Expense	4.2	AB6	$ 92,156	$ 205,842	$ 212,139	$ -	$ -	$ -	$ -	$ 510,137	$ -	(D)	
8	WLDFR-M006	PSPS Collateral/Segment Creations Exp	4.2	AB6	$ 249,466	$ 102,934	$ 106,069	$ 109,389	$ 112,364	$ 115,419	$ 118,557	$ 914,199	$ 455,729	(D)	
9	WLDFR-M006	PSPS EP&R Field Ops Misc.	4.2	AB6	$ 107,693	$ 257,309	$ 265,173	$ -	$ -	$ -	$ -	$ 630,175	$ -	(D)	
10	WLDFR-M006	PSPS Field Exercise Dist. Exp	4.2	AB6	$ 1,073,128	$ 2,469,957	$ 2,545,664	$ 2,625,344	$ 2,696,730	$ 2,770,058	$ 2,845,379	$ 17,026,260	$ 10,937,511	(D)	
11	WLDFR-M006	PSPS Increased Helicopter EU (Dist)	4.2	AB6	$ 28,668,018	$ 7,976,004	$ 14,943,700	$ 15,411,438	$ 15,830,494	$ 16,260,945	$ 16,703,100	$ 115,793,699	$ 64,205,977	(D)	
12	WLDFR-M006	PSPS PMO	4.2	AB6	$ 2,179,576	$ 5,532,972	$ 4,501,918	$ 4,642,828	$ 4,769,073	$ 4,898,750	$ 5,031,953	$ 31,557,070	$ 19,342,604	(D)	
13	WLDFR-M006	PSPS PMO Projects	4.2	AB6	$ 6,898,379	$ 1,543,797	$ 1,591,040	$ 1,640,840	$ 1,685,456	$ 1,731,286	$ 1,778,362	$ 16,869,160	$ 6,835,944	(D)	
14	WLDFR-M006	PSPS Pre-flights Expense	4.2	AB6	$ 1,775,040	$ 1,080,618	$ 1,113,728	$ 1,148,588	$ 1,179,819	$ 1,211,900	$ 1,244,853	$ 8,754,546	$ 4,785,160	(D)	
15	WLDFR-M006	Wildfire Public Engagement Team	4.2	AB6	$ 297,702	$ 1,158,082	$ 956,692	$ 986,582	$ 1,013,408	$ 1,040,964	$ 1,069,269	$ 6,522,700	$ 4,110,223	(D)	
16	WLDFR-M006	EP&R Field Operations (Includes Tech, Training and Other Misc.)	4.2	AB6	$ -	$ -	$ 6,902,959	$ -	$ -	$ -	$ -	$ 6,902,959	$ -	(D)	
17	WLDFR-M006	CRC Preparedness Program (also referred to as Harden CRC)	4.2	AB6	$ 15,422,675	$ 14,774,124	$ 15,226,255	$ 15,702,837	$ 16,129,817	$ 16,568,406	$ 17,018,922	$ 110,843,036	$ 65,419,982		
17	WLDFR-M07A	Situational Awareness and Forecasting Initiatives - Line Sensors	4.3	FZA	$ 1,486,647	$ 2,344,000	$ 2,575,749	$ 3,436,991	$ 4,205,613	$ 4,443,373	$ 4,694,250	$ 23,186,623	$ 16,780,227	(E)	
18	WLDFR-M07A	Situational Awareness and Forecasting Initiatives - Line Sensors	4.3	HG#	$ 10,141	$ -	$ -	$ -	$ -	$ -	$ -	$ 10,141	$ -	(E)	
18	WLDFR-M07B	Situational Awareness and Forecasting Initiatives - Weather Station	4.1	AB6	$ 111,209	$ 1,571,588	$ 1,640,893	$ 1,764,450	$ 1,889,958	$ 1,970,203	$ 2,110,323	$ 11,058,624	$ 7,734,934	Foundational	
19	WLDFR-M07C	Situational Awareness and Forecasting Initiatives - WSOC	4.1	AB6	$ 4,347,756	$ 9,139,296	$ 7,180,706	$ -	$ -	$ -	$ -	$ 20,667,758	$ -	Foundational	
20	WLDFR-M07D	Situational Awareness and Forecasting Initiatives - Cameras	4.1	AB6	$ 6,955,764	$ 9,385,275	$ 11,531,860	$ 8,233,734	$ 8,826,173	$ 9,459,746	$ 10,136,662	$ 64,529,214	$ 36,656,315	19.5	
21	WLDFR-M07E	Situational Awareness and Forecasting Initiatives - Satellite Fire Detection	4.1	AB6	$ -	$ 340,660	$ 351,090	$ 362,079	$ 371,924	$ 382,037	$ 392,425	$ 2,200,215	$ 1,508,465	160.9	
22	WLDFR-M07F	Situational Awareness and Forecasting Initiatives - Sensor IQ	4.3	AB#	$ 1,870,781	$ 145,274	$ -	$ 3,782,683	$ 3,885,539	$ 3,991,191	$ 4,099,717	$ 17,775,185	$ 15,759,130	Foundational	
23	WLDFR-M07G	Situational Awareness and Forecasting Initiatives - Partial Voltage Detection	4.1	AB6	$ 3,657	$ -	$ 84,855	$ 232,759	$ 239,088	$ 245,589	$ 252,267	$ 1,058,215	$ 969,703	291.4	
24	WLDFR-M07H	Situational Awareness and Forecasting Initiatives - SOPP Improvements	4.1	AB6	$ 1,627,083	$ 1,968,861	$ 2,029,107	$ -	$ -	$ -	$ -	$ 5,625,051	$ -	Foundational	
25	WLDFR-M07I	Situational Awareness and Forecasting Initiatives - Advance Fire Modeling	4.1	AB6	$ 5,541,318	$ 5,969,350	$ 6,152,022	$ 6,344,581	$ 6,517,098	$ 6,694,306	$ 6,876,332	$ 44,095,007	$ 26,432,317	Foundational	
26	WLDFR-M07J	Situational Awareness and Forecasting Initiatives - Meteorology	4.1	AB6	$ -	$ 514,608	$ 530,773	$ 437,526	$ 449,524	$ 461,571	$ 474,677	$ 2,868,679	$ 1,823,298	Foundational	
27	WLDFR-M07K	Situational Awareness and Forecasting Initiatives - Fire Potential Index	4.1	AB6	$ 93,187	$ 154,380	$ 159,104	$ 173,790	$ 183,709	$ 194,196	$ 205,282	$ 1,163,648	$ 756,977	Foundational	
26	WLDFR-M008	Safety and Infrastructure Protection Teams	4.1	AB6	$ 15,341,903	$ 30,303,768	$ 24,899,010	$ 25,866,737	$ 26,738,632	$ 27,292,560	$ 28,034,678	$ 178,477,287	$ 107,932,607	1.0	

Workpaper Table 3-5
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Wildfire - Recorded and Forecast Mitigation Costs - Expense
(Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE (B)	Reference
27	WLDFR-M009	Community Wildfire Safety Program Project Management Office	4.4	AB#	$ 17,724,490	$ 15,438,004	$ 14,994,327	$ 13,459,809	$ 15,886,755	$ 16,027,339	$ 16,543,451	$ 110,074,174	$ 61,917,354	Foundational	
28	WLDFR-M017	System Hardening - Remote Grid	4.3	AB#	$ 1,010,419	$ 1,382,468	$ 1,422,646	$ 1,464,187	$ 1,500,792	$ 1,538,312	$ 1,576,769	$ 9,895,593	$ 6,080,060		
29	WLDFR-M017	System Hardening - Remote Grid	4.3	KAT	$ -	$ -	$ 617,438	$ 953,200	$ 1,845,501	$ 3,004,368	$ 4,334,077	$ 10,754,584	$ 10,137,146		
30	WLDFR-M020	Enhanced Powerline Safety Settings	4.6	Various (F)	$ -	$ 18,203,036	$ 148,921,000	$ 151,128,765	$ 146,302,373	$ 140,825,079	$ 133,710,129	$ 739,090,382	$ 571,966,346	105.7	
31		**Total**			**$ 652,187,138**	**$ 763,763,016**	**$ 1,261,007,432**	**$ 452,886,948**	**$ 456,995,250**	**$ 452,594,778**	**$ 442,943,658**	**$ 4,482,378,221**	**$ 1,805,420,635**		
32															
33		Total Chapter 4.1			$ 34,021,876	$ 59,347,786	$ 54,559,420	$ 43,415,656	$ 45,216,106	$ 46,700,208	$ 48,482,646	$ 331,743,698	$ 183,814,616		WP 3-1, Line 1, Col. A
34		Total Chapter 4.2			$ 141,178,436	$ 127,919,536	$ 119,253,849	$ 115,265,780	$ 118,399,999	$ 121,619,442	$ 124,926,424	$ 868,563,466	$ 480,211,645		WP 3-1, Line 2, Col. A
35		Total Chapter 4.3			$ 7,872,098	$ 6,902,728	$ 6,678,836	$ 11,594,539	$ 13,634,782	$ 15,245,793	$ 17,046,888	$ 78,975,664	$ 57,522,002		WP 3-1, Line 3, Col. A
36		Total Chapter 4.4			$ 17,724,490	$ 15,438,004	$ 14,994,327	$ 13,459,809	$ 15,886,755	$ 16,027,339	$ 16,543,451	$ 110,074,174	$ 61,917,354		WP 3-1, Line 4, Col. A
37		Total Chapter 4.6			$ -	$ 18,203,036	$ 148,921,000	$ 151,128,765	$ 146,302,373	$ 140,825,079	$ 133,710,129	$ 739,090,382	$ 571,966,346		WP 3-1, Line 5, Col. A
38		Total Chapter 9			$ 451,390,239	$ 535,951,926	$ 916,600,000	$ 118,022,400	$ 117,555,234	$ 112,176,917	$ 102,234,120	$ 2,353,930,837	$ 449,988,671		WP 3-1, Line 7, Col. A
39		**Total**			**$ 652,187,138**	**$ 763,763,016**	**$ 1,261,007,432**	**$ 452,886,948**	**$ 456,995,250**	**$ 452,594,778**	**$ 442,943,658**	**$ 4,482,378,221**	**$ 1,805,420,635**		

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41 Notes:
42 (A) Updated to include updated forecast costs and RSEs (February 25, 2022) and errata (November 5, 2021 and February 25, 2022).
43 (B) RSEs for mitigation or controls associated with more than one major work category (MWC) or maintenance activity type (MAT) are listed only once, the first time they appear on this schedule.
44 (C) This mitigation is referred to as WLDFR-M018: Modified Enhanced Vegetation Management in the February 25, 2022 risk modeling workpapers.
45 (D) To comply with guidance from the Safety Policy Division (SPD), PG&E is not calculating an RSE for the Wildfire risk mitigation benefits of PSPS, per Resolution (Res.) WSD 002 (June 11, 2020), Appendix A, p. A 1.
46 (E) Certain MAT codes that are aligned to this program are considered foundational and are excluded from the RSE calculation.
47 (F) Expense MATs: BAF, BAH, FZE, GC2, BHE, IG#

Workpaper Table 3-6
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Failure of Electric Distribution Overhead Assets - Recorded and Forecast Control Costs - Capital
(Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE (B)	Reference
1	DOVHD-C003	Equipment Preventive Maintenance and Replacement - Distribution Overhead	11	2AA	$ 179,951,104	$ 232,990,043	$ 201,316,166	$ 205,362,647	$ 212,044,473	$ 218,716,729	$ 230,716,023	$ 1,481,097,185	$ 866,839,872	128.9 (C)	
2	DOVHD-C003	Equipment Preventive Maintenance and Replacement - Distribution Overhead	11	2AB	$ 1,974,878	$ 3,023,258	$ 3,480,503	$ 3,473,731	$ 3,480,670	$ 3,487,401	$ 3,494,182	$ 22,414,623	$ 13,935,984	0.5	
3	DOVHD-C003	Equipment Preventive Maintenance and Replacement - Distribution Overhead	11	2AE	$ 44,166,493	$ 54,680,464	$ 28,174,548	$ 28,119,733	$ 28,175,906	$ 28,230,390	$ 28,285,281	$ 239,832,815	$ 112,811,310		
4	DOVHD-C003	Equipment Preventive Maintenance and Replacement - Distribution Overhead	11	2AF	$ 4,965,509	$ 2,423,543	$ 2,731,666	$ 2,726,352	$ 2,731,798	$ 2,737,080	$ 2,742,402	$ 21,058,350	$ 10,937,632		
5	DOVHD-C003	Equipment Preventive Maintenance and Replacement - Distribution Overhead	11	2AH	$ 2,519,193	$ 1,028,000	$ 2,115,624	$ 7,075,176	$ 7,252,055	$ 7,433,356	$ 7,619,190	$ 35,042,594	$ 29,379,777		
6	DOVHD-C003	Equipment Preventive Maintenance and Replacement - Distribution Overhead	11	2AI	$ 445,401	$ -	$ -	$ 995,145	$ 997,133	$ 999,061	$ 1,001,003	$ 4,437,743	$ 3,992,342		
7	DOVHD-C003	Equipment Preventive Maintenance and Replacement - Distribution Overhead	11	2AS	$ 221,253	$ 638,927	$ 831,233	$ 829,616	$ 831,273	$ 832,881	$ 834,500	$ 5,019,683	$ 3,328,270		
8	DOVHD-C003	Equipment Preventive Maintenance and Replacement - Distribution Overhead	13	49C	$ 308,787	$ 882,000	$ 1,518,808	$ 1,559,813	$ 1,422,162	$ 1,496,700	$ 2,967,395	$ 10,155,665	$ 7,446,070	4.6	
9	DOVHD-C004	Overhead Conductor Replacement	13	08J	$ 16,590,640	$ 41,180,001	$ 32,687,997	$ 43,035,716	$ 44,486,110	$ 45,700,768	$ 46,934,368	$ 270,615,600	$ 180,156,962	0	
10	DOVHD-C007	Supervisory Control and Data Acquisitions	16	09B	$ 11,411,450	$ 10,292,304	$ 12,228,049	$ 18,209,769	$ 18,464,516	$ 16,425,644	$ 16,944,096	$ 103,975,828	$ 70,044,025	Foundational	
11	DOVHD-C007	Supervisory Control and Data Acquisitions	16	09D	$ 14,242,568	$ 6,840,802	$ 6,329,377	$ 469,578	$ 3,404	$ 3,301,389	$ 3,039,744	$ 34,226,862	$ 6,814,115		
12	DOVHD-C007	Supervisory Control and Data Acquisitions	16	09E	$ 4,989,645	$ 2,603,237	$ 2,539,668	$ 2,907,710	$ 3,714,361	$ 3,100,044	$ 3,430,264	$ 23,284,929	$ 13,152,379		
13	DOVHD-C007	Supervisory Control and Data Acquisitions	16	09F	$ 6,695,397	$ 5,746,553	$ 5,273,640	$ 5,416,018	$ 5,562,508	$ 5,712,596	$ 5,866,796	$ 40,273,508	$ 22,557,918		
14	DOVHD-C011	Pole Programs	12	07D	$ 238,713,708	$ 301,006,662	$ 355,298,431	$ 368,381,249	$ 388,114,997	$ 387,888,926	$ 388,354,608	$ 2,427,758,581	$ 1,532,739,780	79.5	
15	DOVHD-C011	Pole Programs	12	07O	$ 11,114,499	$ 10,877,415	$ 7,852,041	$ 7,836,764	$ 8,600,269	$ 9,391,171	$ 10,210,234	$ 65,882,393	$ 36,038,438	70.8	
16	DOVHD-C012	Targeted Reliability Programs	13	49X	$ 1,307,593	$ 3,768,000	$ 3,631,287	$ 3,708,632	$ 4,763,652	$ 4,531,775	$ 5,084,277	$ 26,795,216	$ 18,088,336	1.2	
17	DOVHD-C014	Additional System Automation and Protection - FuseSaver	13	49T	$ 484,931	$ 1,110,185	$ 808,000	$ 1,392,814	$ 1,363,006	$ 1,329,077	$ 1,290,437	$ 7,778,450	$ 5,375,334	18.9	
18	DOVHD-C09A	Overloaded Transformers Replacement	17	06B	$ 858,929	$ 5,017,609	$ 4,745,185	$ 8,172,128	$ 10,721,923	$ 11,320,947	$ 11,729,998	$ 52,566,719	$ 41,944,996	0.6	
19		**Total**			**$ 540,961,978**	**$ 684,109,003**	**$ 671,562,223**	**$ 709,672,591**	**$ 742,730,216**	**$ 752,635,935**	**$ 770,544,798**	**$ 4,872,216,744**	**$ 2,975,583,540**		
20															
21		Total Chapter 11			$ 234,243,831	$ 294,784,235	$ 238,649,740	$ 248,582,400	$ 255,513,308	$ 262,436,898	$ 274,692,581	$ 1,808,902,994	$ 1,041,225,187		WP 3-1, Line 27, Col. H
22		Total Chapter 12			$ 249,828,207	$ 311,884,077	$ 363,150,472	$ 376,218,013	$ 396,715,266	$ 397,280,097	$ 398,564,842	$ 2,493,640,974	$ 1,568,778,218		WP 3-1, Line 28, Col. H
23		Total Chapter 13			$ 18,691,952	$ 46,940,186	$ 38,646,092	$ 49,696,975	$ 52,034,930	$ 53,058,320	$ 56,276,477	$ 315,344,932	$ 211,066,702		WP 3-1, Line 29, Col. H
24		Total Chapter 16			$ 37,339,059	$ 25,482,896	$ 26,370,734	$ 27,003,075	$ 27,744,789	$ 28,539,673	$ 29,280,900	$ 201,761,126	$ 112,568,437		WP 3-1, Line 32, Col. H
25		Total Chapter 17			$ 858,929	$ 5,017,609	$ 4,745,185	$ 8,172,128	$ 10,721,923	$ 11,320,947	$ 11,729,998	$ 52,566,719	$ 41,944,996		WP 3-1, Line 33, Col. H
26		**Total**			**$ 540,961,978**	**$ 684,109,003**	**$ 671,562,223**	**$ 709,672,591**	**$ 742,730,216**	**$ 752,635,935**	**$ 770,544,798**	**$ 4,872,216,744**	**$ 2,975,583,540**		

27
28 Notes:
29 (A) Updated to include updated forecast costs and RSEs (February 25, 2022) and errata (November 5, 2021 and February 25, 2022).

Workpaper Table 3-7
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Failure of Electric Distribution Overhead Assets - Recorded and Forecast Control Costs - Expense
(Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE (B)	Reference
1	DOVHD-C001	Vegetation Management - Distribution Overhead	9	HN#	$ 53,827,558	$ 209,350,486	$ 711,007,474	$ 871,219,828	$ 844,736,102	$ 800,294,252	$ 727,547,910	$ 4,217,983,610	$ 3,243,798,092	4,083.4	
2	DOVHD-C001	Vegetation Management - Distribution Overhead	9	HNA	$ 639,321,408	$ 458,772,476	$ -	$ -	$ -	$ -	$ -	$ 1,098,093,884	$ -		
2	DOVHD-C001i	Incremental Routine Vegetation Management (D)	9	HNA								$ -	$ -	4.6	
3	DOVHD-C002	Vegetation Management - CEMA/Tree Mortality	9	IG#	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
4	DOVHD-C002	Vegetation Management - CEMA/Tree Mortality	9	IGI	$ 93,070,479	$ 67,977,674	$ 144,000,050	$ 69,830,227	$ 70,422,901	$ 71,003,348	$ 70,396,338	$ 586,701,018	$ 281,652,814	3,025.6	
5	DOVHD-C003	Equipment Maintenance and Replacement - Distribution Overhead	11	KAA	$ 98,710,568	$ 49,612,461	$ 48,622,465	$ 58,425,421	$ 49,964,533	$ 50,135,573	$ 50,153,933	$ 405,624,954	$ 208,679,460	128.9 (C)	
6	DOVHD-C003	Equipment Maintenance and Replacement - Distribution Overhead	11	KAC	$ 756,186	$ 828,055	$ 829,262	$ 905,806	$ 930,436	$ 955,736	$ 981,723	$ 6,187,204	$ 3,773,701	0.5	
7	DOVHD-C003	Equipment Maintenance and Replacement - Distribution Overhead	11	KAH	$ 1,602,826	$ 1,874,771	$ 1,877,504	$ 1,992,613	$ 2,046,795	$ 2,102,449	$ 2,159,618	$ 13,656,576	$ 8,301,475		
8	DOVHD-C003	Equipment Maintenance and Replacement - Distribution Overhead	11	KAM	$ 47,526	$ 213,045	$ 213,356	$ 226,436	$ 232,593	$ 238,917	$ 245,414	$ 1,417,287	$ 943,360		
9	DOVHD-C003	Equipment Maintenance and Replacement - Distribution Overhead	11	KAO	$ 680,987	$ 699,869	$ 700,889	$ 196,901	$ 202,255	$ 207,754	$ 213,403	$ 2,902,058	$ 820,313		
10	DOVHD-C003	Equipment Maintenance and Replacement - Distribution Overhead	11	KAP	$ 6,274,511	$ 3,525,850	$ 2,945,598	$ 1,644,796	$ 1,834,412	$ 2,045,216	$ 2,394,058	$ 20,664,441	$ 7,918,482		
11	DOVHD-C003	Equipment Maintenance and Replacement - Distribution Overhead	11	KAS	$ 1,681,320	$ 1,551,385	$ 1,553,646	$ 1,648,902	$ 1,693,738	$ 1,739,793	$ 1,787,100	$ 11,655,884	$ 6,869,533		
12	DOVHD-C005	Inspections - Distribution Overhead	10	BFB	$ 94,061,458	$ 93,350,805	$ 60,534,875	$ 58,807,363	$ 56,937,805	$ 57,441,655	$ 59,291,388	$ 480,425,349	$ 232,478,211	68.6	
13	DOVHD-C005	Inspections	10	BFH	$ 40,607,954	$ 1,876,482	$ -	$ -	$ -	$ -	$ -	$ 42,484,436	$ -		
14	DOVHD-C006	Infrared Inspections -Distribtuion Overhead	10	BFC	$ 1,561,335	$ 2,319,999	$ 2,323,381	$ 2,594,551	$ 2,512,067	$ 2,534,296	$ 2,615,906	$ 16,461,535	$ 10,256,820	41.0	
14	DOVHD-C007	Supervisory Control and Data Acquisitions	16	HX#	$ -	$ (366,810)	$ (367,344)	$ -	$ -	$ -	$ -	$ (734,154)	$ -	Foundational	
15	DOVHD-C007	Supervisory Control and Data Acquisitions	16	HXA	$ 2,344,212	$ 2,778,938	$ 2,782,989	$ 3,008,227	$ 3,090,025	$ 3,174,046	$ 3,319,631	$ 20,498,068	$ 12,591,929		
15	DOVHD-C008	Annual Protection Reviews	17	FZA	$ 11,876,622	$ 14,573,701	$ 14,366,611	$ 16,696,289	$ 17,325,710	$ 17,935,414	$ 18,576,396	$ 111,350,743	$ 70,533,809	Foundational	
16	DOVHD-C011	Pole Programs	11	KAC	$ -	$ -	$ -	$ 224,324	$ 230,423	$ 236,689	$ 243,125	$ 934,561	$ 934,561		
17	DOVHD-C011	Pole Programs	12	GAA	$ 17,446,665	$ 21,227,066	$ 21,258,006	$ 19,309,868	$ 18,454,238	$ 18,531,287	$ 19,139,574	$ 135,366,704	$ 75,434,967		
18	DOVHD-C011	Pole Programs	12	GAD	$ 4,783,468	$ 3,458,006	$ 3,463,046	$ 3,924,191	$ 4,041,189	$ 4,163,206	$ 4,285,725	$ 28,118,831	$ 16,414,311	1,170.6	
19	DOVHD-C011	Pole Programs	12	GAF	$ (195)	$ 131,991	$ 132,183	$ 156,919	$ 169,942	$ 184,046	$ 194,249	$ 969,135	$ 705,156		
20	DOVHD-C011	Pole Programs	12	GAH	$ 329,277	$ 356,000	$ 356,519	$ 424,261	$ 459,472	$ 497,606	$ 525,193	$ 2,948,328	$ 1,906,532		
21	DOVHD-C013	Patrols - Distribution Overhead	10	BFA	$ 6,483,378	$ 3,891,139	$ 3,896,810	$ 4,630,081	$ 4,482,885	$ 4,522,554	$ 4,668,189	$ 32,575,036	$ 18,303,709	136.2	
22		**Total**			**$ 1,075,467,542**	**$ 938,003,389**	**$ 1,020,497,320**	**$ 1,115,867,004**	**$ 1,079,767,520**	**$ 1,037,943,838**	**$ 968,738,873**	**$ 7,236,285,487**	**$ 4,202,317,235**		
23															
24		Total Chapter 9			$ 786,219,445	$ 736,100,636	$ 855,007,524	$ 941,050,055	$ 915,159,002	$ 871,297,601	$ 797,944,248	$ 5,902,778,511	$ 3,525,450,906		WP 3-1, Line 25, Col. B
25		Total Chapter 10			$ 142,714,125	$ 101,438,425	$ 66,755,066	$ 66,031,995	$ 63,932,757	$ 64,498,505	$ 66,575,483	$ 571,946,356	$ 261,038,740		WP 3-1, Line 26, Col. B
26		Total Chapter 11			$ 109,753,924	$ 58,305,436	$ 56,742,720	$ 65,265,199	$ 57,135,185	$ 57,662,127	$ 58,178,374	$ 463,042,965	$ 238,240,885		WP 3-1, Line 27, Col. B
27		Total Chapter 12			$ 22,559,214	$ 25,173,063	$ 25,209,754	$ 23,815,239	$ 23,124,841	$ 23,376,145	$ 24,144,741	$ 167,402,997	$ 94,460,966		WP 3-1, Line 28, Col. B
28		Total Chapter 16			$ 2,344,212	$ 2,412,128	$ 2,415,645	$ 3,008,227	$ 3,090,025	$ 3,174,046	$ 3,319,631	$ 19,763,914	$ 12,591,929		WP 3-1, Line 32, Col. B
29		Total Chapter 17			$ 11,876,622	$ 14,573,701	$ 14,366,611	$ 16,696,289	$ 17,325,710	$ 17,935,414	$ 18,576,396	$ 111,350,743	$ 70,533,809		WP 3-1, Line 33, Col. B
30		**Total**			**$ 1,075,467,542**	**$ 938,003,389**	**$ 1,020,497,320**	**$ 1,115,867,004**	**$ 1,079,767,520**	**$ 1,037,943,838**	**$ 968,738,873**	**$ 7,236,285,487**	**$ 4,202,317,235**		
31															

32 Notes:
33 (A) Updated to include updated forecast costs and RSEs (February 25, 2022) and errata (November 5, 2021 and February 25, 2022).
34 (B) RSEs for mitigation or controls associated with more than one major work category (MWC) or maintenance activity type (MAT) are listed only once, the first time they appear on this schedule.
35 (C) Certain MAT codes that are aligned to this program are considered foundational and are excluded from the RSE calculation.
36 (D) PG&E calculated an RSE for the Incremental Routine Vegetation Management program in addition to and RSE for the Routine VM program.

Workpaper Table 3-8
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Failure of Electric Distribution Overhead Assets - Recorded and Forecast Mitigation Costs - Capital and Expense
(Nominal Dollars)

Recorded and Forecast Control Costs - Capital (Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE(B)	Reference
1	DOVHD-M002	System Hardening	4.3	08W	$ 525,129,116	$ 428,315,297	$ 1,031,321,550	$ 1,501,937,074	$ 2,524,471,000	$ 2,991,542,807	$ 3,423,761,588	$ 12,426,478,432	$ 10,441,712,470	(C)	
2	DOVHD-M003	Non-Exempt Surge Arrester Replacement	11	2AR	$ 63,497,216	$ 88,859,389	$ 16,804,435	$ 17,758,607	$ 35,472,244	$ 36,429,359	$ 37,412,696	$ 296,233,946	$ 127,072,906		
3	DOVHD-M004	Expulsion Fuse Replacement	4.3	2AP	$ 7,846,531	$ 15,124,923	$ 15,388,477	$ 15,751,717	$ 16,257,250	$ 16,777,228	$ 17,314,355	$ 104,460,481	$ 66,100,550	3.8	
4	DOVHD-M006	Grasshopper and KPF Switch Replacement	13	08S	$ 535,972	$ 925,207	$ 949,255	$ 974,883	$ 1,001,251	$ 1,028,267	$ 1,056,023	$ 6,470,858	$ 4,060,424	12.3	
5	DOVHD-M007	Regulated Output Streetlight Replacement	11	2AG	$ 29,786	$ 5,140,000	$ -	$ 2,487,862	$ 2,592,545	$ -	$ -	$ 10,250,193	$ 5,080,407	0	
6	DOVHD-M008	Ceramic Post Insulator Replacement	11	2AQ	$ 2,753,431	$ 3,959,669	$ 5,831,898	$ 5,820,552	$ 5,832,179	$ 5,843,457	$ 5,854,819	$ 35,896,005	$ 23,351,007	0.3	
7	DOVHD-M010	3A and 4C Line Recloser Replacement	4.3	49A	$ 1,455,718	$ 6,990,247	$ -	$ -	$ -	$ -	$ -	$ 8,445,965	$ -	(D)	
8	DOVHD-M010	3A and 4C Line Recloser Replacement	13	49A	$ 17,143	$ -	$ 6,203,333	$ 1,841,446	$ 1,891,253	$ 2,056,535	$ 2,112,047	$ 14,121,757	$ 7,901,281		
9	DOVHD-M010	3A and 4C Line Recloser Replacement	13	49B	$ 1,480	$ 534,558	$ 527,364	$ 4,397,807	$ 4,516,756	$ 4,638,628	$ 4,763,838	$ 19,380,431	$ 18,317,029		
10		**Total (E)**			**$ 601,266,392**	**$ 549,849,290**	**$ 1,077,026,312**	**$ 1,550,969,948**	**$ 2,592,034,478**	**$ 3,058,316,281**	**$ 3,492,275,366**	**$ 12,921,738,067**	**$ 10,693,596,074**		
11															
12		Total Chapter 4.3			$ 534,431,364	$ 450,430,467	$ 1,046,710,027	$ 1,517,688,791	$ 2,540,728,250	$ 3,008,320,035	$ 3,441,075,943	$ 12,539,384,878	$ 10,507,813,020		WP 3-1, Line 3, Col. H
13		Total Chapter 11			$ 66,280,433	$ 97,959,058	$ 22,636,333	$ 26,067,021	$ 43,896,968	$ 42,272,816	$ 43,267,515	$ 342,380,144	$ 155,504,320		WP 3-1, Line 9, Col. H
14		Total Chapter 13			$ 554,595	$ 1,459,765	$ 7,679,952	$ 7,214,136	$ 7,409,260	$ 7,723,430	$ 7,931,908	$ 39,973,046	$ 30,278,734		WP 3-1, Line 11, Col. H
15		**Total**			**$ 601,266,392**	**$ 549,849,290**	**$ 1,077,026,312**	**$ 1,550,969,948**	**$ 2,592,034,478**	**$ 3,058,316,281**	**$ 3,492,275,366**	**$ 12,921,738,067**	**$ 10,693,596,074**		
16															
17															
18															
19															
20															
21															
22															

Recorded and Forecast Mitigation Costs - Expense (Nominal Dollars)

23															
24															
25	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE	
26	WLDFR-M001 (DOVHD-M018) (F)	Enhanced Vegetation Management (Modified Enhanced Vegatation Management) (F)	9	IGJ	$ 451,390,239	$ 535,951,926	$ 916,600,000	$ 118,022,400	$ 117,555,234	$ 112,176,917	$ 102,234,120	$ 2,353,930,837	$ 449,988,671	14.5	
27	DOVHD-M005	Additional Asset Data Captures	22	AB#	$ -	$ -	$ 1,269,347	$ 1,296,793	$ 1,332,054	$ 1,368,275	$ 1,405,480	$ 6,671,949	$ 5,402,602	Foundational	
28	DOVHD-M009	Improved Distribution Risk Model	22	AB#	$ -	$ -	$ 1,473,144	$ 1,513,279	$ 1,553,723	$ 1,596,349	$ 1,640,160	$ 7,776,655	$ 6,303,511	Foundational	
28	DOVHD-M011	Remote Grid	4.3	AB#	$ -	$ 1,382,468	$ 1,422,646	$ 1,464,187	$ 1,500,792	$ 1,538,312	$ 1,576,769	$ 8,885,174	$ 6,080,060	32.8	
28	DOVHD-M011	Remote Grid	4.3	KAT	$ -	$ -	$ 617,438	$ 953,200	$ 1,845,501	$ 3,004,368	$ 4,334,077	$ 10,754,584	$ 10,137,146		
29	DOVHD-M020	Enhanced Powerline Safety Settings	4.6	Various (G)	$ -	$ 18,203,036	$ 148,921,000	$ 151,128,765	$ 146,302,373	$ 140,825,079	$ 133,710,129	$ 739,090,382	$ 571,966,346	105.7	
30		**Total**			**$ 451,390,239**	**$ 555,537,430**	**$ 1,070,303,575**	**$ 274,378,624**	**$ 270,089,678**	**$ 260,509,300**	**$ 244,900,735**	**$ 3,127,109,581**	**$ 1,049,878,337**		
31															
32		Total Chapter 4.3			$ -	$ 1,382,468	$ 2,040,084	$ 2,417,387	$ 3,346,293	$ 4,542,680	$ 5,910,846	$ 19,639,758	$ 16,217,206		WP 3-1, Line 3, Col. B
33		Total Chapter 4.6			$ -	$ 18,203,036	$ 148,921,000	$ 151,128,765	$ 146,302,373	$ 140,825,079	$ 133,710,129	$ 739,090,382	$ 571,966,346		WP 3-1, Line 5, Col. B
34		Total Chapter 9			$ 451,390,239	$ 535,951,926	$ 916,600,000	$ 118,022,400	$ 117,555,234	$ 112,176,917	$ 102,234,120	$ 2,353,930,837	$ 449,988,671		WP 3-1, Line 7, Col. B
35		Total Chapter 22			$ -	$ -	$ 2,742,491	$ 2,810,072	$ 2,885,777	$ 2,964,624	$ 3,045,640	$ 14,448,604	$ 11,706,113		WP 3-1, Line 16, Col. B
36		**Total**			**$ 451,390,239**	**$ 555,537,430**	**$ 1,070,303,575**	**$ 274,378,624**	**$ 270,089,678**	**$ 260,509,300**	**$ 244,900,735**	**$ 3,127,109,581**	**$ 1,049,878,337**		
37															

38 Notes:
39 (A) Updated to include updated forecast costs and RSEs (February 25, 2022) and errata (November 5, 2021 and February 25, 2022).
40 (B) RSEs for mitigation or controls associated with more than one major work category (MWC) or maintenance activity type (MAT) are listed only once, the first time they appear on this schedule.
41 (C) PG&E calculated two RSEs for System Hardening: System Hardening [Overhead] - the RSE is 5.9; and, System Hardening [Underground] - the RSE is 5.4
42 (D) PG&E calculated two RSEs for 3A and 4C Line Recloser Replacement: 3A and 4C Line Recloser Replacement [3A] - the RSE is 0.7; and, 3A and 4C Line Recloser Replacement [4C] - the RSE is 2.0.
43 (E) PG&E is proposing an alternative mitigation: WLDFR-M017 Remote Grid. To the extent Remote Grid projects are conducted the capital funding will come from MAT 08W.
44 For the purposes of risk modeling PG&E is assigning estimated capital costs for Remote Grid each year from 2020-2026.
45 (F) This mitigation is referred to as WLDFR-M018: Modified Enhanced Vegetation Management in the February 25, 2022 risk modeling workpapers.
46 (G) Expense MATs: BAF, BAH, FZE, GC2, BHE, IG#

Workpaper Table 3-9
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Failure of Electric Distribution Network Assets - Recorded and Forecast Control Costs - Capital and Expense
(Nominal Dollars)

Recorded and Forecast Control Costs - Capital (Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE	Reference
1	DNTWK-C001	Network Cable Replacement	14	56N	$ 21,928,964	$ 25,198,998	$ 25,198,998	$ 24,361,302	$ 25,033,296	$ 25,721,797	$ 26,429,737	$ 173,873,092	$ 101,546,132	0.1	
2	DNTWK-C003	Network Component (Transformer, Protector) Replacements - Condition Based	14	2CA	$ 366,490	$ 299,992	$ 316,418	$ 324,961	$ 333,750	$ 342,756	$ 352,008	$ 2,336,375	$ 1,353,475	(B)	
3	DNTWK-C003	Network Component (Transformer, Protector) Replacements - Condition Based	14	2CC	$ -	$ -	$ 2,854,652	$ 986,582	$ 2,462,213	$ 2,278,898	$ 2,115,263	$ 10,697,608	$ 7,842,956	(B)	
4		**Total**			**$ 22,295,454**	**$ 25,498,990**	**$ 28,370,068**	**$ 25,672,845**	**$ 27,829,259**	**$ 28,343,451**	**$ 28,897,008**	**$ 186,907,075**	**$ 110,742,563**		WP 3-1, Line 30, Col. C
5															
6															
7															
8		**Recorded and Forecast Control Costs - Expense (Nominal Dollars)**													
9															
10	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE	
11	DNTWK-C002	Maintenance and Corrective Work	14	KCA	$ 97,557	$ 199,980	$ 200,272	$ 437,557	$ 449,455	$ 461,676	$ 474,230	$ 2,320,727	$ 1,822,918		
12	DNTWK-C002	Maintenance and Corrective Work	14	KCB	$ 132,958	$ 39,996	$ 40,055	$ 32,817	$ 33,709	$ 34,626	$ 35,567	$ 349,728	$ 136,719		
13	DNTWK-C002	Maintenance and Corrective Work	14	KCC	$ 70,201	$ 99,955	$ 100,100	$ 131,267	$ 134,837	$ 138,503	$ 142,269	$ 817,132	$ 546,876		
14	DNTWK-C002	Maintenance and Corrective Work	14	KCD	$ 2,985,679	$ 2,891,303	$ 2,895,517	$ 2,734,733	$ 2,809,094	$ 2,885,477	$ 2,963,936	$ 20,165,739	$ 11,393,240	4.4(C)	
15	DNTWK-C002	Maintenance and Corrective Work	14	KCE	$ 880,903	$ 704,927	$ 705,955	$ 700,092	$ 841,380	$ 954,746	$ 758,768	$ 5,546,771	$ 3,254,986		
16	DNTWK-C002	Maintenance and Corrective Work	14	KCF	$ 723,406	$ 899,933	$ 901,246	$ 984,504	$ 1,011,274	$ 1,038,772	$ 1,067,017	$ 6,626,152	$ 4,101,567		
17		**Total**			**$ 4,890,705**	**$ 4,836,094**	**$ 4,843,145**	**$ 5,020,970**	**$ 5,279,749**	**$ 5,513,800**	**$ 5,441,787**	**$ 35,826,250**	**$ 21,256,306**		WP 3-1, Line 30, Col. I
18															
19															

20 Notes:
21 (A) Updated to include revised RSEs (November 5, 2021 and February 25, 2022).
22 (B) PG&E calcuated two RSEs for this program: Network Component (Transformer, Protector) Replacements - Condition Based [Protector] - the RSE is 13.2; and, Network Component (Transformer, Protector - Condition Based [Transformer] - the RSE is 1.2.
23 (C) Certain MAT codes that are aligned to this program are considered foundational and are excluded from the RSE calculation.

Workpaper Table 3-10
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Failure of Electric Distribution Network Assets - Recorded and Forecast Mitigation Costs - Capital
(Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE	Reference
1	DNTWK-M001	Network Component Replacements - Targeted Replacement of Oil Filled Transformers in High-Rise Buildings	14	2CC	$ 5,877,976	$ 3,122,145	$ -	$ -	$ -	$ -	$ -	$ 9,000,121	$ -	No 2023-2026 forecast	
2	DNTWK-M002	Venting Manhole Cover Replacements	14	2CD	$ 4,065,348	$ 3,519,601	$ 550,000	$ -	$ -	$ -	$ -	$ 8,134,949	$ -	No 2023-2026 forecast	
3	DNTWK-M003	Network Component Replacements - Targeted Network Protector Replacement	14	2CE	$ 12,074,521	$ 8,926,059	$ 9,110,000	$ 9,337,000	$ 9,571,000	$ 9,810,000	$ 10,055,000	$ 68,883,580	$ 38,773,000	Foundational	
4	DNTWK-M004	Incremental Primary Network Cable Replacements	14	56N	$ -	$ -	$ -	$ 6,510,000	$ 6,673,000	$ 6,840,000	$ 7,011,000	$ 27,034,000	$ 27,034,000	0.1	
5	DNTWK-M005	Network Component Replacements - High-Rise Dry-Type Transformers	14	2CC	$ 347,074	$ -	$ 5,378,163	$ 2,684,233	$ 1,013,266	$ 1,040,606	$ 1,068,696	$ 11,532,038	$ 5,806,801	0.6	
6	DNTWK-M006	Network Component Replacements - Targeted Network Protector Replacement	14	2CC	$ -	$ -	$ 529,895	$ 219,240	$ 225,170	$ 231,246	$ 237,488	$ 1,443,039	$ 913,144	5.2	
7		**Total**			**$ 22,364,919**	**$ 15,567,805**	**$ 15,568,058**	**$ 18,750,473**	**$ 17,482,436**	**$ 17,921,852**	**$ 18,372,184**	**$ 126,027,727**	**$ 72,526,945**		WP 3-1, Line 12, Col. C
8															

9 Notes:

10 (A) Updated to include revised RSEs (November 5, 2021 and February 25, 2022).

Workpaper Table 3-11
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Failure of Electric Distribution Substation Assets - Recorded and Forecast Control Costs - Capital
(Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE	Reference
												$ 20,573,366	$ 15,115,322	(B)	
1	SBSTN-C001	Substation Security Enhancements	15	58S	$ 572,668	$ 3,151,566	$ 1,733,810	$ 4,982,737	$ 5,562,508	$ 4,570,077	$ -				
2	SBSTN-C002	Animal Abatement Substation	15	48X	$ 4,960,889	$ 4,533,184	$ 5,403,529	$ 5,760,222	$ 4,962,690	$ 4,465,842	$ 4,576,101	$ 34,662,457	$ 19,764,855	(B)	
3	SBSTN-C005	Civil Structures Replacement	15	48H	$ (889)	$ -	$ 3,326,000	$ 4,056,000	$ 9,456,264	$ 6,283,856	$ 6,453,476	$ 29,574,707	$ 26,249,596	(B)	
4	SBSTN-C007	Substation Seismic Retrofit	15	58B	$ 197,643	$ 1,125,993	$ -	$ -	$ 3,982,323	$ 10,030,448	$ 21,045,078	$ 36,381,485	$ 35,057,849	(B)	
5	SBSTN-C009	Fire Protection / Suppression Systems	15	58A	$ 2,583,286	$ 1,681,078	$ 3,877	$ 3,249,611	$ 3,337,505	$ 1,142,519	$ 1,173,359	$ 13,171,235	$ 8,902,994	(B)	
6	SBSTN-C16A	Proactive Asset Replacement - Ground Grid	15	48A	$ 2,472,985	$ 4,397,244	$ 11,509,767	$ 4,219,926	$ 2,879,739	$ 2,856,298	$ 2,933,398	$ 31,269,357	$ 12,889,361	(B)	
7	SBSTN-C16C	Proactive Asset Replacement - Batteries	15	48C	$ 282,048	$ 181,361	$ 3,024,758	$ 3,249,611	$ 3,337,505	$ 3,427,558	$ 3,520,078	$ 17,022,919	$ 13,534,752	(B)	
8	SBSTN-C16D	Proactive Asset Replacement - Circuit Breakers	15	48D	$ 4,513,366	$ 14,290,160	$ 31,255,215	$ 28,564,458	$ 31,987,261	$ 34,461,619	$ 29,333,980	$ 174,406,059	$ 124,347,318	0.7	
9	SBSTN-C16E	Proactive Asset Replacement - Switches	15	48E	$ 2,538,065	$ 945,304	$ 3,457,206	$ 2,166,407	$ 4,450,006	$ 4,570,077	$ 3,520,078	$ 21,647,143	$ 14,706,568	(B)	
10	SBSTN-C16F	Proactive Asset Replacement - Switchgear	15	48F	$ 45,359,745	$ 26,807,570	$ 31,269,372	$ 32,433,238	$ 16,689,797	$ 16,587,670	$ 15,651,896	$ 184,799,288	$ 81,362,601	0.10	
11	SBSTN-C16G	Proactive Asset Replacement - Line Support Work	15	48L	$ 15,821,218	$ 24,930,547	$ 6,026,869	$ 9,104,860	$ 7,891,927	$ 5,712,596	$ 5,866,796	$ 75,354,813	$ 28,576,179	(B)	
12	SBSTN-C16H	Proactive Asset Replacement - Insulators	15	48N	$ 52,916	$ -	$ 527,364	$ 5,416,018	$ 5,562,508	$ 5,712,596	$ 5,866,796	$ 23,138,198	$ 22,557,918	(B)	
13	SBSTN-C16K	Proactive Asset Replacement - Transformer	15	54A	$ 33,035,943	$ 40,879,429	$ 22,077,035	$ 16,013,788	$ 23,990,858	$ 28,471,578	$ 31,328,691	$ 195,797,322	$ 99,804,915	0.1	
14		**Total**			**$ 112,389,883**	**$ 122,923,436**	**$ 119,614,802**	**$ 119,216,876**	**$ 124,090,891**	**$ 128,292,734**	**$ 131,269,727**	**$ 857,798,349**	**$ 502,870,228**		WP 3-1, Line 31, Col. K
15															

16 Notes:
17 (A) Updated to include revised RSEs (November 5, 2021 and February 25, 2022).
18 (B) Failure of Substation Assets is a non-RAMP Risk and is subject to the supplemental Step-3 analysis. This program did not meet the Step-3 threshold requiring an RSE.

Workpaper Table 3-12
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Failure of Electric Distribution Substation Assets - Recorded and Forecast Control Costs - Expense
(Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE (B)	Reference
1	SBSTN-C008	Design Criteria	15	GC1	$ 4,860,271	$ 4,765,208	$ 454,431	$ 514,539	$ 559,180	$ 640,389	$ 815,858	$ 12,609,876	$ 2,529,966	(C)	
2	SBSTN-C017	Proactive Maintenance	15	GC1	$ -	$ -	$ 3,579,115	$ 3,804,522	$ 3,971,924	$ 4,276,459	$ 4,934,468	$ 20,566,488	$ 16,987,373	1.6	
3	SBSTN-C017	Proactive Maintenance	15	GC1	$ 4,860,271	$ 4,765,208	$ -	$ -	$ -	$ -	$ -	$ 9,625,479	$ -	No 2023-2026 forecast	
4	SBSTN-C017	Proactive Maintenance	15	GCA	$ 930,069	$ 1,019,954	$ 1,021,441	$ 1,084,048	$ 1,113,525	$ 1,143,803	$ 1,174,904	$ 7,487,744	$ 4,516,280	3,013.4	
5	SBSTN-C017	Proactive Maintenance	15	GCB	$ 558,913	$ 741,045	$ 742,125	$ 787,603	$ 809,019	$ 831,017	$ 853,614	$ 5,323,336	$ 3,281,253	1,339.7	
6	SBSTN-C017	Proactive Maintenance	15	GCC	$ 2,294,039	$ 1,422,402	$ 1,424,475	$ 1,511,760	$ 1,552,867	$ 1,595,091	$ 1,638,464	$ 11,439,098	$ 6,298,182	346.2	
7	SBSTN-C017	Proactive Maintenance	15	GCD	$ 4,645,189	$ 2,944,623	$ 2,948,915	$ 3,129,629	$ 3,214,727	$ 3,302,139	$ 3,391,929	$ 23,577,151	$ 13,038,424	(C)	
8	SBSTN-C017	Proactive Maintenance	15	GCE	$ 402,989	$ 479,618	$ 480,317	$ 509,754	$ 523,615	$ 537,853	$ 552,478	$ 3,486,624	$ 2,123,700	Foundational	
9	SBSTN-C017	Proactive Maintenance	15	GCF	$ 423,368	$ 470,352	$ 471,038	$ 499,909	$ 513,502	$ 527,465	$ 541,808	$ 3,447,442	$ 2,082,684	2,243.2	
10	SBSTN-C017	Proactive Maintenance	15	GCH	$ 1,656,768	$ 979,816	$ 981,244	$ 1,041,386	$ 1,069,703	$ 1,098,789	$ 1,128,667	$ 7,956,373	$ 4,338,545	(C)	
11	SBSTN-C017	Proactive Maintenance	15	GCI	$ 68,048	$ 94,686	$ 94,824	$ 100,638	$ 103,375	$ 106,186	$ 109,073	$ 676,830	$ 419,272	307	
12	SBSTN-C017	Proactive Maintenance	15	GCM	$ 1,543,787	$ 1,413,136	$ 1,415,196	$ 1,501,915	$ 1,542,754	$ 1,584,704	$ 1,627,794	$ 10,629,286	$ 6,257,167	188.1	
13	SBSTN-C017	Proactive Maintenance	15	GCO	$ 540,612	$ 1,148,605	$ 1,150,279	$ 1,220,785	$ 1,253,979	$ 1,288,077	$ 1,323,101	$ 7,925,438	$ 5,085,942	80.3	
14	SBSTN-C017	Proactive Maintenance	15	GCS	$ 192,971	$ 191,426	$ 191,705	$ 203,464	$ 208,997	$ 214,679	$ 220,517	$ 1,423,759	$ 847,657	96	
15	SBSTN-C017	Proactive Maintenance	15	GCV	$ 72,350	$ 18,521	$ 18,548	$ 19,690	$ 20,225	$ 20,775	$ 21,340	$ 191,449	$ 82,030	114.9	
16	SBSTN-C017	Proactive Maintenance	15	GCW	$ 371,478	$ 411,690	$ 412,290	$ 437,557	$ 449,455	$ 461,676	$ 474,230	$ 3,018,376	$ 1,822,918	541.1	
17	SBSTN-C021	Vegetation Management	15	GCG	$ 5,737,006	$ 7,803,377	$ 6,548,018	$ 8,559,715	$ 9,519,457	$ 6,301,881	$ 7,531,955	$ 52,001,409	$ 31,913,008	(C)	
18		**Total**			**$ 29,158,130**	**$ 28,669,667**	**$ 21,933,961**	**$ 24,926,914**	**$ 26,426,304**	**$ 23,930,983**	**$ 26,340,200**	**$ 181,386,159**	**$ 101,624,401**		WP 3-1, Line 31, Col. E
19															

20 Notes:
21 (A) Updated to include revised RSEs (November 5, 2021 and February 25, 2022).
22 (B) RSEs for mitigation or controls associated with more than one major work category (MWC) or maintenance activity type (MAT) are listed only once, the first time they appear on this schedule.
23 (C) Failure of Substation Assets is a non-RAMP Risk and is subject to the supplemental Step-3 analysis. This program did not meet the Step-3 threshold requiring an RSE.

Workpaper Table 3-13
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Failure of Electric Distribution Substation Assets - Recorded and Forecast Mitigation Costs - Capital
(Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE	Reference
1	SBSTN-M001	Transformer Life Extension	15	54L	$ -	$ -	$ 3,164,184	$ 3,249,611	$ 3,337,505	$ 3,427,558	$ 3,520,078	$ 16,698,936	$ 13,534,752	0.8	
2	SBSTN-M002	Increase Capitalized Emergency Material (CEM) Stock for Transformers, Breakers, Regulators, Emergency Mobile Breakers and Transformers.	15	54A	$ -	$ -	$ 2,728,622	$ 1,979,232	$ 2,965,162	$ 3,518,959	$ 3,872,085	$ 15,064,060	$ 12,335,438	0.1	
3	SBSTN-M006	Minimize Wood in Substations	15	48H	$ 192,074	$ 514,499	$ 787,440	$ 1,360,018	$ -	$ -	$ -	$ 2,854,031	$ 1,360,018	0	
4	SBSTN-M006	Minimize Wood in Substations	15	48H	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
5		**Total**			**$ 192,074**	**$ 514,499**	**$ 6,680,246**	**$ 6,588,861**	**$ 6,302,667**	**$ 6,946,517**	**$ 7,392,163**	**$ 34,617,027**	**$ 27,230,208**		WP 3-1, Line 13, Col. K
6															
7	Notes:														
8	(A) Updated to include revised RSEs (November 5, 2021 and February 25, 2022).														

Workpaper Table 3-14
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Failure of Electric Distribution Underground Assets - Recorded and Forecast Control Costs - Expense
(Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE	Reference
1	DUNGD-C001	Patrols	10	BF3	$ -	$ 45,283	$ 45,349	$ 53,820	$ 52,109	$ 52,570	$ 54,263	$ 303,394	$ 212,762	(B)	
2	DUNGD-C001	Patrols	10	BF4	$ 85,435	$ 111,468	$ 111,631	$ 133,428	$ 129,186	$ 130,329	$ 134,526	$ 836,003	$ 527,469	(B)	
3	DUNGD-C001	Patrols	10	BFD	$ 2,226,225	$ 2,268,243	$ 2,430,208	$ 2,454,510	$ 2,479,055	$ 2,503,846	$ 2,528,884	$ 16,890,973	$ 9,966,296	1.0	
4	DUNGD-C001	Patrols	10	BFE	$ 11,345,172	$ 12,730,991	$ 13,051,003	$ 13,318,664	$ 12,792,670	$ 12,903,020	$ 13,374,113	$ 89,515,631	$ 52,388,466	1.9	
5	DUNGD-C002	Underground Notifications	11	KBA	$ 11,877,519	$ 14,596,475	$ 14,617,751	$ 15,966,985	$ 16,401,147	$ 16,847,114	$ 17,305,208	$ 107,612,199	$ 66,520,454	16.5	
6	DUNGD-C003	Equipment Maintenance and Replacement	11	KBC	$ 929,321	$ 1,356,449	$ 1,358,426	$ 1,441,713	$ 1,480,915	$ 1,521,183	$ 1,562,546	$ 9,650,553	$ 6,006,357	(B)	
7	DUNGD-C003	Equipment Maintenance and Replacement	11	KBD	$ -	$ -	$ 22,108	$ 23,464	$ 24,102	$ 24,757	$ 25,431	$ 119,862	$ 97,754	(B)	
8	DUNGD-C003	Equipment Maintenance and Replacement	11	KBE	$ 9,567	$ 61,752	$ 61,842	$ 65,634	$ 67,418	$ 69,251	$ 71,134	$ 406,598	$ 273,437	(B)	
9	DUNGD-C004	Planned Major Projects	11	KBP	$ 42,521	$ 672,032	$ 673,012	$ 735,131	$ 755,120	$ 775,652	$ 796,743	$ 4,450,211	$ 3,062,646	(B)	
10		**Total**			**$ 26,515,759**	**$ 31,842,693**	**$ 32,371,330**	**$ 34,193,349**	**$ 34,181,722**	**$ 34,827,722**	**$ 35,852,848**	**$ 229,785,422**	**$ 139,055,641**		
11															
12		Total Chapter 10			$ 13,656,831	$ 15,155,985	$ 15,638,191	$ 15,960,422	$ 15,453,020	$ 15,589,765	$ 16,091,786	$ 107,546,000	$ 63,094,993		WP 3-1, Line 26, Col. D
13		Total Chapter 11			$ 12,858,927	$ 16,686,708	$ 16,733,139	$ 18,232,927	$ 18,728,702	$ 19,237,957	$ 19,761,062	$ 122,239,422	$ 75,960,648		WP 3-1, Line 27, Col. D
14		**Total**			**$ 26,515,759**	**$ 31,842,693**	**$ 32,371,330**	**$ 34,193,349**	**$ 34,181,722**	**$ 34,827,722**	**$ 35,852,848**	**$ 229,785,422**	**$ 139,055,641**		
15															

16 Notes:
17 (A) Updated to include revised RSEs (November 5, 2021 and February 25, 2022).
18 (B) Certain MAT codes that are aligned to this program are considered foundational and are excluded from the RSE calculation.

Workpaper Table 3-15
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Failure of Electric Distribution Underground Assets - Recorded and Forecast Control Costs - Capital
(Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE	Reference
1	DUNGD-C003	Equipment Maintenance and Replacement	11	2BA	$ 37,863,824	$ 46,680,438	$ 46,391,326	$ 47,806,625	$ 49,171,337	$ 53,333,297	$ 54,772,922	$ 336,019,769	$ 205,084,181	0.8	
2	DUNGD-C003	Equipment Maintenance and Replacement	11	2BB	$ 646,369	$ 796,328	$ 791,355	$ 862,534	$ 885,822	$ 909,740	$ 934,303	$ 5,826,451	$ 3,592,399	(B)	
3	DUNGD-C003	Equipment Maintenance and Replacement	11	2BD	$ 7,579,265	$ 6,572,827	$ 6,354,201	$ 6,925,788	$ 7,113,114	$ 7,305,040	$ 7,502,225	$ 49,352,460	$ 28,846,167	(B)	
4	DUNGD-C003	Equipment Maintenance and Replacement	13	56C	$ 21,040,939	$ 34,260,002	$ 33,030,294	$ 36,001,507	$ 36,625,348	$ 37,257,623	$ 37,901,215	$ 236,116,928	$ 147,785,693	(B)	
5	DUNGD-C004	Planned Major Projects	11	2BP	$ 2,026,219	$ 3,263,130	$ 7,308,658	$ 8,107,704	$ 8,259,489	$ 8,703,187	$ 8,929,898	$ 46,598,285	$ 34,000,278	(C)	
6	DUNGD-C005	UG Idle Facility Removal	11	2BF	$ 175,804	$ 26,964	$ 27,665	$ 28,412	$ 29,179	$ 29,967	$ 30,776	$ 348,767	$ 118,334	(C)	
7	DUNGD-C007	LBOR Switch Replacement	13	56S	$ 5,414,767	$ 9,251,961	$ 9,492,552	$ 8,124,177	$ 8,343,762	$ 8,568,894	$ 8,800,194	$ 57,996,307	$ 33,837,027	(C)	
8	DUNGD-C008	UG Transformers Temperature Sensor	13	56T	$ 8,162,492	$ 9,588,815	$ 3,302,843	$ 9,098,910	$ 9,345,013	$ 9,597,161	$ 9,856,217	$ 58,951,451	$ 37,897,301	(C)	
9	DUNGD-C06A	Primary Cable Replacement Program	13	56A	$ 17,161,260	$ 38,013,001	$ 39,556,399	$ 36,975,537	$ 37,616,254	$ 38,265,635	$ 38,926,641	$ 246,514,727	$ 151,784,067	0.10	
10	DUNGD-C06B	Primary Cable Rejuvenation Program	13	56B	$ 2,113,909	$ -	$ -	$ 1,116,588	$ 1,135,937	$ 1,155,547	$ 1,175,508	$ 6,697,489	$ 4,583,580	(C)	
11		**Total**			**$ 102,184,847**	**$ 148,453,466**	**$ 146,255,293**	**$ 155,047,782**	**$ 158,525,255**	**$ 165,126,091**	**$ 168,829,899**	**$ 1,044,422,633**	**$ 647,529,027**		
12															
13		Total Chapter 11			$ 48,291,481	$ 57,339,687	$ 60,873,205	$ 63,731,063	$ 65,458,941	$ 70,281,231	$ 72,170,124	$ 438,145,732	$ 271,641,359		WP 3-1, Line 27, Col. J
14		Total Chapter 13			$ 53,893,367	$ 91,113,779	$ 85,382,088	$ 91,316,719	$ 93,066,314	$ 94,844,860	$ 96,659,775	$ 606,276,902	$ 375,887,668		WP 3-1, Line 29, Col. J
15		**Total**			**$ 102,184,847**	**$ 148,453,466**	**$ 146,255,293**	**$ 155,047,782**	**$ 158,525,255**	**$ 165,126,091**	**$ 168,829,899**	**$ 1,044,422,633**	**$ 647,529,027**		
16															

17 Notes:
18 (A) Updated to include revised RSEs (November 5, 2021 and February 25, 2022).
19 (B) Certain MAT codes that are aligned to this program are considered foundational and are excluded from the RSE calculation.
20 (C) Failure of Underground Assets is a non-RAMP Risk and is subject to the supplemental Step-3 analysis. This program did not meet the Step-3 threshold requiring an RSE.

Workpaper Table 3-16
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Emergency Preparedness and Response - Recorded and Forecast Control Costs - Capital and Expense
(Nominal Dollars)

Recorded and Forecast Control Costs - Capital (Nominal Dollars)

Line No.	GRC RISK ID (B)	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	Reference
1	EPNDR-C002	Situational Awareness and Forecasting Initiatives - WSOC	5	21A	$ -	$ -	$ -	$ 108,471	$ 188,458	$ 190,821	$ 196,197	$ 683,947	$ 683,947	
1	EPNDR-C004	EP&R Field Operations Technology	5	21A	$ -	$ -	$ -	$ 3,250,143	$ 3,145,953	$ 3,173,017	$ 3,269,277	$ 12,838,390	$ 12,838,390	
2		**Total**			**$ -**	**$ -**	**$ -**	**$ 3,358,614**	**$ 3,334,411**	**$ 3,363,838**	**$ 3,465,474**	**$ 13,522,337**	**$ 13,522,337**	WP 3-1, Line 24, Col. L
3														
4														
5		**Recorded and Forecast Control Costs - Expense (Nominal Dollars)**												
6														
7	GRC RISK ID (B)	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	
8	EPNDR-C000	EP&R Controls	5	AB6	$ 4,023,132	$ 2,636,803	$ 2,314,487	$ 5,104,404	$ 5,266,573	$ 5,413,973	$ 5,565,500	$ 30,324,872	$ 21,350,450	
9	EPNDR-C001	Situational Awareness and Forecasting Initiatives - SOPP Improvements	5	AB6	$ -	$ -	$ -	$ 2,086,712	$ 2,149,519	$ 2,207,967	$ 2,268,004	$ 8,712,202	$ 8,712,202	
10	EPNDR-C002	Situational Awareness and Forecasting Initiatives - WSOC	5	AB6	$ -	$ -	$ -	$ 7,384,560	$ 7,606,825	$ 7,813,664	$ 8,026,127	$ 30,831,176	$ 30,831,176	
11	EPNDR-C005	EP&R Field Operations (Includes Tech, Training and Other Misc.)	5	AB6	$ -	$ -	$ -	$ 600,402	$ 618,472	$ 634,912	$ 652,428	$ 2,506,214	$ 2,506,214	
12	EPNDR-C006	EP&R Distribution Support Headcount	5	AB6	$ -	$ -	$ -	$ 7,098,928	$ 7,312,596	$ 7,511,435	$ 7,715,680	$ 29,638,639	$ 29,638,639	WP 3-1, Line 24, Col. F
13		**Total**			**$ 4,023,132**	**$ 2,636,803**	**$ 2,314,487**	**$ 22,275,005**	**$ 22,953,985**	**$ 23,581,951**	**$ 24,227,739**	**$ 102,013,103**	**$ 93,038,680**	
14														
15														

16 Notes:
17 (A) Updated to include revised RSEs (November 5, 2021 and February 25, 2022).
18 (B) EPNDR-C003 is All Hazard – EP&R Field Ops Tech Expense. There is no separate cost forecast for this work.

Workpaper Table 3-17
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management (A)
Emergency Preparedness and Response - Recorded and Forecast Mitigation Costs - Capital and Expense
(Nominal Dollars)

Recorded and Forecast Mitigation Costs - Capital (Nominal Dollars)

Line No.	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE	Reference
1	EPNDR-M000	EP&R Mitigations	5	21A	$ 517,871	$ 2,046,001	$ 1,966,251	$ 2,143,316	$ 2,075,033	$ 2,093,032	$ 2,160,165	$ 13,001,669	$ 8,471,546	(B)	
2		**Total**			**$ 517,871**	**$ 2,046,001**	**$ 1,966,251**	**$ 2,143,316**	**$ 2,075,033**	**$ 2,093,032**	**$ 2,160,165**	**$ 13,001,669**	**$ 8,471,546**		WP 3-1, Line 6, Col. L
3															
4															
5															
6															
7															
8															

Recorded and Forecast Mitigation Costs - Expense (Nominal Dollars)

	GRC RISK ID	GRC Program Name	Chapter	MAT	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	Total (2023-2026)	RSE	
9	EPNDR-M000	EP&R Mitigations	5	AB#	$ 522	$ -	$ -	$ -	$ -	$ -	$ -	$ 522	$ -		
10	EPNDR-M000	EP&R Mitigations	5	AB6	$ 2,905,770	$ 976,457	$ 1,893,671	$ 4,176,329	$ 4,309,014	$ 4,429,615	$ 4,553,591	$ 23,244,447	$ 17,468,549	(B)	
11		**Total**			**$ 2,906,292**	**$ 976,457**	**$ 1,893,671**	**$ 4,176,329**	**$ 4,309,014**	**$ 4,429,615**	**$ 4,553,591**	**$ 23,244,969**	**$ 17,468,549**		WP 3-1, Line 6, Col. F
12															

13 Notes:
14 (A) Updated to include revised RSEs (November 5, 2021 and February 25, 2022).
15 (B) PG&E calculated two RSEs for this mitigation: EOC Enhancements - the RSE is 307.8; and, Mutual Aid Enhancements - the RSE is 21,343.9

Workpaper Table 3-18
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management
Estimated Costs from PG&E's 2020 RAMP Report Compared to GRC Forecast Costs (2020-2026) - Wildfire
(Thousands of Nominal Dollars)

Line No.	MAT RAMP	MAT GRC	2020 RAMP Mitigation Name	2020 RAMP RISK ID	2020 RAMP Ch.	2023 GRC Mitigation Name	2023 GRC RISK ID	2023 GRC Exh. 4, Ch.	As Presented in RAMP Filing 2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	2023 GRC (Updated February 25, 2022 Forecast) 2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	RAMP 2020-2026	GRC 2020-2026	Difference (GRC - RAMP)
1	IG#	IGJ	Enhanced Vegetation Management	M1	10	Enhanced Vegetation Management	WLDFR-M001	9	$ 494,627	$ 506,993	$ 519,668	$ 532,660	$ 545,976	$ 559,625	$ 573,616	$ 3,733,166	$ 451,390	$ 535,952	$ 916,600	$ 118,022	$ 117,555	$ 112,177	$ 102,234	$ 2,353,931	$ 3,733,166	$ 2,353,931	$ (1,379,235)
2	08W	08W	System Hardening	M2	10	System Hardening	WLDFR-M002	4.3	$ 366,725	$ 565,640	$ 698,360	$ 796,320	$ 850,040	$ 868,052	$ 886,390	$ 5,031,527	$ 484,915	$ 375,440	$ 977,250	$ 1,457,955	$ 2,497,364	$ 2,991,543	$ 3,423,762	$ 12,208,229	$ 5,031,527	$ 12,208,229	$ 7,176,702
3					10	System Hardening - Butte	WLDFR-M002	23								$ -	$ -	$ 40,214	$ 52,875	$ 54,072	$ 43,982	$ 27,107	$ -	$ 218,250	$ -	$ 218,250	$ 218,250
4	Subtotal System Hardening								$ 366,725	$ 565,640	$ 698,360	$ 796,320	$ 850,040	$ 868,052	$ 886,390	$ 5,031,527	$ 484,915	$ 415,654	$ 1,030,125	$ 1,512,026	$ 2,541,346	$ 3,018,650	$ 3,423,762	$ 12,426,478	$ 5,031,527	$ 12,426,478	$ 7,394,952
5	2AR	2AR	Non-Exempt Surge Arrester Replacement	M3	10	Non-Exempt Surge Arrester Replacement	WLDFR-M003	11	$ 62,448	$ 53,290	$ -	$ -	$ -	$ -	$ -	$ 115,738	$ 63,497	$ 88,859	$ 16,804	$ -	$ -	$ -	$ -	$ 169,160	$ 115,738	$ 169,160	$ 53,422
6	2AP	2AP	Expulsion Fuse Replacement	M4	10	Expulsion Fuse Replacement	WLDFR-M004	4.3	$ 5,423	$ 5,559	$ 5,698	$ 5,840	$ 6,136	$ 6,289	$ 6,446	$ 41,391	$ 7,847	$ 15,125	$ 15,388	$ 15,752	$ 16,257	$ 16,777	$ 17,314	$ 104,460	$ 41,391	$ 104,460	$ 63,070
7	AB#	AB#	Public Safety Power Shutoff	M5	10	Public Safety Power Shutoff	WLDFR-M005	4.2	$ 15,596	$ 15,986	$ 16,385	$ 16,795	$ 17,215	$ 17,645	$ 18,086	$ 117,708									$ 117,708	$ -	$ (117,708)
8	IG#	AB6	Public Safety Power Shutoff	M5	10	PSPS Event (Distribution)	WLDFR-M005	4.2	$ 155,104	$ 158,981	$ 162,956	$ 167,030	$ 171,205	$ 175,486	$ 179,873	$ 1,170,634	$ 80,706	$ 82,741	$ 70,782	$ 72,998	$ 74,983	$ 77,022	$ 79,116	$ 538,348	$ 1,170,634	$ 538,348	$ (632,286)
9	Subtotal PSPS Event								$ 170,699	$ 174,967	$ 179,341	$ 183,825	$ 188,420	$ 193,131	$ 197,959	$ 1,288,342	$ 80,706	$ 82,741	$ 70,782	$ 72,998	$ 74,983	$ 77,022	$ 79,116	$ 538,348	$ 1,288,342	$ 538,348	$ (749,994)
10	IG#		PSPS Program and Reduction Initiatives - Expense (A)	M6	10				$ 225,785	$ 211,198	$ 207,502	$ 185,576	$ 141,277	$ 97,011	$ 98,378	$ 1,166,727									$ 1,166,727	$ -	$ (1,166,727)
11		AB6				EP&R Field Operations	WLDFR-M006	4.2									$ 3,691	$ 9,974	$ -	$ -	$ -	$ -	$ -	$ 13,665	$ -	$ 13,665	$ 13,665
12		AB6				EP&R Field Ops Tech	WLDFR-M006	4.2									$ 18	$ 103	$ 106	$ -	$ -	$ -	$ -	$ 227	$ -	$ 227	$ 227
13		IG#				Generation Enablement and Deployment PMO	WLDFR-M006	4.3									$ 3,494	$ 3,031	$ -	$ -	$ -	$ -	$ -	$ 6,525	$ -	$ 6,525	$ 6,525
14		AB#				Generation Enablement and Deployment PMO	WLDFR-M006	4.3									$ -	$ -	$ 2,063	$ 1,957	$ 2,197	$ 2,269	$ 2,342	$ 10,828	$ -	$ 10,828	$ 10,828
15		AB6				PSPS - EP&R Field Ops Tech Expense	WLDFR-M006	4.2									$ 92	$ 206	$ 212	$ -	$ -	$ -	$ -	$ 510	$ -	$ 227	$ 227
16		AB6				PSPS Collateral/Segment Creations Exp	WLDFR-M006	4.2									$ 249	$ 103	$ 106	$ 109	$ 112	$ 115	$ 119	$ 914	$ -	$ 914	$ 914
17		AB6				PSPS EP&R Field Ops Misc.	WLDFR-M006	4.2									$ 108	$ 257	$ 265	$ -	$ -	$ -	$ -	$ 630	$ -	$ 630	$ 630
18		AB6				PSPS Field Exercise Dist. Exp	WLDFR-M006	4.2									$ 1,073	$ 2,470	$ 2,546	$ 2,625	$ 2,697	$ 2,770	$ 2,845	$ 17,026	$ -	$ 17,026	$ 17,026
19		AB6				PSPS Increased Helicopter EU (Dist)	WLDFR-M006	4.2									$ 28,668	$ 7,976	$ 14,944	$ 15,411	$ 15,830	$ 16,261	$ 16,703	$ 115,794	$ -	$ 115,794	$ 115,794
20		AB6				PSPS PMO	WLDFR-M006	4.2									$ 2,180	$ 5,533	$ 4,502	$ 4,643	$ 4,769	$ 4,899	$ 5,032	$ 31,557	$ -	$ 31,557	$ 31,557
21		AB6				PSPS PMO Projects	WLDFR-M006	4.2									$ 6,898	$ 1,544	$ 1,591	$ 1,641	$ 1,685	$ 1,731	$ 1,778	$ 16,869	$ -	$ 16,869	$ 16,869
22		AB6				PSPS Pre-flights Expense	WLDFR-M006	4.2									$ 1,775	$ 1,081	$ 1,114	$ 1,149	$ 1,180	$ 1,212	$ 1,245	$ 8,755	$ -	$ 8,755	$ 8,755
23		AB6				Wildfire Public Engagement Team	WLDFR-M006	4.2									$ 298	$ 1,158	$ 957	$ 987	$ 1,013	$ 1,041	$ 1,069	$ 6,523	$ -	$ 6,523	$ 6,523
24		AB6				EP&R Field Operations (Includes Tech, Training and Other Misc.)	WLDFR-M006	4.2									$ -	$ -	$ 6,903	$ -	$ -	$ -	$ -	$ 6,903	$ -	$ 6,903	$ 6,903
25		AB6				CRC Preparedness Program	WLDFR-M006	4.2									$ 15,423	$ 14,774	$ 15,226	$ 15,703	$ 16,130	$ 16,568	$ 17,019	$ 110,843	$ -	$ 110,843	$ 110,843
26	Subtotal PSPS Program and Reduction Initiatives - Expense								$ 225,785	$ 211,198	$ 207,502	$ 185,576	$ 141,277	$ 97,011	$ 98,378	$ 1,166,727	$ 63,967	$ 48,210	$ 50,534	$ 44,225	$ 45,614	$ 46,866	$ 48,152	$ 347,570	$ 1,166,727	$ 347,570	$ (819,158)
28	21#, 49H, 49M		PSPS Program and Reduction Initiatives - Capital (A)	M6	10				$ 120,572	$ 140,495	$ 121,456	$ 74,280	$ 74,716	$ 74,943	$ 75,174	$ 681,636									$ 681,636	$ -	$ (681,636)
29		21A	PSPS Reduction Initiatives	M6	10	PSPS Field Ops Tech. Capital	WLDFR-M006	4.2									$ -	$ 1,028	$ 994	$ -	$ -	$ -	$ -	$ 2,022	$ -	$ 2,022	$ 2,022
30		21A		M6		PSPS Capital Equipment	WLDFR-M006	4.2									$ 1,376	$ 2,056	$ 1,987	$ -	$ -	$ -	$ -	$ 5,419	$ -	$ 5,419	$ 5,419
31		21A		M6		CRC Preparedness Program	WLDFR-M006	4.2									$ 1,021	$ -	$ 255	$ 262	$ 269	$ 277	$ 284	$ 2,368	$ -	$ 2,368	$ 2,368
32		49H	PSPS Reduction Initiatives	M6	10	PSPS Reduction Initiatives - Sectionalizer Device Install/Replace	WLDFR-M006	4.3									$ 69,441	$ 42,890	$ 20,919	$ 11,933	$ 12,255	$ 12,586	$ 12,926	$ 182,950	$ -	$ 182,950	$ 182,950
33		49M	PSPS Reduction Initiatives	M6	10	PSPS Reduction Initiatives - Temporary Distribution Microgrids	WLDFR-M006	4.3									$ 3,746	$ 16,448	$ 13,558	$ -	$ -	$ -	$ -	$ 33,752	$ -	$ 33,752	$ 33,752
34	Subtotal PSPS Program and Reduction Initiatives - Capital								$ 120,572	$ 140,495	$ 121,456	$ 74,280	$ 74,716	$ 74,943	$ 75,174	$ 681,636	$ 75,584	$ 62,422	$ 37,713	$ 12,195	$ 12,524	$ 12,863	$ 13,210	$ 226,511	$ 681,636	$ 226,511	$ (455,125)
35	IG#		Situational Awareness and Forecasting Initiatives - Expense	M7	10	Situational Awareness and Forecasting Initiatives			$ 30,229	$ 32,379	$ 31,214	$ 30,884	$ 31,656	$ 32,447	$ 33,258	$ 222,068									$ 222,068	$ -	
36		FZA				SA&FI - Line Sensors	WLDFR-M07A	4.3									$ 1,487	$ 2,344	$ 2,576	$ 3,437	$ 4,206	$ 4,443	$ 4,694	$ 23,187	$ -	$ 23,187	$ 23,187
37		HG#				SA&FI - Line Sensors	WLDFR-M07A	4.3									$ 10	$ -	$ -	$ -	$ -	$ -	$ -	$ 10	$ -	$ 10	$ 10
38		AB6				SA&FI - Weather Stations	WLDFR-M07B	4.1									$ 111	$ 1,572	$ 1,641	$ 1,764	$ 1,890	$ 1,970	$ 2,110	$ 11,058	$ -	$ 11,058	$ 11,058
39		AB6				SA&FI - Wildfire Command Center (WSOC)	WLDFR-M07C	4.1									$ 4,348	$ 9,139	$ 7,181	$ -	$ -	$ -	$ -	$ 20,668	$ -	$ 20,668	$ 20,668
40		AB6				SA&FI - Cameras	WLDFR-M07D	4.1									$ 6,956	$ 9,385	$ 11,532	$ 8,234	$ 8,826	$ 9,460	$ 10,137	$ 64,530	$ -	$ 64,530	$ 64,530
41		AB6				SA&FI - Satellite Fire Detection	WLDFR-M07E	4.1									$ -	$ 341	$ 351	$ 362	$ 372	$ 382	$ 392	$ 2,199	$ -	$ 2,199	$ 2,199
42		AB6				SA&FI - Sensor IQ	WLDFR-M07F	4.3									$ 1,871	145	$ -	$ 3,783	$ 3,886	$ 3,991	$ 4,100	$ 17,775	$ -	$ 17,775	$ 17,775
43		AB6				SA&FI - Partial Voltage Detection	WLDFR-M07G	4.1									$ 4	$ -	$ 85	$ 233	$ 239	$ 246	$ 252	$ 1,059	$ -	$ 1,059	$ 1,059
44		AB6				SA&FI - SOPP Improvements	WLDFR-M07H	4.1									$ 1,627	$ 1,969	$ 2,029	$ -	$ -	$ -	$ -	$ 5,625	$ -	$ 5,625	$ 5,625
45		AB6				SA&FI - Advanced Fire Modeling	WLDFR-M07I	4.1									$ 5,541	$ 5,969	$ 6,152	$ 6,345	$ 6,517	$ 6,694	$ 6,876	$ 44,095	$ -	$ 44,095	$ 44,095
46		AB6				SA&FI - Meteorology	WLDFR-M07J	4.1									$ -	$ 515	$ 531	$ 438	$ 450	$ 462	$ 475	$ 2,871	$ -	$ 2,871	$ 2,871
47		AB6				SA&FI - Fire Potential Index	WLDFR-M07K	4.1									$ 93	$ 154	$ 159	$ 174	$ 184	$ 194	$ 205	$ 1,163	$ -	$ 1,163	$ 1,163
48	Subtotal SA&FI - Expense								$ 30,229	$ 32,379	$ 31,214	$ 30,884	$ 31,656	$ 32,447	$ 33,258	$ 222,068	$ 22,048	$ 31,533	$ 32,236	$ 24,769	$ 26,569	$ 27,843	$ 29,241	$ 194,239	$ 222,068	$ 194,239	$ 194,239
50	21A, 49I	21A	Situational Awareness and Forecasting Initiatives - Capital	M7	10	Situational Awareness and Forecasting Initiatives			$ 13,163	$ 12,371	$ 7,433	$ 7,619	$ 7,810	$ 8,005	$ 8,205	$ 64,605									$ 64,605	$ -	
51		49I				SA&FI - Line Sensors	WLDFR-M07A	4.3									$ 2,272	$ 12,369	$ 8,037	$ 8,254	$ 6,474	$ 5,964	$ 6,125	$ 49,495	$ -	$ 49,495	$ 49,495
52		21A				SA&FI - Weather Stations	WLDFR-M07B	4.1									$ 8,315	$ 6,399	$ 6,377	$ 3,270	$ 1,122	$ 1,155	$ 1,189	$ 27,827	$ -	$ 27,827	$ 27,827
53		21A				SA&FI - Wildfire Command Center (WSOC)	WLDFR-M07C	4.1									$ (34)	$ 1,542	$ 129	$ -	$ -	$ -	$ -	$ 1,637	$ -	$ 1,637	$ 1,637
54		21A				SA&FI - Sensor IQ	WLDFR-M07F	4.3									$ -	$ -	$ -	$ 10,507	$ -	$ -	$ -	$ 10,507	$ -	$ 10,507	$ 10,507
55		21A				SA&FI - Partial Voltage Detection	WLDFR-M07G	4.1									$ 1,216	$ 331	$ 627		$ -	$ -	$ -	$ 2,174	$ -	$ 2,174	$ 2,174
56		21A				SA&FI - Advance Fire Modeling	WLDFR-M07I	4.1									$ 899		$ -	$ -	$ -	$ -	$ -	$ 899	$ -	$ 899	$ 899
57		21A				SA&FI - Meteorology	WLDFR-M07J	4.1									$ -	$ 1,028	$ 1,055	$ 1,083	$ 1,890	$ 1,905	$ 1,967	$ 8,928	$ -	$ 8,928	$ 8,928
58		49I				SA&FI - EFD	WLDFR-M011	4.3									$ -	$ -	$ 4,647	$ 5,434	$ 6,234	$ 7,486	$ 8,786	$ 32,588	$ -	$ 32,588	$ 32,588
59		49I				SA&FI - DFA	WLDFR-M012	4.3									$ -	$ -	$ 10,351	$ 8,965	$ 9,002	$ 9,245	$ 9,495	$ 47,058	$ -	$ 47,058	$ 47,058
60	Subtotal SA&FI - Capital								$ 13,163	$ 12,371	$ 7,433	$ 7,619	$ 7,810	$ 8,005	$ 8,205	$ 64,605	$ 12,668	$ 21,669	$ 31,223	$ 37,514	$ 24,722	$ 25,755	$ 27,562	$ 181,112	$ 64,605	$ 181,112	$ 116,507

Workpaper Table 3-18
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management
Estimated Costs from PG&E's 2020 RAMP Report Compared to GRC Forecast Costs (2020-2026) - Wildfire
(Thousands of Nominal Dollars)

Line No.	MAT RAMP	MAT GRC	2020 RAMP Mitigation Name	2020 RAMP RISK ID	2020 RAMP Ch.	2023 GRC Mitigation Name	2023 GRC RISK ID	2023 GRC Exh. 4, Ch.	As Presented in RAMP Filing 2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	2023 GRC (Updated February 25, 2022 Forecast) 2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	RAMP 2020-2026	GRC 2020-2026	Difference (GRC - RAMP)
61	IG#	AB6	Safety and Infrastructure Protection Teams	M8	10	Safety and Infrastructure Protection Teams	WLDFR-M008	4.1	$ 23,668	$ 37,057	$ 41,286	$ 42,318	$ 43,376	$ 44,460	$ 45,572	$ 277,736	$ 15,342	$ 30,304	$ 24,899	$ 25,867	$ 26,739	$ 27,293	$ 28,035	$ 178,479	$ 277,736	$ 178,479	$ (99,257)
62	21A	21A	Safety and Infrastructure Protection Teams	M8	10	SIPT - Capital Equipment	WLDFR-M008	4.1	$ 676	$ 1,152	$ -	$ -	$ -	$ -	$ -	$ 1,828	$ 1,254	$ 152	$ 1,187	$ 248	$ 278	$ 281	$ 290	$ 3,690	$ 1,828	$ 3,690	$ 1,862
63	IG#	AB6	Community Wildfire Safety Program Project Management Office	M9	10	Community Wildfire Safety Program Project Management Office	WLDFR-M009	4.4								$ -	$ 17,724	$ 15,438	$ 14,994	$ 13,460	$ 15,887	$ 16,027	$ 16,543	$ 110,073	$ -	$ 110,073	$ 110,073
64	IG#	IG#	Community Wildfire Safety Program Project Management Office	M9	10	Community Wildfire Safety Program Project Management Office	WLDFR-M009	4.4	$ 18,529	$ 19,071	$ 19,625	$ 20,116	$ 20,619	$ 21,134	$ 21,663	$ 140,758	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 140,758	$ -	$ (140,758)
65	Subtotal - CWSP PMO								$ 18,529	$ 19,071	$ 19,625	$ 20,116	$ 20,619	$ 21,134	$ 21,663	$ 140,758	$ 17,724	$ 15,438	$ 14,994	$ 13,460	$ 15,887	$ 16,027	$ 16,543	$ 110,073	$ 140,758	$ 110,073	$ (30,684)
66	AT, IG		Additional System Automation and Protection - Expense	M10	10	Additional System Automation and Protection	WLDFR-M10A	4.3	$ 5,150	$ 130	$ 134	$ 137	$ 141	$ 144	$ 148	$ 5,984								$ -	$ 5,984	$ -	$ (5,984)
67																											
68	09A, 49T	49A	Additional System Automation and Protection - Capital	M10	10	Additional System Automation and Protection	WLDFR-M10A	4.3	$ 10,753	$ 17,443	$ 17,772	$ 18,216	$ 18,778	$ 19,247	$ 19,728	$ 121,938	$ 1,456	$ 6,990	$ -	$ -	$ -	$ -	$ -	$ 8,446	$ 121,938	$ 8,446	$ (113,492)
69		49T			10	Additional System Automation and Protection - FuseSavers	WLDFR-M10B	4.3								$ -	$ -	$ 2,305	$ 2,764	$ 2,940	$ 3,087	$ 3,241	$ 3,403	$ 17,740	$ -	$ 17,740	$ 17,740
70		49R			10	Additional System Automation and Protection - REFCL	WLDFR-M10C	4.3								$ -											
																	$ 4,798	$ 8,224	$ 16,876	$ 17,331	$ 17,800	$ 18,280	$ 18,774	$ 102,083	$ -	$ 102,083	$ 102,083
71	Subtotal Additional Automation and System Protection - Capital								$ 10,753	$ 17,443	$ 17,772	$ 18,216	$ 18,778	$ 19,247	$ 19,728	$ 121,938	$ 4,798	$ 10,529	$ 19,640	$ 20,271	$ 20,887	$ 21,521	$ 22,177	$ 128,269	$ 121,938	$ 128,269	$ 6,331
72	N/A	07C			10	Pole Programs – Replace Tree Attachments	WLDFR-M013	12	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 87	$ -	$ 3,303	$ 3,296	$ 3,500	$ 3,709	$ 3,924	$ 17,819	$ -	$ 17,819	$ 17,819
73	N/A	95F			10	Butte County Rebuild	WLDFR-M014	23	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 88,450	$ 71,511	$ 44,087	$ -	$ 204,048	$ -	$ 204,048	$ 204,048
74	49M	(B)	Remote Grid - Capital	M11	10				$ 4,749							$ 4,749								$ -	$ 4,749	$ -	$ (4,749)
75																											
76	N/A	AB#			10	System Hardening - Remote Grid (B)	WLDFR-M017	4.3									$ 1,010	$ 1,382	$ 1,423	$ 1,464	$ 1,501	$ 1,538	$ 1,577	$ 9,895	$ -	$ 9,895	$ 9,895
77	N/A	KAT			10	System Hardening - Remote Grid (B)	WLDFR-M017	4.3									$ -	$ -	$ 617	$ 953	$ 1,846	$ 3,004	$ 4,334	$ 10,755	$ -	$ 10,755	$ 10,755
78	Subtotal Remote Grid - Expense								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,010	$ 1,382	$ 2,040	$ 2,417	$ 3,346	$ 4,543	$ 5,911	$ 20,650	$ -	$ 20,650	$ 20,650
79	N/A	Various		N/A		Enhanced Powerline Safety Settings	WLDFR-M020	4.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 18,203	$ 148,921	$ 151,129	$ 146,302	$ 140,825	$ 133,710	$ 739,090	$ -	$ 739,090	$ 739,090
80						**TOTAL MITIGATIONS - Expense (C)**			**$ 968,687**	**$ 981,795**	**$ 998,770**	**$ 995,515**	**$ 971,465**	**$ 947,954**	**$ 970,594**	**$ 6,834,781**	**$ 652,187**	**$ 763,763**	**$ 1,261,007**	**$ 452,888**	**$ 456,997**	**$ 452,596**	**$ 442,943**	**$ 4,482,380**	**$ 6,834,781**	**$ 4,482,380**	**$ (2,352,400)**
81						**TOTAL MITIGATIONS - Capital (C)**			**$ 584,509**	**$ 795,950**	**$ 850,719**	**$ 902,276**	**$ 957,479**	**$ 976,536**	**$ 995,944**	**$ 6,063,413**	**$ 650,650**	**$ 614,410**	**$ 1,155,384**	**$ 1,689,752**	**$ 2,691,025**	**$ 3,143,643**	**$ 3,508,238**	**$ 13,453,103**	**$ 6,063,413**	**$ 13,453,103**	**$ 7,389,690**
82																											
83	Notes:																										
84	(A)		In the RAMP PG&E included three PSPS Reduction Initiatives aligned to Electric Transmission MATs (67D, 94A, 94B). Those programs and associated costs are excluded from this analysis.																								
85																											
86																											
	MAT RAMP	MAT GRC	2020 RAMP Mitigation/Control Name	2020 RAMP RISK ID	2020 RAMP Ch.	2023 GRC Mitigation/Control Name	2023 GRC RISK ID	2023 GRC Exh. 4, Ch.	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)											
87	67D	N/A	PSPS Reduction Initiatives	M6	10	[ET - not included in GRC]			$ 1,671	$ 1,713	$ 1,756	$ 1,800	$ 1,891	$ 1,938	$ 1,987	$ 12,757											
88	94A	N/A	PSPS Reduction Initiatives	M6	10	[ET - not included in GRC]			$ 37,458	$ 281	$ 288	$ 295	$ 310	$ 318	$ 326	$ 39,276											
89	Total Electric Transmission PSPS Reduction Initiatives								$ 39,129	$ 1,994	$ 2,044	$ 2,095	$ 2,201	$ 2,256	$ 2,313	$ 52,033											
90																											
91																											
92	(B)		PG&E is forecasting expense amounts related to the Remote Grid pilot projects. The expense amounts cover costs for the Remote Grid team and operations and maintenance.																								
93			For the purposes of risk modeling PG&E is assigning estimated capital costs for remote grid pilot projects for each year 2020-2026. To the extent a remote grid project is conducted the capital funding will come from MAT 08W.																								

Workpaper Table 3-19
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management
Estimated Costs from PG&E's 2020 RAMP Report Compared to GRC Forecast Costs (2020-2026) - Failure of Electric Distribution Overhead Assets
(Thousands of Nominal Dollars)

Line No.	MAT RAMP	MAT GRC	2020 RAMP Mitigation Name	2020 RAMP RISK ID	2020 RAMP Ch.	2023 GRC Mitigation Name	2023 GRC RISK ID	2023 GRC Exh. 4, Ch.	As Presented in RAMP Filing 2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	2023 GRC (Updated February 25, 2022 Forecast 2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	RAMP 2020-2026	GRC 2020-2026	Difference (GRC - RAMP)
1	IG#	IGJ	Enhanced Vegetation Managemen	M1	11	Enhanced Vegetation Managemen	DOVHD-M001	9	$ 494,627	$ 506,993	$ 519,668	$ 532,660	$ 545,976	$ 559,625	$ 573,616	$ 3,733,166	$ 451,390	$ 535,952	$ 357,000	$ 118,022	$ 117,555	$ 112,177	$ 102,234	$ 1,794,331	$ 3,733,166	$ 1,794,331	$ (1,938,835)
2	08W	08W	System Hardening	M2	11	System Hardening	DOVHD-M002	4.3	$ 366,725	$ 565,640	$ 698,360	$ 796,320	$ 850,040	$ 868,052	$ 886,390	$ 5,031,527	$ 484,915	$ 415,654	$ 1,030,125	$ 1,512,026	$ 2,541,346	$ 3,018,650	$ 3,423,762	$ 12,426,478	$ 5,031,527	$ 12,426,478	$ 7,394,952
3	2AR	2AR	Non-Exempt Surge Arrester Replacement	M3	11	Non-Exempt Surge Arrester Replacement	DOVHD-M003	11	$ 8,132	$ 14,360	$ 62,632	$ 47,686	$ -	$ -	$ -	$ 132,810	$ 63,497	$ 88,859	$ 16,804	$ 17,759	$ 35,472	$ 36,429	$ 37,413	$ 296,234	$ 132,810	$ 296,234	$ 163,424
4																											
5	2AP	2AP	Expulsion Fuse Replacement	M4	11	Expulsion Fuse Replacement	DOVHD-M004	4.3	$ 5,423	$ 5,559	$ 5,698	$ 5,840	$ 6,136	$ 6,289	$ 6,446	$ 41,391	$ 7,847	$ 15,125	$ 15,388	$ 15,752	$ 16,257	$ 16,777	$ 17,314	$ 104,460	$ 41,391	$ 104,460	$ 63,069
6																											
7	AB#	AB#	Additional Asset Data Capture	M5	11	Additional Asset Data Capture	DOVHD-M005	22 (B)	$ 4,200	$ 1,230	$ 1,261	$ 1,292	$ 1,325	$ 1,358	$ 1,392	$ 12,057	$ -	$ -	$ 1,269	$ 1,297	$ 1,332	$ 1,368	$ 1,405	$ 6,671	$ 12,057	$ 6,671	$ (5,386)
8	08S	08S	Grasshopper and KPF Switch Replacement	M6	11	Grasshopper and KPF Switch Replacement	DOVHD-M006	13	$ 30	$ 1,135	$ 1,165	$ 1,195	$ 1,224	$ 1,255	$ -	$ 6,004	$ 536	$ 925	$ 949	$ 975	$ 1,001	$ 1,028	$ 1,056	$ 6,470	$ 6,004	$ 6,470	$ 466
9	2AG	2AG	Regulated Output Streetlight Replacement	M7	11	Regulated Output Streetlight Replacement	DOVHD-M007	11	$ -	$ -	$ -	$ 5,277	$ -	$ -	$ -	$ 5,277	$ 30	$ 5,140	$ -	$ 2,488	$ 2,593	$ -	$ -	$ 10,251	$ 5,277	$ 10,251	$ 4,974
10	2AQ	2AQ	Ceramic Post Insulator Replacement	M8	11	Ceramic Post Insulator Replacement	DOVHD-M008	11	$ 3,440	$ 2,620	$ 2,686	$ 1,310	$ -	$ -	$ -	$ 10,057	$ 2,753	$ 3,960	$ 5,832	$ 5,821	$ 5,832	$ 5,843	$ 5,855	$ 35,896	$ 10,057	$ 35,896	$ 25,839
11	AB#	AB#	Improved Distribution Risk Model	M9	11	Improved Distribution Risk Model	DOVHD-M009	22 (B)	$ 2,900	$ 1,435	$ 1,471	$ 1,508	$ 1,545	$ 1,584	$ 1,624	$ 12,066	$ -	$ -	$ 1,473	$ 1,513	$ 1,554	$ 1,596	$ 1,640	$ 7,776	$ 12,066	$ 7,776	$ (4,290)
12																											
13		49A	3A and 4C Line Recloser Replacement	M10	11	3A and 4C Line Recloser Replacement	DOVHD-M010	4.3	$ -	$ 513	$ 525	$ 8,723	$ 8,941	$ 9,164	$ 9,394	$ 37,259	$ 1,456	$ 6,990	$ -	$ -	$ -	$ -	$ -	$ 8,446	$ 37,259	$ 8,446	$ (28,813)
14		49A	3A and 4C Line Recloser Replacement	M10	11	3A and 4C Line Recloser Replacement	DOVHD-M010	13	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 18	$ -	$ 6,203	$ 1,841	$ 1,891	$ 2,057	$ 2,112	$ 14,122	$ -	$ 14,122	$ 14,122
15		49B	3A and 4C Line Recloser Replacement	M10	11	3A and 4C Line Recloser Replacement	DOVHD-M010	13	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1	$ 535	$ 527	$ 4,398	$ 4,517	$ 4,639	$ 4,764	$ 19,380	$ -	$ 19,380	$ 19,380
16			Subtotal - 3A and 4C Line Recloser Replacement						$ -	$ 513	$ 525	$ 8,723	$ 8,941	$ 9,164	$ 9,394	$ 37,259	$ 1,475	$ 7,525	$ 6,731	$ 6,239	$ 6,408	$ 6,695	$ 6,876	$ 41,949	$ 37,259	$ 41,949	$ 4,689
17																											
18	49M			M11	10	System Hardening - Remote Grid (B)	DOVHD-M011	4.3	$ 4,749	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,749								$ -	$ 4,749	$ -	$ (4,749)
19		AB#			10	System Hardening - Remote Grid (B)	DOVHD-M011	4.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,382	$ 1,423	$ 1,464	$ 1,501	$ 1,538	$ 1,577	$ 8,885	$ -	$ 8,885	$ 8,885
20		KAT			10	System Hardening - Remote Grid (B)	DOVHD-M011	4.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 617	$ 953	$ 1,846	$ 3,004	$ 4,334	$ 10,755	$ -	$ 10,755	$ 10,755
21			Subtotal - Remote Grid						$ 4,749	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,749	$ -	$ 1,382	$ 2,040	$ 2,417	$ 3,346	$ 4,543	$ 5,911	$ 19,640	$ 4,749	$ 19,640	$ 14,891
22																											
23						**TOTAL MITIGATIONS - Expense**		**$ 501,727**	**$ 509,658**	**$ 522,400**	**$ 535,460**	**$ 548,846**	**$ 562,567**	**$ 576,631**	**$ 3,757,289**	**$ 451,390**	**$ 537,334**	**$ 361,782**	**$ 123,250**	**$ 123,788**	**$ 119,684**	**$ 111,190**	**$ 1,828,418**	**$ 3,757,289**	**$ 1,828,418**	**$ (1,928,871)**
24						**TOTAL MITIGATIONS - Capital**		**$ 388,499**	**$ 589,826**	**$ 771,066**	**$ 866,351**	**$ 866,341**	**$ 884,760**	**$ 902,230**	**$ 5,269,073**	**$ 561,053**	**$ 537,188**	**$ 1,075,829**	**$ 1,561,060**	**$ 2,608,909**	**$ 3,085,423**	**$ 3,492,275**	**$ 12,921,738**	**$ 5,269,073**	**$ 12,921,738**	**$ 7,652,665**
26																											
27	BFB	BFB	Enhanced Inspections - Distributior	C5	11	Inspections - Distribution Overhead	DOVHD-C005	10	$ 166,015	$ 156,446	$ 160,358	$ 164,367	$ 168,476	$ 172,688	$ 177,005	$ 1,165,354	$ 94,061	$ 93,351	$ 60,535	$ 58,807	$ 56,938	$ 57,442	$ 59,291	$ 480,425	$ 1,165,354	$ 480,425	$ (684,929)
28		BFH	Enhanced Inspections - Distribution	C5	11	Inspections	DOVHD-C005	10	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 40,608	$ 1,876	$ -	$ -	$ -	$ -	$ -	$ 42,484	$ -	$ 42,484	$ 42,484
29						**Total Pilot Control**			**$ 166,015**	**$ 156,446**	**$ 160,358**	**$ 164,367**	**$ 168,476**	**$ 172,688**	**$ 177,005**	**$ 1,165,354**	**$ 134,669**	**$ 95,227**	**$ 60,535**	**$ 58,807**	**$ 56,938**	**$ 57,442**	**$ 59,291**	**$ 522,910**	**$ 1,165,354**	**$ 522,910**	**$ (642,444)**

32 Notes: (A) Remote Grid was an alternate mitigation in RAMP (M11a). PG&E planned to pilot the project in 2020 and, if successful, implement remote grid as a mitigation 2023-2026
33 Estimated costs for the potential mitigation were provided in workpapers ($5.11M in 2023, $5.24M in 2024, $5.37M in 2025 and $5.51M in 2026) and the proposed pace of th
34 work would be similar to the pilot project at 25 miles removed per year. No estimated cost for 2020 was included in the RAMP Repor
35
36 (B) The costs for this mitgiation are presented in Exhibit (PG&E-3), Chapter 22. The mitigation is discussed in Exhibit (PG&E-3), Chapter 3
37
38 (C) PG&E is forecasting expense amounts related to the Remote Grid pilot projects. The expense amounts cover costs for the Remote Grid team and operations and maintenance
39 For the purposes of risk modeling PG&E is assigning estimated capital costs for remote grid pilot projects for each year 2020-2026. To the extent a remote grid project is conducted the capital funding will come from MAT 08\

Workpaper Table 3-20
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management
Estimated Costs from PG&E's 2020 RAMP Report Compared to GRC Forecast Costs (2020-2026) - Failure of Electric Distribution Network Assets
(Thousands of Nominal Dollars)

									As Presented in RAMP Filing								2023 GRC										
Line No.	MAT RAMP	MAT GRC	2020 RAMP Mitigation Name	2020 RAMP RISK ID	2020 RAMP Ch.	2023 GRC Mitigation Name	2023 GRC RISK ID	2023 GRC Exh. 4, Ch.	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	RAMP 2020-2026	GRC 2020-2026	Difference (GRC - RAMP)
1	2CC	2CC	Network Component Replacements - Targeted Replacement of Oil-Filled Transformers in High-Rise Buildings	M1	12	Network Component Replacements - Targeted Replacement of Oil-Filled Transformers in High-Rise Buildings	DNTWK-M001	14	$ 3,467	$ 3,553	$ 1,634	$ -	$ -	$ -	$ -	$ 8,654	$ 5,878	$ 3,122	$ -	$ -	$ -	$ -	$ -	$ 9,000	$ 8,654	$ 9,000	$ 346
2	2CD	2CD	Venting Manhole Cover Replacements	M2	12	Venting Manhole Cover Replacements	DNTWK-M002	14	$ 2,597	$ 5,533	$ 4,307	$ -	$ -	$ -	$ -	$ 12,437	$ 4,065	$ 3,520	$ 550	$ -	$ -	$ -	$ -	$ 8,135	$ 12,437	$ 8,135	$ (4,302)
3	2CE	2CE	Installation of SCADA Equipment for Safety Monitoring	M3	12	Installation of SCADA Equipment for Safety Monitoring	DNTWK-M003	14	$ 8,467	$ 8,873	$ 9,110	$ 9,337	$ 9,571	$ 9,810	$ 10,055	$ 65,223	$ 12,075	$ 8,926	$ 9,110	$ 9,337	$ 9,571	$ 9,810	$ 10,055	$ 68,884	$ 65,223	$ 68,884	$ 3,661
4	56N	56N	Incremental Primary Network Cable Replacements	M4	12	Incremental Primary Network Cable Replacements	DNTWK-M004	14	$ -	$ -	$ -	$ 6,510	$ 6,673	$ 6,840	$ 7,011	$ 27,033	$ -	$ -	$ -	$ 6,510	$ 6,673	$ 6,840	$ 7,011	$ 27,034	$ 27,033	$ 27,034	$ 1
5	2CC	2CC	Network Component Replacements - Targeted Replacement of Dry-Type Transformers in High-Rise Buildings	M5	12	Network Component Replacements - Targeted Replacement of Dry-Type Transformers in High-Rise Buildings	DNTWK-M005	14	$ -	$ -	$ -	$ 4,077	$ 4,615	$ 2,301	$ -	$ 10,992	$ 347	$ -	$ 5,378	$ 2,684	$ 1,013	$ 1,041	$ 1,069	$ 11,532	$ 10,992	$ 11,532	$ 540
6	2CC	2CC	Network Component Replacements - Targeted Replacement of CMD-Type Network Protectors	M6	12	Network Component Replacements - Targeted Replacement of CMD-Type Network Protectors	DNTWK-M006	14	$ -	$ -	$ -	$ 1,615	$ 1,656	$ 1,697	$ 1,740	$ 6,708	$ -	$ -	$ 530	$ 219	$ 225	$ 231	$ 237	$ 1,442	$ 6,708	$ 1,442	$ (5,266)
	Total Mitigations								**$ 14,531**	**$ 17,959**	**$ 15,051**	**$ 21,540**	**$ 22,514**	**$ 20,648**	**$ 18,806**	**$ 131,048**	**$ 22,365**	**$ 15,568**	**$ 15,568**	**$ 18,750**	**$ 17,482**	**$ 17,922**	**$ 18,372**	**$ 126,027**	**$ 131,048**	**$ 126,027**	**$ (5,021)**

Workpaper Table 3-21
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management
Estimated Costs from PG&E's 2020 RAMP Report Compared to GRC Forecast Costs (2020-2026) - Emergency Preparedness and Response
(Thousands of Nominal Dollars)

Line No.	MAT RAMP	MAT GRC	2020 RAMP Mitigation Name	2020 RAMP RISK ID	2020 RAMP Ch.	2023 GRC Mitigation Name	2023 GRC RISK ID	2023 GRC Exh. 4, Ch.	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)
1	AB6		Base Camp Project	M1	20				$ 1,000	$ 2,050	$ 1,051	$ 1,077	$ -	$ -	$ -	$ 5,178
2	AB6		Emergency Operations Center Check-in, Check-out, with Salesforce	M2	20				$ 30	$ 31	$ 32	$ 32	$ 33	$ 14	$ -	$ 172
3	AB6		Secondary Emergency Roles Enterprise-wide	M3	20				$ 500	$ 513	$ 525	$ 538	$ 552	$ 566	$ -	$ 3,194
4	AB6		Mutual Aid Tools and Equipment	M4	20				$ 40	$ -	$ -	$ -	$ -	$ -	$ -	$ 40
5	AB6		Mutual Assistance Improvement	M5	20				$ 50	$ 51	$ 53	$ 54	$ -	$ -	$ -	$ 208
6	AB6		New Incident Specific Annexes	M6	20				$ 250	$ 256	$ 263	$ 269	$ -	$ -	$ -	$ 1,038
7	AB6		Emergency Operations Center/Incident Command System Training Program Enhancements	M7	20				$ 980	$ 980	$ 980	$ 980	$ 980	$ 980	$ 980	$ 6,860
8	21#		Early Earthquake Warning Enhancements	M8	20				$ 255	$ 255	$ 255	$ 255	$ 255	$ 255	$ 255	$ 1,785
9		AB6				EP&R Mitigations (A)	EPNDR-M000	5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
10		AB#				EP&R Mitigations (A)	EPNDR-M000	5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
11		21A				EP&R Mitigations (A)	EPNDR-M000	5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
12									**$ 3,105**	**$ 4,136**	**$ 3,159**	**$ 3,205**	**$ 1,820**	**$ 1,815**	**$ 1,235**	**$ 18,475**
13																
14			**Total Mitgiations - Expense**						**$ 2,850**	**$ 3,881**	**$ 2,904**	**$ 2,950**	**$ 1,565**	**$ 1,560**	**$ 980**	**$ 16,690**
15			**Total Mitgiations - Capital**						**$ 255**	**$ 255**	**$ 255**	**$ 255**	**$ 255**	**$ 255**	**$ 255**	**$ 1,785**
16																

Line No.	2020	2021	2022	2023	2024	2025	2026	Total (2020-2026)	RAMP 2020-2026	GRC 2020-2026	Difference (GRC - RAMP)
1									$ 5,178	$ -	$ (5,178)
2									$ 172	$ -	$ (172)
3									$ 3,194	$ -	$ (3,194)
4									$ 40	$ -	$ (40)
5									$ 208	$ -	$ (208)
6									$ 1,038	$ -	$ (1,038)
7									$ 6,860	$ -	$ (6,860)
8									$ 1,785	$ -	$ (1,785)
9	$ 2,906	$ 976	$ 1,894	$ 4,176	$ 4,309	$ 4,430	$ 4,554	$ 23,245	$ -	$ 23,245	$ 23,245
10	$ 522	$ -	$ -	$ -	$ -	$ -	$ -	$ 522	$ -	$ 522	$ 522
11	$ 518	$ 2,046	$ 1,966	$ 2,143	$ 2,075	$ 2,093	$ 2,160	$ 13,002	$ -	$ 13,002	$ 13,002
12	**$ 3,946**	**$ 3,022**	**$ 3,860**	**$ 6,319**	**$ 6,384**	**$ 6,523**	**$ 6,714**	**$ 36,768**	**$ 18,475**	**$ 23,345**	**$ 4,770**
13											
14	**$ 3,428**	**$ 976**	**$ 1,894**	**$ 4,176**	**$ 4,309**	**$ 4,430**	**$ 4,554**	**$ 23,767**	**$ 16,690**	**$ 23,767**	**$ 7,077**
15	**$ 518**	**$ 2,046**	**$ 1,966**	**$ 2,143**	**$ 2,075**	**$ 2,093**	**$ 2,160**	**$ 13,002**	**$ 1,785**	**$ 13,002**	**$ 11,217**
16											

17 Notes: (A) The planned mitigations for EP&R in EPNDR-M000 include several of the individual mitigations from the RAMP: Base Camp Project, Check-in/Check-out with Salesforce; Secondary Emergency Roles Enterprise-wide; and Mutual Aid Enhancemer
18 Information about the specific programs is included in the workpapers. See Exhibit (PG&E-3), Chapter 5, Project Summary - Field Operations Core Wor

Workpaper Table 3-22
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management
Step-3 Supplemental Analysis in the GRC - Failure of Electric Distribution Substation Assets
(Nominal Dollars)

Line of Business: Electric Operations
Risk: Failure of Substation Assets

Line No.	GRC Exhibit and Chapter No.	2020 RAMP Ch. No.	Unique ID	Control Name	Expense MAT(s)	Capital MAT(s)	2023_Exp Forecast (A)	Sum of 2023-2026 Cap. Forecast (A)	RSE Required	Step3_1b (B)	Step3_1c (B)	Step3_1di (B)	Step3_1dii (B)	Step3_2 (B)
1	Exh. 4, Ch. 15	19	SBSTN-C001	Substation Security Enhancements		58S		$ 15,115,322	No	TRUE	TRUE	FALSE	FALSE	FALSE
2	Exh. 4, Ch. 15	19	SBSTN-C002	Animal Abatement Substation		48X		$ 19,764,855	No	TRUE	TRUE	FALSE	FALSE	FALSE
3	Exh. 4, Ch. 15	19	SBSTN-C005	Civil Structures Replacement		48H		$ 26,249,596	No	TRUE	TRUE	FALSE	FALSE	FALSE
4	Exh. 4, Ch. 15	19	SBSTN-C007	Substation Seismic Retrofit		58B		$ 35,057,849	No	TRUE	TRUE	FALSE	FALSE	FALSE
5	Exh. 4, Ch. 15	19	SBSTN-C008	Design Criteria	GC1		$ 514,539		No	TRUE	TRUE	FALSE	FALSE	FALSE
6	Exh. 4, Ch. 15	19	SBSTN-C009	Fire Protection / Suppression Systems		58A		$ 8,902,994	No	TRUE	TRUE	FALSE	FALSE	FALSE
7	Exh. 4, Ch. 15	19	SBSTN-C016A	Proactive Asset Replacement - Ground Grid		48A		$ 12,889,361	No	TRUE	TRUE	FALSE	FALSE	FALSE
8	Exh. 4, Ch. 15	19	SBSTN-C016C	Proactive Asset Replacement - Batteries		48C		$ 13,534,752	No	TRUE	TRUE	FALSE	FALSE	FALSE
9	Exh. 4, Ch. 15	19	SBSTN-C016D	Proactive Asset Replacement - Circuit Breakers		48D		$ 124,347,318	YES	TRUE	TRUE	TRUE	FALSE	FALSE
10	Exh. 4, Ch. 15	19	SBSTN-C016E	Proactive Asset Replacement - Switches		48E		$ 14,706,568	No	TRUE	TRUE	FALSE	FALSE	FALSE
11	Exh. 4, Ch. 15	19	SBSTN-C016F	Proactive Asset Replacement - Switchgear		48F		$ 81,362,601	YES	TRUE	TRUE	TRUE	FALSE	FALSE
12	Exh. 4, Ch. 15	19	SBSTN-C016G	Proactive Asset Replacement - Line Support Work		48L		$ 28,576,179	No	TRUE	TRUE	FALSE	FALSE	FALSE
13	Exh. 4, Ch. 15	19	SBSTN-C016H	Proactive Asset Replacement - Insulators		48N		$ 22,557,918	No	TRUE	TRUE	FALSE	FALSE	FALSE
14	Exh. 4, Ch. 15	19	SBSTN-C016J	Proactive Asset Replacement - Transformer		54A		$ 99,804,915	No	TRUE	TRUE	FALSE	FALSE	FALSE
15	Exh. 4, Ch. 15	19	SBSTN-C017	Proactive Maintenance	GC1, GCA, GCB, GCC, GCD, GCE, GCF, GCG, GCH, GCI, GCM, GCO, GCS, GCV, GCW		$ 15,852,660		YES	TRUE	TRUE	FALSE	FALSE	FALSE
16	Exh. 4, Ch. 15	19	SBSTN-C021	Vegetation Management	GCG		$ 9,904,110		No	TRUE	TRUE	FALSE	FALSE	FALSE

Notes:
(A) Where more than 1 expense MAT is listed in the 2023 Expense Forecast column, the value provided is sum of the MATs. Where more than 1 capital MAT is listed in the Capital Forecast column, the value provided is sum of the MATs for the years 2023-2026.

(B) Step 3_1b The utility justifies the program primarily on the basis of reducing a safety or reliability risk
Step 3_1c The program is associated with the portion of the electric system under CPUC jurisdiction or with the natural gas transmission or distribution pipeline system or storage facilities
Step 3_1di The forecast cost of the program equals or exceeds $100M capital (4 years cumulative)
Step 3_1dii The forecast cost of the program equals or exceeds $15M expense in 2023
Step 3_2 Step-3 analysis is not required for Administrative and General programs, work requested by others or programs that meet a compliance obligation

Source: Decision (D.) 18-12-014, Appendix A, Row 28, pp. A-14 to A-15.

Workpaper Table 3-23
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 3, Electric Distribution Risk Management
Step-3 Supplemental Analysis in the GRC - Failure of Electric Distribution Underground Assets
(Nominal Dollars)

Line of Business: Electric Operations
Risk: Failure of Electric Distribution Underground Assets

Line No.	GRC Exhibit and Chapter No.	2020 RAMP Ch. No.	Unique ID	Control Name	Expense MAT(s)	Capital MAT(s)	2023_Exp Forecast (A)	Sum of 2023-2026 Cap. Forecast (A)	RSE Required	Step3_1b (B)	Step3_1c (B)	Step3_1di (B)	Step3_1dii (B)	Step3_2 (B)
1	Exh. 4, Ch. 10	19	DUNGD-C001	Patrols and Inspections	BF3, BF4, BFD, BFE		$ 15,960,422	$0	YES	TRUE	TRUE	FALSE	TRUE	FALSE
2	Exh. 4, Ch. 11	19	DUNGD-C002	Underground Notifications	KBA		$ 15,966,985	$0	YES	TRUE	TRUE	FALSE	TRUE	FALSE
3	Exh. 4, Chs. 11 and 13	19	DUNGD-C003	Equipment Maintenance and Replacement	KBC, KBD, KBE		$ 1,530,811	$0	No	TRUE	TRUE	FALSE	FALSE	FALSE
4	Exh. 4, Ch. 11	19	DUNGD-C004	Planned Major Projects	KBP		$ 735,131	$0	No	TRUE	TRUE	FALSE	FALSE	FALSE

Notes:
(A) Where more than 1 expense MAT is listed in the 2023 Expense Forecast column, the value provided is sum of the MATs. Where more than 1 capital MAT is listed in the Capital Forecast column, the value provided is sum of the MATs for the years 2023-2026.

(B) Step 3_1b The utility justifies the program primarily on the basis of reducing a safety or reliability risk
Step 3_1c The program is associated with the portion of the electric system under CPUC jurisdiction or with the natural gas transmission or distribution pipeline system or storage facilities
Step 3_1di The forecast cost of the program equals or exceeds $100M capital (4 years cumulative)
Step 3_1dii The forecast cost of the program equals or exceeds $15M expense in 2023
Step 3_2 Step-3 analysis is not required for Administrative and General programs, work requested by others or programs that meet a compliance obligation

Source: Decision (D.) 18-12-014, Appendix A, Row 28, pp. A-14 to A-15.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) Chapter 3, Electric Distribution Risk Management
Project Summary – Additional Asset Data Capture

Project Title: Additional Asset Data Capture
Major Work Categories: AB#
Planning Order Numbers: 5058274
Project Start Date: 2022
Project Completion Date: 2026
Operative Date (only applies to Capital): Operative as installed

Project Description

This mitigation consists of various efforts to improve PG&E's ability to capture information about the location and cause of outages, and about the reasons for equipment failures. It may include facilitating asset data capture on mobile devices in the field or automatically, efforts to improve PG&E's outage database, and changes in standards and procedures to expand the amount of asset failure information gathered by field personnel.

Additional Asset Data Capture is a mitigation for the Failure of Electric Distribution Overhead Assets risk (DOVHD-M005).

Justification

These improvements will facilitate PG&E's move towards a more data-driven, risk-based asset management strategy.

Cost

Costs were based on Subject Matter Expert judgement.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded											
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Workpaper Ref.
Expense												
5058274							$1,269	$1,297	$1,332	$1,368	$1,405	WP 22-11, Line 3
Total							**$1,269**	**$1,297**	**$1,332**	**$1,368**	**$1,405**	

Benefits

Collecting additional outage information, outage cause and failure analysis supports PG&E's risk modeling and mitigation efforts. With this information PG&E will be able to conduct more granular risk analysis and will be able to design mitigations that target specific areas of risk in the system.

Alternatives Considered

The status quo alternative is to not increase the type and amount of asset data PG&E captures. This is not a reasonable alternative as PG&E is continually working to improve its risk modeling, analysis.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) Chapter 3 – Electric Distribution Risk Management
Project Summary – Improved Distribution Risk Model

Project Title: Improved Distribution Risk Model
Major Work Categories: AB#
Planning Order Numbers: 5058275
Project Start Date: 2022
Project Completion Date: 2026
Operative Date (only applies to Capital): Operative as installed

Project Description

PG&E continues development of an improved distribution risk model that when fully implemented will provide a more risk-based framework for decisions about asset inspection, maintenance, and replacement of all overhead electric distribution assets. Each asset will receive a risk score, in line with the Multi-Attribute Value Function Framework, that considers the probability of failure (based on asset health factors) and the resulting consequences (based on the function and location of the assets).
Improved Distribution Risk Model is a mitigation for the Failure of Electric Distribution Overhead Assets risk (DOVHD-M009).

Justification

PG&E believes this risk-based approach will address drivers of asset failure more effectively than the traditional, compliance-based approach. In 2020 PG&E implemented the Conductor Failure Risk Model and Vegetation Risk Model that focus on two of the largest drivers of distribution overhead risk specifically focused on ignition risk for wildfire. PG&E will be continually evolving this improved model through at least 2026.

Cost

Costs were based on Subject Matter Expert judgement.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded											
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Workpaper Ref.
Expense												
5058275							$1,473	$1,513	$1,554	$1,596	$1,640	WP 22-11, Line 4
Total							**$1,473**	**$1,513**	**$1,554**	**$1,596**	**$1,640**	

Benefits

Improving the distribution risk model is critical to PG&E's efforts to identify and prioritize the highest risk work on the overhead electric distribution system.

Alternatives Considered

The status quo alternative is to continue using existing risk models. This is not a reasonable alternative as existing models do not provide asset specific information allowing for granular risk analysis.

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE

Testimony: ☐ **Workpapers:** ☒ **SOQ:** ☐

Exhibit Number: 4 **Chapter Number:** 3

Chapter Title: Electric Operations Risk Management

Witness Name: Paul McGregor

Page No.	Line No.	Item	As Filed	As Corrected
Errata as of November 5, 2021				
WP 3-1	All	Electric Operations Risk Mitigation and Control Costs 2023-2026		Replaced in its Entirety
Changes to Risk Spend Efficiency (RSE) Scores				
WP 3-2	1	WLDFR-C008	90.22	159.69
WP 3-2	3	WLDFR-C011	1.83	0.37
WP 3-2	5	WLDFR-C018	35.00	35.12
WP 3-2	8	WLDFR-C10D	0.68	0.72
WP 3-2	10	WLDFR-C10F	0.13	0.14
WP 3-2	12	WLDFR-C10I	0.94	0.95
WP 3-2	13	WLDFR-C10K	0.1	0.09
WP 3-2	15	WLDFR-C12C	76.09	90.28
WP 3-2	16	WLDFR-C12D	67.77	80.41
WP 3-3	1	WLDFR-C001	95.24	168.96
WP 3-3	2	WLDFR-C01A	47.67	85.04
WP 3-3	3	WLDFR-C01B	28.57	50.91
WP 3-3	5	WLDFR-C003	982.57	947.79
WP 3-3	6	WLDFR-C004	3,541.19	4,116.92
WP 3-3	9	WLDFR-C007	2,122.15	3,040.49
WP 3-3	10	WLDFR-C008	90.22	159.69
WP 3-3	13	WLDFR-C011	1.83	0.37
WP 3-3	15	WLDFR-C12A	343.39	408.97
WP 3-3	17	WLDFR-C12E	1,118.45	1,325.73
WP 3-4	4	WLDFR-M004	1.20	3.60

Page No.	Line No.	Item	As Filed	As Corrected
WP 3-4	7	WLDFR-M006	12.67	12.25
WP 3-4	9	WLDFR-M006	3.56	CRC is not a separate initiative. It is an element of the PSPS program.
WP 3-4	10	WLDFR-M07A	16.85	17.55
WP 3-4	19	WLDFR-M10B	20.00	19.43
WP 3-4	20	WLDFR-M10C	23.02	23.06
WP 3-4	21	WLDFR-M011	60.66	71.01
WP 3-4	23	WLDFR-M013	0.30	0.35
WP 3-4	24	WLDFR-M014	1.00	1.01
WP 3-5	38	Note B	(B) PG&E calculated two RSEs for System Hardening: System Hardening [Overhead] - the RSE is 5.64; and, System Hardening [Underground] - the RSE is 4.50.	(B) PG&E calculated two RSEs for System Hardening: System Hardening [Overhead] - the RSE is 6.16; and, System Hardening [Underground] - the RSE is 4.52.
WP 3-6	1	WLDFR-M001	2.52	3.88
WP 3-6	20	WLDFR-M07D	19.40	19.45
WP 3-6	21	WLDFR-M07E	154.01	154.74
WP 3-6	23	WLDFR-M07G	281.25	283.04
WP 3-8	1	DOVHD-C003	90.22	159.69
WP 3-8	14	DOVHD-C011	76.09	90.28
WP 3-8	15	DOVHD-C011	67.77	80.41
WP 3-8	17	DOVHD-C014	20.00	19.43
WP 3-8	18	DOVHD-C09A	0.60	0.53
WP 3-9	1	DOVHD-C001	3,541.19	4,116.92
WP 3-9	3	DOVHD-C002	2,122.15	3,040.49
WP 3-9	5	DOVHD-C003	90.22	159.69
WP 3-9	12	DOVHD-C005	47.67	85.04
WP 3-9	14	DOVHD-C006	28.57	50.91
WP 3-9	17	DOVHD-C011	67.77	80.41
WP 3-9	18	DOVHD-C011	1,118.45	1,325.73
WP 3-9	21	DOVHD-C013	95.24	168.96
WP 3-10	3	DOVHD-M004	0.14	3.6
WP 3-10	6	DOVHD-M008	0.36	0.34
WP 3-10	26	DOVHD-M001	2.52	3.88
WP 3-10	28	DOVHD-M011	30.08	32.17

Page No.	Line No.	Item	As Filed	As Corrected
WP 3-10	39	Note B	(B) PG&E calculated two RSEs for System Hardening: System Hardening [Overhead] - the RSE is 5.64; and, System Hardening [Underground] - the RSE is 4.50.	(B) PG&E calculated two RSEs for System Hardening: System Hardening [Overhead] - the RSE is 6.16; and, System Hardening [Underground] - the RSE is 4.52.
WP 3-11	1	DNTWK-C001	0.08	0.05
WP 3-11	14	DNTWK-C002	2167.46	4.37
WP 3-11	20	Note A	(A) PG&E calculated two RSEs for this program: Network Component (Transformer, Protector) Replacements - Condition Based [Protector] - the RSE is 14.68; and, Network Component (Transformer, Protector - Condition Based [Transformer] - the RSE is 1.32.	(A) PG&E calculated two RSEs for this program: Network Component (Transformer, Protector) Replacements - Condition Based [Protector] - the RSE is 13.22 and, Network Component (Transformer, Protector - Condition Based [Transformer] - the RSE is 1.19
WP 3-12	4	DNTWK-M004	0.08	0.05
WP 3-12	6	DNTWK-M006	5.21	5.22
WP 3-13	8	SBSTN-C16D	0.68	0.72
WP 3-13	10	SBSTN-C16F	0.13	0.14
WP 3-13	13	SBSTN-C16K	0.10	0.09
WP 3-14	2	SBSTN-C017 (GC1)	1.66	1.64
WP 3-14	4	SBSTN-C017 (GCA)	3,670.38	3,013.41
WP 3-14	5	SBSTN-C017 (GCB)	1,237.38	1,339.70
WP 3-14	6	SBSTN-C017 (GCC)	1,565.31	346.23
WP 3-14	8	SBSTN-C017	848.89	Foundational
WP 3-14	9	SBSTN-C017 (GCF)	2,420.24	2,243.17
WP 3-14	11	SBSTN-C017 (GCI)	314.68	306.99
WP 3-14	12	SBSTN-C017 (GCM)	173.77	188.13
WP 3-14	13	SBSTN-C017 (GCO)	97.31	80.34
WP 3-14	14	SBSTN-C017 (GCS)	98.37	96.03
WP 3-14	15	SBSTN-C017 (GCV)	106.18	114.92
WP 3-14	16	SBSTN-C017 (GCW)	577.62	541.06
WP 3-15	1	SBSTN-M001	0.95	0.8
WP 3-16	3	DUNGD-C001	1.15	0.97
WP 3-16	5	DUNGD-C002	2.29	16.49
WP 3-17	1	DUNGD-C003	0.92	0.76

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WP 3-17	9	DUNGD-C06A	0.09	0.08
WP 3-19	13	Note (A)	(A) PG&E calculated two RSEs for this mitigation: EOC Enhancements - the RSE is 360.45; and, Mutual Aid Enhancements - the RSE is 21,219.32.	(A) PG&E calculated two RSEs for this mitigation: EOC Enhancements - the RSE is 308.18; and, Mutual Aid Enhancements - the RSE is 21,334.04
Changes to Control and Mitigation Costs				
WP 3-2	8	WLDFR-C10D (48D)	2020: $4,513,353	2020: $4,513,366
WP 3-2	10	WLDFR-C10F (48F)	2021: $26,825,147 2022: $31,607,072 2023: $34,716,307 2024: $183,47,427 2025: $17,153,555 2026: $15,724,024 2020-2026: $189,733,277 2023-2026: $85,941,313	2021: $26,807,570 2022: $31,269,372 2023: $32,433,238 2024: $16,689,797 2025: $16,587,670 2026: $15,651,896 2020-2026: $184,799,288 2023-2026: $81,362,601
WP 3-2	11	WLDFR-C10H (48L)	2020: $15,923,250	2020: $15,926,097
WP 3-2	17	Total	2020: $550,049,623 2021: $686,584,763 2022: $688,210,415 2023: $705,058,538 2024: $729,211,154 2025: $737,756,630 2026: $742,606,060 2020-2026: $4,839,477,183 2023-2026: $2,914,632,382	2020: $550,052,482 2021: $686,567,186 2022: $687,872,715 2023: $702,775,469 2024: $727,553,524 2025: $737,190,745 2026: 742,533,932 2020-2026: $4,834,546,054 2023-2026: $ 2,910,053,670
WP 3-2	21	Chapter 15 Total	2020: $107,326,967 2021: $114,755,350 2022: $113,905,350 2023: $113,662,955 2024: $110,312,406 2025: $111,597,432 2026: $103,139,285 2020-2026: $774,699,745 2023-2026: $438,712,078	2020: $107,329,827 2021: $114,737,773 2022: $113,567,650 2023: $111,379,886 2024: $108,654,776 2025: $111,031,547 2026: $103,067,157 2020-2026: $769,768,616 2023-2026: $434,133,366

Page No.	Line No.	Item	As Filed	As Corrected
WP 3-2	22	Total	2020: $550,049,623 2021: $686,584,763 2022: $688,210,415 2023: $705,058,538 2024: $729,211,154 2025: $737,756,630 2026: $742,606,060 2020-2026: $4,839,477,183 2023-2026: $2,914,632,382	2020: $550,052,482 2021: $686,567,186 2022: $687,872,715 2023: $702,775,469 2024: $727,553,524 2025: $737,190,745 2026: 742,533,932 2020-2026: $4,834,546,054 2023-2026: $ 2,910,053,670
WP 3-13	10	SBSTN-C16F (48F)	2021: $26,825,147 2022: $31,607,072 2023: $34,716,307 2024: $183,47,427 2025: $17,153,555 2026: $15,724,024 2020-2026: $189,733,277 2023-2026: $85,941,313	2021: $26,807,570 2022: $31,269,372 2023: $32,433,238 2024: $16,689,797 2025: $16,587,670 2026: $15,651,896 2020-2026: $184,799,288 2023-2026: $81,362,601
WP 3-13	14	Total	2021: $122,941,013 2022: $119,952,502 2023: $121,499,945 2024: $125,748,521 2025: $128,858,619 2026: $131,341,855 2020-2026: $862,732,338 2023-2026: $507,448,940	2021: $122,923,436 2022: $119,614,802 2023: $119,216,876 2024: $124,090,891 2025: $128,292,734 2026: $131,269,727 2020-2026: $857,798,349 2023-2026: $502,870,228
WP 3-15	4	SBSTN-M006 (48H)	2020: $(889) 2020-2026: $(889)	2020: $192,074
WP 3-15	5	Total	2020: 191,185 2020-2026: $34,616,138	2020: 192,074 2020-2026: $34,617,027

Page No.	Line No.	Item	As Filed	As Corrected
WP 3-17	2	DUNGD-C003 (2BB)	2021: $1,051,802 2022: $1,045,287 2023: $1,139,315 2024: $1,170,131 2025: $1,201,703 2026: $1,234,141 2020-2026: $7,488,748 2023-2026: $4,745,290	2021: $796,328 2022: $791,355 2023: $862,534 2024: $885,822 2025: $909,740 2026: $934,303 2020-2026: $5,826,451 2023-2026: $3,592,399
WP 3-17	6	DUNGD-C005 (2BF)	2021: $43,644 2022: $43,374 2023: $47,276 2024: $48,554 2025: $49,864 2026: $51,210 2020-2026: $459,726 2023-2026: $196,904	2021: $26,964 2022: $27,665 2023: $28,412 2024: $29,179 2025: $29,967 2026: $30,776 2020-2026: $348,767 2023-2026: $118,334
WP 3-17	11	Total	2021: $148,725,620 2022: $146,524,934 2023: $155,343,427 2024: $158,828,939 2025: $165,437,950 2026: $169,150,170 2020-2026: $1,046,195,889 2023-2026: $648,760,487	2021: $148,453,466 2022: $146,255,293 2023: $155,047,782 2024: $158,525,255 2025: $165,126,091 2026: $168,829,899 2020-2026: $1,044,422,633 2023-2026: $647,529,027
WP 3-17	13	Chapter 11 Total	2021: $57,611,841 2022: $61,142,846 2023: $64,026,708 2024: $65,762,625 2025: $70,593,090 2026: $72,490,395 2020-2026: $439,918,987 2023-2026: $272,872,819	2021: $57,339,687 2022: $60,873,205 2023: $63,731,063 2024: $65,458,941 2025: $70,281,231 2026: $72,170,124 2020-2026: $438,145,732 2023-2026: $271,641,359

Page No.	Line No.	Item	As Filed	As Corrected
WP 3-17	15	Total	2021: $148,725,620 2022: $146,524,934 2023: $155,343,427 2024: $158,828,939 2025: $165,437,950 2026: $169,150,170 2020-2026: $1,046,195,889 2023-2026: $648,760,487	2021: $148,453,466 2022: $146,255,293 2023: $155,047,782 2024: $158,525,255 2025: $165,126,091 2026: $168,829,899 2020-2026: $1,044,422,633 2023-2026: $647,529,027
WP 3-18	8	EPNDR-C000 (AB6)	2021: $3,408,815 2022: $2,318,311 2023: $5,123,186 2020-2026: $31,119,491 2023-2026: $21,369,232	2021: $2,636,803 2022: $2,314,487 2023: $5,104,404 2020-2026: $30,324,872 2023-2026: $21,350,450
WP 3-18	9	EPNDR-C001 (AB6)	2023: $2,092,618 2020-2026: $8,718,108 2023-2026: $8,718,108	2023: $2,086,712 2020-2026: $8,712,202 2023-2026: $8,712,202
WP 3-18	10	EPNDR-C0002 (AB6)	2023: $7,405,462 2020-2026: $30,852,078 2023-2026: $30,852,078	2023: $7,384,560 2020-2026: $30,831,176 2023-2026: $30,831,176
WP 3-18	11	EPNDR-C0005 (AB6)	2023: $602,101 2020-2026: $2,507,913 2023-2026: $2,507,913	2023: $600,402 2020-2026: $2,506,214 2023-2026: $2,506,214
WP 3-18	12	EPNDR-C006 (AB6)	2023: $7,119,021 2020-2026: $29,658,732 2023-2026: $29,658,732	2023: $7,098,928 2020-2026: $29,638,639 2023-2026: $29,638,639
WP 3-18	13	Total	2021: $34,08,815 2022: $23,18,311 2023: $22,342,388 2020-2026: $102,856,322 2023-2026: $93,106,063	2021: $2 636,803 2022: $2,314,487 2023: $22,275,005 2020-2026: $102,013,103 2023-2026: $93,038,680
3-19	10	EPNDR-M000 (AB6, AB#)	2022: $1,896,800 2023: 4,191,696 2020-2026: $23,263,465 2023-2026: $17,483,916	2022: $1,893,671 2023: $4,176,329 2020-2026: $23,244,969 2023-2026: $17,468,549

Page No.	Line No.	Item	As Filed	As Corrected
3-19	11	Total	2022: $1,896,800 2023: 4,191,696 2020-2026: $23,263,465 2023-2026: $17,483,916	2022: $1,893,671 2023: 4,176,329 2020-2026: $23,244,969 2023-2026: $17,468,549
Changes to RAMP Cost Forecasts Compared to GRC Cost Estimates ($000s)				
WP 3-21	56	WLDFR-M07I (21A)	2021: $1,208 Total: 1,927	2021: $0 Total: $899
WP 3-21	57	WLDFR-M07J (21A)	2021: $0 Total: $7,900	2021: $1,208 Total: $8,928
WP 3-24	9	EPNDR-M000 (AB6)	2020: $2,781 2022: $1,897 2023: $4,192 2020-2026: $23,128 Difference GRC-RAMP: $23,138	2020: $2,906 2022: $1,894 2023: $4,176 2020-2026: $23,245 Difference GRC-RAMP: $23,245
WP 3-24	12	EPNDR-M000 Total	2020: $3,821 2022: $3,863 2023: $6,335	2020: $3,946 2022: $3,860 2023: $6,319
WP 3-24	15	Total Expense	2020: $3,303 2022: $1,897 2023: $4,192	2020: $3,428 2022: $1,894 2023: $4,176
Changes to Step-3 Analysis Inputs				
WP 3-25	3	48H (2023-2026)	$58,487,149	$26,249,596
WP 3-25	6	58A (2023-2026)	$8,906,871	$8,902,994
WP 3-25	9	48D (2023-2026)	$124,347,381	$124,347,318
WP 3-25	11	48F (2023-2026)	$85,941,313	$81,362,601
WP 3-25	16	GCG (2023)	$8,559,715	$9,904,110
Errata as of February 25, 2022				
WP 3-17	Note (A)	Correct RSE for EPNDR-M000	21,334	21,346

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
EXHIBIT (PG&E-4) ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING
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Workpaper Table 4-1
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4
Wildfire Mitigations
Expenses by Major Work Category
(Thousands of Nominal Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast [1]	2022 Forecast	2023 Forecast	Reference (A)
1	AB	Misc Expense			28,477	237,620	217,725	216,597	192,293	179,346	
2	BA	E Dist Operate System				1		2,998	2,152	2,219	
3	BH	E Dist Routine Emergency						12,658	109,095	112,510	
4	FZ	E Dist Planning & Ops Engineer		705	775	455	1,487	5,303	9,745	5,500	
5	GC	E Dist Subst O&M							808	833	
6	HG	Elec Trans Ops Engr & Tech			17	201	10	134			
7	IG	Manage Var Bal Acct Processes			1,102	5,978	24,972	39,233	65,397	69,204	
8	JV	Maintain IT Apps & Infra			(34)						
9	KA	E Dist Maint OH General							617	953	
10	**Total**			**705**	**30,338**	**244,254**	**244,194**	**276,923**	**380,107**	**370,565**	**WP 4-3, WP 4-4**

[1] 2021 pre-adjusted recorded cost for MWCs in Lines 2, 3, 4, and 7 related to Chapter 4.6 Enhanced Powerline Safety Settings is reflected in 2021 Forecast.

Workpaper Table 4-2
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4
Wildfire Mitigations
Expenses by Major Work Category
(Thousands of Base Year Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast [1]	2022 Forecast	2023 Forecast
1	AB	Misc Expense			28,915	237,524	217,725	212,427	183,742	166,439
2	BA	E Dist Operate System				1		2,932	2,051	2,052
3	BH	E Dist Routine Emergency						12,598	103,995	104,014
4	FZ	E Dist Planning & Ops Engineer		757	798	449	1,487	5,201	9,262	5,040
5	GC	E Dist Subst O&M							770	770
6	HG	Elec Trans Ops Engr & Tech			18	198	10	134		
7	IG	Manage Var Bal Acct Processes			1,135	5,952	24,972	39,007	62,921	64,676
8	JV	Maintain IT Apps & Infra			(33)					
9	KA	E Dist Maint OH General							600	902
10	**Total**			**757**	**30,832**	**244,124**	**244,194**	**272,299**	**363,342**	**343,892**

[1] 2021 pre-adjusted recorded cost for MWCs in Lines 2, 3, 4, and 7 related to Chapter 4.6 Enhanced Powerline Safety Settings is reflected in 2021 Forecast.

Workpaper Table 4-3
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Recorded Expense Walk by Major Work Category
(Thousands of Nominal Dollars)

Ln. No.	Year	Amount	MWC AB	MWC FZ	MWC IG	MWC JV	MWC BA	MWC HG	Detailed Description/Explanation	Reference
1	**2016**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
2				705					4.3 - Asset Health and Performance Center began operations in 2017; increase represents preliminary costs for program	WP 4-5, Line 14
3	**2017**	**705**	**0**	**705**	**0**	**0**	**0**	**0**		
4			28,477						4.2 - First ever PSPS event for PG&E	WP 4-5, Line 10
5				70					4.3 - No significant change	WP 4-5, Line 14
6					1,102				4.5 - Preliminary IT wildfire spend to begin program, represents field work management (Maps+), customer service (situational awareness, CC&B/Salesforce enhancements), and asset management spend (STAR conductor, transmission support structures, and vegetation management next priority insights).	WP 4-5, Line 20
7	**2018**	**30,338**	**28,477**	**775**	**1,102**	**(34)**	**0**	**17**		
8			209,142						4.1 - Increase due to cameras project and WSOC program. Both these programs were ramping up between 2018 and 2019. 4.2 - Increase from one PSPS event in 2018 to nine PSPS events in 2019	WP 4-5, Line 10
9				(320)					4.3 - Decrease due to reduced staffing as company underwent restructuring	WP 4-5, Line 14
10					4,875				4.5 - Increase to support customer service (situational awareness, CC&B Salesforce enhancements), and WSIP efforts (WF IT Services & Infrastructure investments, Sherlock).	WP 4-5, Line 20
11	**2019**	**244,254**	**237,620**	**455**	**5,978**	**0**	**1**	**201**		
12			(19,894)						4.1 - Increase drivers due to increased HD camera installations, SIPT staffing and other program costs, and meteorology project enhancements. 4.2 - Decrease from nine PSPS events in 2019 to six in 2020	WP 4-5, Line 10
13				1,031					4.3 - Increased operations work and staffing to restore to normal levels	WP 4-5, Line 14
14					18,994				4.2 - Cost from PSPS event that should have moved to MWC AB	WP 4-5, Line 20
15	**2020**	**244,194**	**217,725**	**1,487**	**24,972**	**0**	**0**	**10**		

Workpaper Table 4-4
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Forecast Expense Walk by Major Work Category
(Thousands of Nominal Dollars)

Ln. No.	Year	Amount	MWC AB	MWC FZ	MWC IG	MWC KA	MWC BA	MWC HG	MWC GC	MWC BH	Detailed Description/Explanation	Reference
1	**2020**	**244,194**	**217,725**	**1,487**	**24,972**	**0**	**0**	**10**	**0**	**0**		
2			(1,129)								4.2 - Decrease due to four forecast PSPS events in 2021 compared to six actual PSPS events in 2020 4.4 - Approximate $6M decrease is primarily driven by the forecasted Operational and Management Support costs (PO 5057602) allocated to the FRMMA/WMPMA that was necessary to support the incremental FRMMA/WMPMA work that was not forecasted in the 2020 GRC. The 2021 forecasted costs for the MWCs with incremental costs compared to the 2020 GRC imputed costs (for the 2021 GRC operating period) were less than the 2020 recorded costs for those MWCs.	WP 4-5, Line 10
3				3,816							4.3 - Increase due to increased staffing in order to operate the analytics and sensor technology that has been deployed to date and continues to be deployed. Forecasting to double the number of sensors installed in 2021 vs 2020. 4.6 - Reflects support by Distribution Operations Engineers for device programming and testing, and running fault location analysis.	WP 4-5, Line 14
4					14,261						4.5 - Increase due to O&M forecast for products and tools we installed in prior years, primarily driven by emergency web and other IT products installed (O&M consists of labor and non-labor support). 4.6 - Increase due to customer communication and outreach development and program support work.	WP 4-5, Line 20
5							2,998				4.6 - PG&E launched the EPSS program in late July 2021 and increase reflects Control Center work to enable EPSS mode by adjusting the setting of devices and monitoring the system for outages, and coordinate with field personnel and engineering on the safe patrol and restoration of circuits that experience an outage while in EPSS mode.	WP 4-5, Line 30
6										12,658	4.6 - Increase reflects additional post-outage patrols before power can be restored to customers on circuits that experience an outage while in EPSS mode.	WP 4-5, Line 39
7	**2021**	**276,922**	**216,597**	**5,302**	**39,233**	**0**	**2,998**	**134**	**0**	**12,658**		
8			(24,303)								4.1 - Decrease mainly driven by adjustment to labor cost assumptions (e.g., 2022 forecast adjusted to remove over-applied labor burdens) 4.2 - Decrease mainly driven by adjusted cost assumptions for PSPS events (e.g., 2022 forecast used average PSPS event cost based on 2019 and 2020 recorded) 4.4 - 1) A decrease of $8.7M associated with Operational and Management Support costs (PO 5057602) allocated to the FRMMA/WMPMA that are necessary to support the incremental FRMMA/WMPMA work that was not forecasted in the 2020 GRC. The 2021 forecasted costs, for the MWCs with incremental costs, compared to the 2020 GRC imputed costs (for the 2021 GRC operating period) were less than the 2020 recorded costs for those MWCs. 2) A decrease of ~$3.6M associated with the Electric Compliance and Quality Assurance department (PO 5056974) which consists of headcount related costs allocated to the FRMMA/WMPMA that are necessary to support the incremental data requests and quality assurance monitoring associated with FRMMA/WMPMA work that was not forecasted in the 2020 GRC.	WP 4-5, Line 10
9				4,442							4.3 - Decrease due to efficiences as a result of automating operations 4.6 - Increase of device programming and testing, and running fault location analysis reflects the growth of the number of circuits planned for programming and potential enablement.	WP 4-5, Line 14
10					26,164						4.3 - Decrease driven by DGEMS (Distributed Generation Enabled Microgrid) related costs forecasted through 2021 4.6 - Increases mainly driven by customer support activities: a) outreach and education, b) communications and marketing, c) resiliency and support programs such as temporary generation, Fixed Power Solutions, and Generator and Battery Rebate programs.	WP 4-5, Line 20
11						617					4.3 - Operations and maintenance of Standalone Power Systems assets deployed in the remote grid program.	WP 4-5, Line 26
12							(846)				4.6 - Decrease due to reduction of costs that do not contribute to device setting changes that increase sensitivity, enable EPSS mode, and monitor the distribution system for EPSS outages.	WP 4-5, Line 30
13									808		4.6 - Increase of programming and testing of newly installed devices for EPSS enablement reflects the growth of the number of circuits planned for programming and potential enablement.	WP 4-5, Line 36
14										96,437	4.6 - Increase in additional patrols reflects increase of the number of circuits planned for programming and potential enablement (currently estimated to increase from 170 circuits in 2021 to 988 circuits in 2022).	WP 4-5, Line 39
15	**2022**	**380,107**	**192,293**	**9,745**	**65,397**	**617**	**2,152**	**0**	**808**	**109,095**		
16			(12,948)								4.1 - Main driver for decrease due to WSOC and SOPP programs being moved to EP&R (CH 5).	WP 4-5, Line 10
17				(4,245)							4.3 - Increase due to ongoing O&M costs for licensing and software associated with deployed technology 4.6 - PG&E anticipates the bulk of initial device programming and testing will be complete by 2022 and most of the remaining work will be running fault location analysis to facilitate restoration when fault occurs on an EPSS enabled circuit.	WP 4-5, Line 14
18					3,807						4.5 - No significant change 4.6 - Increase due to escalation, and expansion of customer resiliency program to reach more customers.	WP 4-5, Line 20
19						336					4.3 - Increased number of Standalone Power Systems assets deployed in the remote grid program.	WP 4-5, Line 26
20							67				4.6 - Increase due to escalation	WP 4-5, Line 30
21									25		4.6 - Increase due to escalation.	WP 4-5, Line 36
22										3,415	4.6 - Increase due to escalation.	WP 4-5, Line 39
23	**2023**	**370,565**	**179,346**	**5,500**	**69,204**	**953**	**2,219**	**0**	**833**	**112,510**		

Workpaper Table 4-5
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Wildfire Expense Summary
(Thousands of Nominal Dollars)

Line No.		2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	Assumptions	Reference
1	**MWC AB**										
2	4.1 - Situational Awareness and Forecasting	$ -	$ -	$ 18,960	$ 24,321	$ 34,022	$ 59,348	$ 54,559	$ 43,416		WP 4-6
3	4.2 - PSPS Operations	$ -	$ -	$ 4,981	$ 182,233	$ 141,178	$ 127,920	$ 119,254	$ 115,266		WP 4-8
4	4.3 - System Hardening, Enhanced Automation, and PSPS Impact Mitigations (Remote Grid)	$ -	$ -	$ -	$ 31	$ 755	$ 1,382	$ 1,423	$ 1,464		WP 4-104
5	4.3 - System Hardening, Enhanced Automation, and PSPS Impact Mitigations (Sensor IQ)	$ -	$ -	$ -	$ 24	$ 1,871	$ 145	$ -	$ 3,783		WP 4-116
6	4.3 - System Hardening, Enhanced Automation, and PSPS Impact Mitigations (Temp Gen Dept)	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,063	$ 1,957		WP 4-125
7	4.3 - System Hardening, Enhanced Automation, and PSPS Impact Mitigations (Misc.)	$ -	$ -	$ 7	$ 377	$ 255	$ -	$ -	$ -		
8	4.4 - Community Wildfire Safety Program PMO	$ -	$ -	$ 4,530	$ 30,635	$ 34,144	$ 27,802	$ 14,994	$ 13,460		WP 4-9
9	4.5 - Information Technology for Wildfire Mitigations	$ -	$ -	$ -	$ -	$ 5,500	$ -	$ -	$ -		WP 4-10
10	**Total**	**$ -**	**$ -**	**$ 28,477**	**$ 237,620**	**$ 217,725**	**$ 216,597**	**$ 192,293**	**$ 179,346**		
11	**MWC FZ**										
12	4.3 - System Hardening, Enhanced Automation, and PSPS Impact Mitigations - Asset Health & Performance Center	$ -	$ 705	$ 775	$ 455	$ 1,487	$ 3,256	$ 2,576	$ 3,437		WP 4-80
13	4.6 - Enhanced Powerline Safety Settings	$ -	$ -	$ -	$ -	$ -	$ 2,046	$ 7,169	$ 2,063	(2)	WP 4-154
14	**Total**	**$ -**	**$ 705**	**$ 775**	**$ 455**	**$ 1,487**	**$ 5,302**	**$ 9,745**	**$ 5,500**		
15	**MWC IG**										
16	4.3 - System Hardening, Enhanced Automation, and PSPS Impact Mitigations	$ -	$ -	$ -	$ 22	$ 3,494	$ 3,031	$ -	$ -		WP 4-125
17	4.4 - Community Wildfire Safety Program PMO	$ -	$ -	$ -	$ -	$ 119	$ -	$ -	$ -		WP 4-9
18	4.5 - Information Technology for Wildfire Mitigations	$ -	$ -	$ 1,102	$ 5,955	$ 21,358	$ 35,700	$ 35,700	$ 35,700		WP 4-10
19	4.6 - Enhanced Powerline Safety Settings	$ -	$ -	$ -	$ -	$ -	$ 502	$ 29,697	$ 33,504	(2)	WP 4-157
20	**Total**	**$ -**	**$ -**	**$ 1,102**	**$ 5,978**	**$ 24,972**	**$ 39,233**	**$ 65,397**	**$ 69,204**		
21	**MWC JV**										
22	4.5 - Information Technology for Wildfire Mitigations	$ -	$ -	$ (34)	$ -	$ -	$ -	$ -	$ -		WP 4-10
23	**Total**	**$ -**	**$ -**	**$ (34)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**		
24	**MWC KA**										
25	4.3 - System Hardening, Enhanced Automation, and PSPS Impact Mitigations	$ -	$ -	$ -	$ -	$ -	$ -	$ 617	$ 953		WP 4-104
26	**Total**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 617**	**$ 953**		
27	**MWC BA**										
28	4.3 - System Hardening, Enhanced Automation, and PSPS Impact Mitigations	$ -	$ -	$ -	$ 1	$ -	$ -	$ -	$ -		
29	4.6 - Enhanced Powerline Safety Settings	$ -	$ -	$ -	$ -	$ -	$ 2,998	$ 2,152	$ 2,219	(2)	WP 4-153
30	**Total**	**$ -**	**$ -**	**$ -**	**$ 1**	**$ -**	**$ 2,998**	**$ 2,152**	**$ 2,219**		
31	**MWC HG**										
32	4.3 - System Hardening, Enhanced Automation, and PSPS Impact Mitigations	$ -	$ -	$ 17	$ 201	$ 10	$ 134	$ -	$ -	(1)	
33	**Total**	**$ -**	**$ -**	**$ 17**	**$ 201**	**$ 10**	**$ 134**	**$ -**	**$ -**		
34	**MWC GC**										
35	4.6 - Enhanced Powerline Safety Settings	$ -	$ -	$ -	$ -	$ -	$ -	$ 808	$ 833		WP 4-155
36	**Total**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 808**	**$ 833**		
37	**MWC BH**										
38	4.6 - Enhanced Powerline Safety Settings	$ -	$ -	$ -	$ -	$ -	$ 12,658	$ 109,095	$ 112,510	(2)	WP 4-156
39	**Total**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 12,658**	**$ 109,095**	**$ 112,510**		
40	**Total for Chapter 4**	**$ -**	**$ 705**	**$ 30,338**	**$ 244,254**	**$ 244,194**	**$ 276,922**	**$ 380,107**	**$ 370,565**		

Forecast Assumptions and Details

(1) Costs recorded and forecast in MWC HG reflect cellular and satellite costs for SCADA reclosers in the Tier 2 and Tier 3 HFTD.

(2) 2021 cost for Chapter 4.6 - Enhanced Powerline Safety Settings reflects 2021 pre-adjusted recorded cost.

Workpaper Table 4-6
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Chapter 4.1: Situational Awareness and Forecasting Expense Forecast Details
(Thousands of Nominal Dollars)

Line No.		2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	Reference
	MWC AB - Miscellaneous Expense									
1	Wildfire Safety Operations Center (WSOC)	$ -	$ -	$ 1,491	$ 4,708	$ 4,348	$ 9,139	$ 7,181	$ -	WP 4-61
2	Safety and Infrastructure Protection Team (SIPT)	$ -	$ -	$ 15,770	$ 12,918	$ 15,342	$ 30,304	$ 24,899	$ 25,867	WP 4-58
3	Wildfire Cameras	$ -	$ -	$ 692	$ 2,063	$ 6,956	$ 9,385	$ 11,532	$ 8,234	WP 4-7
4	Partial Voltage Detection	$ -	$ -	$ -	$ 0	$ 4	$ -	$ 85	$ 233	WP 4-38
5	Weather Stations	$ -	$ -	$ 29	$ 606	$ 111	$ 1,572	$ 1,641	$ 1,764	WP 4-21
6	Meteorology									
7	SOPP	$ -	$ -	$ -	$ -	$ 1,627	$ 1,969	$ 2,029	$ -	WP 4-41
8	Satellite Fire Detection System	$ -	$ -	$ -	$ -	$ -	$ 341	$ 351	$ 362	WP 4-41
9	Advanced Fire Modeling (Fuel Moisture, Fire Spread Modeling)	$ -	$ -	$ 833	$ 3,940	$ 5,541	$ 5,969	$ 6,152	$ 6,345	WP 4-51
10	Fire Potential Index (FPI)	$ -	$ -	$ 146	$ 86	$ 93	$ 154	$ 159	$ 174	WP 4-51
11	Meteorology IT Support	$ -	$ -	$ -	$ -	$ -	$ 515	$ 531	$ 438	WP 4-51
12	**Total**	**$ -**	**$ -**	**$ 18,960**	**$ 24,321**	**$ 34,022**	**$ 59,348**	**$ 54,559**	**$ 43,416**	

Workpaper Table 4-7
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Unit Cost and Forecast Details: MAT AB6 - Wildfire Cameras

Line No.

1	**MAT Code**	AB6 - Wildfire Cameras
2	**GRC Ch.**	4.1 - Situational Awareness and Forecasting
3	**MAT Code Definition**	AB6 is a shared MAT code. The information in this workpaper is specific to work associated with installation and operations & maintenance (O&M) of wildfire cameras. Wildfire cameras improve PG&E's overall situational awareness and are a valuable tool for assisting the Wildfire Safety Operations Center (and it's future state as an All Hazards Center), first responders, and fire agencies.

	Risk ID	Type	Name
4	WLDFR-M07D	Mitigation	Wildfire Cameras

5	**Program Area**	Risk Reduction
6	**Forecast Method**	Unit Cost
7	**Unit of Measure**	Cameras installed
8	**Unit Cost (2023)**	$ 33,465

9	**Unit Cost Forecast Basis**	Historic average costs for installations.
10	**Unit Forecast Basis**	PG&E's plan to install approximately 135 cameras in 2021 and 2022 to achieve 90% viewshed coverage of Tier 2 and Tier 3 HFTD areas. Units forecast in 2023-2026 represent the estimated number of replacement installations

		Recorded Costs & Units (A) (B)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ -	$ -	$ 692,131	$ 2,063,369	$ 6,955,764	
12	**No. of Units**	-	-	-	-	-	
13	**Unit Cost**	$ -	$ -	$ -	$ -	$ -	

	Camera Installation	Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 3,996,215	$ 4,200,080	$ 334,653	Calculated - Line 15 * Line 16
15	**No. of Units**	134	133	10	
16	**Unit Cost**	$ 29,822	$ 31,580	$ 33,465	

	O&M	Forecast Costs & Units (Escalated) (A)		
	Year	**2021**	**2022**	**2023**
17	**Forecast Costs**	$ 5,389,060	$ 7,331,780	$ 7,899,081

	Total	Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
18	**Forecast Costs**	$ 9,385,275	$ 11,531,860	$ 8,233,734	Calculated - Line 14 + Line 17

Notes

19 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

20 **(B)** Breakdown between camera installation and O&M costs not available prior to 2021

Workpaper Table 4-8
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Chapter 4.2: PSPS Operations Expense Forecast Details
(Thousands of Nominal Dollars)

Line No.		2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	Assumptions	Reference
1	**MWC AB - Miscellaneous Expense**										
2	**PSPS Events**	$ -	$ -	$ 4,971	$ 178,868	$ 80,706	$ 82,741	$ 70,782	$ 72,998		WP 4-64
3	EOC Admin	$ -	$ -	$ -	$ 5,115	$ 8,148	$ 4,228	$ 3,617	$ 3,730	(1)	
4	IT	$ -	$ -	$ -	$ 3,366	$ 962	$ 1,380	$ 1,180	$ 1,217	(1)	
5	Distribution Field Support	$ -	$ -	$ -	$ 112,420	$ 45,001	$ 50,179	$ 42,927	$ 44,270	(1)	
6	Community Resource Centers	$ -	$ -	$ -	$ 21,862	$ 12,623	$ 10,992	$ 9,404	$ 9,698	(1)	
7	Customer Outreach	$ -	$ -	$ -	$ 9,643	$ 7,603	$ 5,497	$ 4,703	$ 4,850	(1)	
8	Helicopter	$ -	$ -	$ -	$ 9,642	$ 4,616	$ 4,545	$ 3,888	$ 4,010	(1)	
9	Mutual Assistance	$ -	$ -	$ -	$ 9,628	$ (1,112)	$ 2,715	$ 2,322	$ 2,395	(1)	
9	Veg Mgmt	$ -	$ -	$ -	$ -	$ 2,117	$ 675	$ 577	$ 595	(1)	
10	Other	$ -	$ -	$ -	$ 7,193	$ 746	$ 2,531	$ 2,165	$ 2,233	(1)	
11	**PSPS Program Cost**	**$ -**	**$ -**	**$ 9**	**$ 3,365**	**$ 60,473**	**$ 45,179**	**$ 48,471**	**$ 42,268**		
12	EP&R Field Operations	$ -	$ -	$ -	$ -	$ 3,691	$ 9,974	$ 6,903	$ -		WP 5-20
13	EP&R Field Ops Misc.	$ -	$ -	$ -	$ -	$ 126	$ 360	$ 371	$ -		WP 5-20
14	EP&R Field Ops Tech	$ -	$ -	$ -	$ -	$ 92	$ 206	$ 212	$ -		WP 5-20
15	PSPS Collateral/Segment Creations	$ -	$ -	$ -	$ -	$ 249	$ 103	$ 106	$ 109		WP 5-20
16	Field Exercise	$ -	$ -	$ -	$ 2,431	$ 1,073	$ 2,470	$ 2,546	$ 2,625		WP 5-20
17	PSPS Program Team	$ -	$ -	$ -	$ 722	$ 2,180	$ 5,533	$ 4,502	$ 4,643		WP 4-74
18	PSPS Projects	$ -	$ -	$ 9	$ 22	$ 6,898	$ 1,544	$ 1,591	$ 1,641		WP 4-69
19	CRC Preparedness	$ -	$ -	$ -	$ -	$ 15,423	$ 14,774	$ 15,226	$ 15,703		WP 4-71
20	Exclusive Use Helicopter Contracts	$ -	$ -	$ -	$ -	$ 28,668	$ 7,976	$ 14,944	$ 15,411	(2)	WP 4-76
21	Pre-flights	$ -	$ -	$ -	$ 189	$ 1,775	$ 1,081	$ 1,114	$ 1,149		WP 5-20
22	Wildfire Safety Public Engagement Team	$ -	$ -	$ -	$ -	$ 298	$ 1,158	$ 957	$ 987		WP 4-78
23	**Total**	**$ -**	**$ -**	**$ 4,981**	**$ 182,233**	**$ 141,178**	**$ 127,920**	**$ 119,254**	**$ 115,266**		

Notes

(1) Forecasted at event total level; 2021-2023 breakout are for visual purposes

(2) 2020 recorded is $14.3M higher due to timing of when data was pulled for the GRC showing; there was a subsequent post-close adjustment that allocated $14.3M to various other non-PSPS programs/projects for prorated use of helicopters

Workpaper Table 4-9
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Chapter 4.4: CWSP PMO Expense Forecast Details
(Thousands of Nominal Dollars)

Line No.	Line of Business	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	Notes	Reference
1	Total CWSP PMO Expense	**$ -**	**$ -**	**$ 4,530**	**$ 30,635**	**$ 34,263**	**$ 27,802**	**$ 14,994**	**$ 16,414**		
3	CWSP PMO Expense (Electric Transmission)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,955	(1)	
2	CWSP PMO Expense (Electric Distribution)	$ -	$ -	$ 4,530	$ 30,635	$ 34,263	$ 27,802	$ 14,994	$ 13,460	(1)	WP 4-128
4	**Total CWSP PMO Expense (Electric Distribution)**	**$ -**	**$ -**	**$ 4,530**	**$ 30,635**	**$ 34,263**	**$ 27,802**	**$ 14,994**	**$ 13,460**		

Notes

(1) The 2023 forecast was allocated between electric distribution and electric transmission. 82% of the total forecast was allocated to electric distribution and 18% of the total forecast was allocated to electric transmission. The allocation percentages were based on the transmission and distribution split of the total HFTD Zone 1, Tier 2, Tier 3 mileage.

	Cost Allocation Percentage (2023 Only)	2023 Forecast
Total CWSP PMO Expense	**100%**	**$ 16,414**
CWSP PMO Expense (Electric Transmission)	18%	$ 2,955
CWSP PMO Expense (Electric Distribution)	**82%**	**$ 13,460**

Workpaper Table 4-10
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Chapter 4.5 Expense Forecast Details - Information Technology for Wildfire Mitigations Expense Forecast Details
(Thousands of Nominal Dollars)

Line No.		2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	Notes	Reference
	MWC IG										
1	Asset Management & Risk Analysis	$ -	$ -	$ 172	$ 349	$ 14	$ 6,300	$ 5,500	$ 4,000		WP 4-131
2	Customer Service	$ -	$ -	$ 680	$ 690	$ 7,136	$ 400	$ 200	$ 200		WP 4-134
3	Data Enablement	$ -	$ -	$ -	$ 28	$ 1,802	$ 3,700	$ 4,000	$ 4,500		WP 4-138
4	Event Management	$ -	$ -	$ 245	$ 1,231	$ 6,097	$ 4,500	$ 3,400	$ 3,000		WP 4-142
5	Field Work Management	$ -	$ -	$ 6	$ 3,658	$ 464	$ 2,000	$ 1,500	$ 1,000		WP 4-148
6	Operations & Maintenance	$ -	$ -	$ -	$ -	$ 5,632	$ 18,800	$ 21,100	$ 23,000	(1)	
7	Other	$ -	$ -	$ -	$ -	$ 213	$ -	$ -	$ -	(2)	
8	**MWC IG Total**	**$ -**	**$ -**	**$ 1,102**	**$ 5,955**	**$ 21,358**	**$ 35,700**	**$ 35,700**	**$ 35,700**		
	MWC AB										
9	Palantir	$ -	$ -	$ -	$ -	$ 5,500	$ -	$ -	$ -	(3)	
10	**MWC AB Total**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 5,500**	**$ -**	**$ -**	**$ -**		
	MWC JV										
11	Miscellaneous	$ -	$ -	$ (34)	$ -	$ -		$ -	$ -		
12	**MWC JV Total**	**$ -**	**$ -**	**$ (34)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**		
13	**Expense Total**	**$ -**	**$ -**	**$ 1,069**	**$ 5,955**	**$ 26,858**	**$ 35,700**	**$ 35,700**	**$ 35,700**		

Notes

(1) The O&M costs include both non-labor and labor activities resulting from operational expenditures associated with technology projects put into service. The 2021-2023 forecast method assumes a 10% year over year reduction the Company expects to realize through operational efficiencies offset by an increase of 10% of the Technology Project Investments per year.

(2) These recorded costs are attributed to a cybersecurity project designed to protect PG&E data and assets in the cloud.

(3) The $5.5M in Palantir vendor contract costs were supporting all of the use cases (pilots) conducted in 2020.

Workpaper Table 4-11
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 4
Wildfire Mitigations
Capital Expenditures by Major Work Category
(Thousands of Nominal Dollars)

			Capital Expenditures											
No.	**MWC**	**MWC Description**	**2016 Recorded Adjusted**	**2017 Recorded Adjusted**	**2018 Recorded Adjusted**	**2019 Recorded Adjusted**	**2020 Recorded Adjusted**	**2021 Forecast**	**2022 Forecast**	**2023 Forecast**	**2024 Forecast**	**2025 Forecast**	**2026 Forecast**	**Reference**
1	8	E Dist Replace OH Asset	-	70	23,670	297,884	484,916	415,654	1,030,125	1,512,026	2,541,346	3,018,650	3,423,762	
2	9	E Dist Automation & Protection	-	-	-	-	-	-	-	-	-	-	-	(1)
3	21	Misc Capital	-	-	7,167	11,164	14,016	12,535	12,612	15,369	3,559	3,618	3,731	
4	2A	E Dist Inst/Repl OH General	-	-	0	9,130	7,847	15,125	15,388	15,752	16,257	16,777	17,314	
5	2F	Build IT Apps & Infra	-	-	6,125	18,349	22,658	25,300	25,300	25,300	25,300	25,300	25,300	
6	48	E Dist Subst Repl Other Equip	-	-	-	-	-	-	-	-	-	-	-	(1)
7	49	E Dist Reliability Ckt/Zone	-	-	8,360	63,986	91,685	89,226	77,153	54,857	54,853	56,803	59,508	
8		**Grand Total**	**-**	**70**	**45,322**	**400,513**	**621,121**	**557,840**	**1,160,578**	**1,623,305**	**2,641,315**	**3,121,148**	**3,529,615**	WP 4-16, WP 4-17

(1) Line 2 and 6, 2022 - 2026 forecast value varies from the value listed in the Results of Operations (RO) Model. This amount does not align to the RO Model provided to the Public Advocates Office at the time of filing.
The RO will be updated to incorporate these errata with the Joint Comparison Exhibit submittal.

Workpaper Table 4-12
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 4
Wildfire Mitigations
Forecast Capital Expenditures Summary
(Thousands of Nominal Dollars)

		Capital Expenditures							
Line No.	**Description**	**2020 CWIP**	**2021 Forecast**	**2022 Forecast**	**2023 Forecast**	**2024 Forecast**	**2025 Forecast**	**2026 Forecast**	**Reference**
1	Projects > $3 Million*	80,457	545,484	1,180,473	1,649,745	2,668,469	3,149,035	3,558,254	WP 4-14, Line 54
2	Other Work	35,561	12,356	2,005	262	269	277	284	WP 4-15
3	**Total**	**116,018**	**557,840**	**1,182,478**	**1,650,007**	**2,668,738**	**3,149,311**	**3,558,538**	
4	* Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.								

Workpaper Table 4-13
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 4
Wildfire Mitigations
Recorded CWIP and Forecast Capital Expenditures Details - Projects Over $3 Million*
(Thousands of Nominal Dollars)

					CWIP	Capital Expenditures							
Line No.	Planning Order	Description	MWC	Operative Date	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Subtotal	Reference
	MWC - 08	**E Dist Replace OH Asset**											
1	5786123	08W Rebuild	8	Sep-2023	13,203	-	-	-	-	-	-	13,203	
2	5793698	Butte Rebuild 08W - Planning only	8	Dec-2020	-	40,214	-	-	-	-	-	40,214	
3	5793892	FRRB - NB NAPA COUNTY	8	Aug-2021	56,074	-	-	-	-	-	-	56,074	
4	5795518	2021 08W OH WLDFR-M002 DOVHD-M002	8	Dec-2020	-	286,560	-	-	-	-	-	286,560	
5	5795519	2021 08W UG WLDFR-M002 DOVHD-M002	8	Dec-2020	-	87,560	-	-	-	-	-	87,560	
6	5795520	2022 08W OH WLDFR-M002 DOVHD-M002	8	Dec-2020	-	-	366,000	-	-	-	-	366,000	
7	5795521	2022 08W UG WLDFR-M002 DOVHD-M002	8	Dec-2020	-	-	611,250	-	-	-	-	611,250	
8	5795522	2023 08W OH WLDFR-M002 DOVHD-M002	8	Dec-2020	-	-	-	265,377	-	-	-	265,377	
9	5795523	2023 08W UG WLDFR-M002 DOVHD-M002	8	Dec-2020	-	-	-	1,192,578	-	-	-	1,192,578	
10	5795524	2024 08W OH WLDFR-M002 DOVHD-M002	8	Dec-2020	-	-	-	-	81,507	-	-	81,507	
11	5795525	2024 08W UG WLDFR-M002 DOVHD-M002	8	Dec-2020	-	-	-	-	2,415,857	-	-	2,415,857	
12	5795526	2025 08W OH WLDFR-M002 DOVHD-M002	8	Dec-2020	-	-	-	-	-	83,918	-	83,918	
13	5795527	2025 08W UG WLDFR-M002 DOVHD-M002	8	Dec-2020	-	-	-	-	-	2,907,625	-	2,907,625	
14	5795528	2026 08W OH WLDFR-M002 DOVHD-M002	8	Dec-2020	-	-	-	-	-	-	86,402	86,402	
15	5795529	2026 08W UG WLDFR-M002 DOVHD-M002	8	Dec-2020	-	-	-	-	-	-	3,337,360	3,337,360	
16	5795565	SYSPLAN FRMMA 08W WLDFR-M002	8	Dec-2020	-	-	52,875	54,072	43,982	27,107	-	178,036	
17	**Total**				**69,277**	**414,334**	**1,030,125**	**1,512,026**	**2,541,346**	**3,018,650**	**3,423,762**	**12,009,520**	**WP 4-19 Line 3**
	MWC - 09	**E Dist Automation & Protection**											
18	5548505	Fast Trip (EPSS) - Substation IPAC	9		-	-	13,500	-	-	-	-	13,500	
19	5548506	Fast Trip (EPSS) - Substation IPAC	9		-	-	-	12,324	12,657	12,998	13,349	51,329	
20	**Total**				**-**	**-**	**13,500**	**12,324**	**12,657**	**12,998**	**13,349**	**64,829**	
	MWC - 21	**Misc Capital**											
21	5531503	Weather Station WLDFR-M07B	21		242	6,399	6,377	3,270	1,122	1,155	1,189	19,754	
22	5535720	SIPT - Capital equipment WLDFR-M008	21		1,832	152	1,187	248	278	281	290	4,267	
23	5536139	PSPS Capital Equipment WLDFR-C006	21		2,124	2,056	1,987	-	-	-	-	6,167	
24	5544495	SYSPLAN WMBA 21A WLDFR-M07F	21		-	-	-	10,507	-	-	-	10,507	
25	5795513	Meteorology IT Support WLDFR-M07J	21	Dec-2020	-	-	1,055	1,083	1,890	1,905	1,967	7,900	
26	**Total**				**4,198**	**8,606**	**10,606**	**15,107**	**3,290**	**3,341**	**3,446**	**48,595**	**WP 4-19 Line 10**
	MWC - 2A	**E Dist Inst/Repl OH General**											
27	5535160	CWSP Non-exempt Fuses – CC	2A		-	3,340	-	-	-	-	-	3,340	
28	5535167	CWSP Non-exempt Fuses – LP	2A		-	6,983	-	-	-	-	-	6,983	
29	5544496	SYSPLAN WMBA 2AP WLDFR-M004 DOVHD-M(	2A		-	-	15,388	15,752	16,257	16,777	17,314	81,489	
30	**Total**				**-**	**10,323**	**15,388**	**15,752**	**16,257**	**16,777**	**17,314**	**91,812**	**WP 4-19 Line 13**
	MWC - 2F	**Build IT Apps & Infra**											
31	5785099	CWSP: Sherlock Tool (C) DIST	2F	Dec-2021	3,149	-	-	-	-	-	-	3,149	
32	5794698	EO_Event_Management _FRMMA_R (C)	2F	Dec-2020	-	10,200	8,000	8,000	6,000	6,000	6,000	44,200	
33	5794700	EO_Customer Service _FRMMA_R (C)	2F	Dec-2020	-	2,600	2,000	2,000	3,000	3,000	3,300	15,900	
34	5794706	EO_ADM&RA _FRMMA_R (C)	2F	Dec-2020	-	5,000	8,500	8,500	8,500	8,000	8,000	46,500	
35	5794708	EO_DE _FRMMA_R (C)	2F	Dec-2020	-	2,500	3,300	3,800	5,300	6,300	6,500	27,700	
36	5794710	EO_FWM _FRMMA_R (C)	2F	Dec-2020	-	5,000	3,500	3,000	2,500	2,000	1,500	17,500	
37	**Total**				**3,149**	**25,300**	**25,300**	**25,300**	**25,300**	**25,300**	**25,300**	**154,949**	**WP 4-19 Line 16**

Workpaper Table 4-13
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 4
Wildfire Mitigations
Recorded CWIP and Forecast Capital Expenditures Details - Projects Over $3 Million*
(Thousands of Nominal Dollars)

	MWC - 48	**E Dist Subst Repl Other Equip**											
38	5548507	Fast Trip (EPSS) - Sub Breaker Replace	48		-	-	8,400	-	-	-	-	8,400	
39	5548508	Fast Trip (EPSS) - Sub Breaker Replace	48		-	-	-	14,378	14,766	15,165	15,574	59,883	
40	**Total**				**-**	**-**	**8,400**	**14,378**	**14,766**	**15,165**	**15,574**	**68,283**	
	MWC - 49	**E Dist Reliability Ckt/Zone**											
41	5530201	CWSP - PIH Non Generation	49		4,236	16,448	-	-	-	-	-	20,684	
42	5532235	49H - PSPS Sectionalizing - DA	49		-	42,890	-	-	-	-	-	42,890	
43	5535121	CWSP - Line Sensor Pilot	49		(403)	12,369	-	-	-	-	-	11,965	
44	5539545	CWSP - Line Sensor Pilot PLAN WLDFR-M07A	49		-	-	8,037	8,254	6,474	5,964	6,125	34,855	
45	5540619	RF Radio Freq (EFD) WLDFR-M011	49		-	-	4,647	5,434	6,234	7,486	8,786	32,588	
46	5540620	ECCVM Sensors (DFA) WLDFR-M012	49		-	-	10,351	8,965	9,002	9,245	9,495	47,058	
47	5541620	CWSP REFCL Dist. Pilot (EPIC 3.15) at Ca	49		-	8,224	-	-	-	-	-	8,224	
48	5543609	SYSPLAN FRMMA 49H WLDFR-M006	49		-	-	20,919	11,933	12,255	12,586	12,926	70,619	
49	5543611	SYSPLAN FRMMA 49M WLDFR-M005	49		-	-	13,559	-	-	-	-	13,559	
50	5544490	SYSPLAN FRMMA 49R WLDFR-M10C	49		-	-	16,876	17,331	17,800	18,280	18,774	89,061	
51	5544491	SYSPLAN FRMMA 49T WLDFR-M10B	49		-	-	2,764	2,940	3,087	3,241	3,403	15,435	
52	5790140	FRMMA SCADA 49A PLAN	49	Dec-2021	-	6,990	-	-	-	-	-	6,990	
53	**Total**				**3,833**	**86,921**	**77,153**	**54,857**	**54,853**	**56,803**	**59,508**	**393,929**	**WP 4-19 Line 19**
54		**Grand Total**			**80,457**	**545,484**	**1,180,473**	**1,649,745**	**2,668,469**	**3,149,035**	**3,558,254**	**12,831,916**	

55 * Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.

Workpaper Table 4-14
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 4
Wildfire Mitigations
Recorded and Forecast Capital Expenditures Details - Other Work*
(Thousands of Nominal Dollars)

			Capital Expenditures											
Line No.	MWC	MWC Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference
1	8	E Dist Replace OH Asset	-	70	23,670	281,066	368,815	1,320	-	-	-	-	-	
2	21	Misc Capital	-	-	3,395	2,831	3,071	3,929	2,005	262	269	277	284	
3	2A	E Dist Inst/Repl OH General	-	-	0	7,198	7,324	4,802	-	-	-	-	-	
4	2F	Build IT Apps & Infra	-	-	6,125	16,612	20,168	-	-	-	-	-	-	
5	49	E Dist Reliability Ckt/Zone	-	-	7,775	57,795	78,763	2,305	-	-	-	-	-	
6	**Grand Total**		**-**	**70**	**40,965**	**365,503**	**478,142**	**12,356**	**2,005**	**262**	**269**	**277**	**284**	WP 4-19 Line 20

7 * Excludes projects greater than $3M

Workpaper Table 4-15
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Recorded Capital Walk by Major Work Category
(Thousands of Nominal Dollars)

Ln. No.	Year	Amount	MWC 08	MWC 21	MWC 2A	MWC 2F	MWC 49	Detailed Description/Explanation	Reference
1	**2016**	**0**	**0**	**0**	**0**	**0**	**0**		
2			70					**4.3 (MAT 08W)** No significant change	WP 4-19 Line 3
3	**2017**	**70**	**70**	**0**	**0**	**0**	**0**		
4			23,600					**4.3 (MAT 08W)** Increase due to System Hardening planning and estimating costs	WP 4-19 Line 3
5				7,167				**4.1** - Increase due to preliminary weather station spend, WSOC, and partial voltage detection costs	WP 4-19 Line 10
6						6,125		**4.5** - Preliminary IT wildfire spend to begin program, represents field work management (Maps+, Sherlock), customer service (situational awareness, CC&B/Salesforce enhancements), and asset management spend (STAR conductor, transmission support structures, and vegetation management next priority insights)	WP 4-19 Line 16
7							8,360	**4.3 (MAT 49A and 49M)** Increase due to beginning Distribution Line Automation (49A) and Microgrids (49M) work in 2018	WP 4-19 Line 19
8	**2018**	**45,322**	**23,670**	**7,167**	**0**	**6,125**	**8,360**		
9			274,214					**4.3 (MAT 08W)** Increase due to System Hardening program initiation	WP 4-19 Line 3
10				3,997				**4.1** - Increase to installed weather stations, enhanced wire down deployment schedule changes were pushed back, and SIPT program launched midway through 2019.	WP 4-19 Line 10
11					9,130			**4.3 (MAT 2AP)** Increase due to beginning Non-Exempt Fuse Replacement program	WP 4-19 Line 13
12						12,224		**4.5** - Increase to support customer service (situational awareness, CC&B Salesforce enhancements), and WSIP efforts (WF IT Services & Infrastructure investments, Sherlock).	WP 4-19 Line 16
13							55,626	**4.3 (MAT 49H)** Beginning in 2019, PG&E repurposed MAT 49H from underground fault indicator projects to the installation of PSPS distribution sectionalizing devices. Recorded costs in 2019 inclde over 260 installed sectionalizing devices, plus engineering and material costs for additional projects that would not be constructed until 2020 **4.3 (MAT 49M)** Completed pilot site and incurred program management costs for additional sites to be completed in 2020-2021.	WP 4-19 Line 19
14	**2019**	**400,513**	**297,884**	**11,164**	**9,130**	**18,349**	**63,986**		
15			187,032					**4.3 (MAT 08W)** Increase due to significant ramp-up in System Hardening wildfire risk-related reconstruction costs	WP 4-19 Line 3
16				2,853				**4.1** - AFM projects continued ramp-up (partnership with Technosylva, enhancements of data modeling, etc.), increase to weather station installations, SIPT program continues to ramp up, and enhanced wires down resumes software deployment after being on hold.	WP 4-19 Line 10
17					(1,284)			**4.3 (MAT 2AP)** Decrease due to improved unit cost as result of gained efficencies	WP 4-19 Line 13
18						4,309		**4.5** - Increase driven by emergency web work and PSPS viewer.	WP 4-19 Line 16
19							27,699	**4.3 (MAT 49H)** Increase due to installing over 600 SCADA commissioned sectionalizing devices for PSPS **4.3 (MAT 49R)** Increase due to completion of estimating and construction for CWSP REFCL Distribution Pilot project in 2020 **4.3 (MAT 49A)** Decrease due to the completion of CWSP Line Recloser Automation project in 2019 **4.3 (MAT 49M)** Completed two additional sites (two times more than completed in 2019), including a site that was three times larger than orginal forecast. In addition, incurred program management costs for additional sites to be completed in 2021.	WP 4-19 Line 19
20	**2020**	**621,121**	**484,916**	**14,016**	**7,847**	**22,658**	**91,685**		

Workpaper Table 4-16
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Forecast Capital Walk by Major Work Category
(Thousands of Nominal Dollars)

Ln. No.	Year	Amount	MWC 08	MWC 21	MWC 2A	MWC 2F	MWC 49	Detailed Description/Explanation	Reference
1	**2020**	**621,121**	**484,916**	**14,016**	**7,847**	**22,658**	**91,685**		
2			(69,262)					**4.3 (MAT 08W)** Decrease due to a shift in risk modeling which forced a restart of the System Hardening program. Without a full workplan, execution risks dictated a lower target.	WP 4-19 Line 3
3				(1,481)				4.1 - weather station installations starting to ramp down, enhanced wires down hoping to increase capital forecast dollars by $280K; anticipated to go through IT for recovery, SIPT decrease due to a non-ramp up period / more costs in expense.	WP 4-19 Line 10
4					7,278			**4.3 (MAT 2AP)** Increase due to increasing the number of units replaced (increase from ~650 in 2020 to ~1,200 in 2021)	WP 4-19 Line 13
5						2,642		Increase is driven by technology program investments, primarily in the Asset Management and Risk Analysis value stream.	WP 4-19 Line 16
6							(2,459)	**4.3 (MAT 49H)** Decrease due to PG&E installing less SCADA PSPS distribution sectionalizing devices in 2021 compared to 2020 (approx. 600 in 2020 and approx. 250 in 2021) **4.3 (MAT 49A)** Increase due to a new company standard in 2021 requiring replacement of equipment (Cooper LR Controls and Cooper Tank) with equipment from a new manufacturue (Bechtel and Viper repsecitively). This change in scope tripled the cost per location. **4.3 (MAT 49I)** Increase due to ramp up in 2021 of additional ~900 line sensors, ~50 DFA circuits, and ~3 EFD circuits **4.3 (MAT 49M)** Forecasting completion of up to eight additional sites (up to four times more than completed in 2020). In addition, incurring program management costs for additional sites to be completed in 2022. **4.3 (MAT 49R)** CWSP - REFCL distribution pilot system testing and operations is targeted for completion by Q3 2021, and estimating, design, and material purchase for the new 2021 REFCL project is planned.	WP 4-19 Line 19
7	**2021**	**557,840**	**415,654**	**12,535**	**15,125**	**25,300**	**89,226**		
8			614,471					**4.3 (MAT 08W)** Increase due to siginificant ramp up in System Hardening wildfire-risk related reconstruction costs	WP 4-19 Line 3
9				76				**4.1** - SIPT ramp-up in expense-related costs (new engines, pumps, etc.), enhanced wires down covers remaining updates to meters and software deployment, and if budget increase approved for 2020, these two years will have closer alignment.	WP 4-19 Line 10
10					0			**4.3 (MAT 2AP)** No significant change	WP 4-19 Line 13
11						0		**4.5** No change	WP 4-19 Line 16
12							(12,072)	**4.3 (MAT 49H)** Decrease due to PG&E installing less SCADA PSPS distribution sectionalizing devices in 2022 compared to 2021 (approx. 250 in 2021 and approx. 100 in 2022) **4.3 (MAT 49I)** Increase due to 2022 planned increase in number of sensors in all categories, and additional IT spend to integrate all of the sensor technologies **4.3 (MAT 49M)** Forecasting completion of three to five sites. **4.3 (MAT 49R)** Construction is planned for the completion of the 2021 REFCL project and estimating design. Material purchase and construction is planned for the new 2022 REFCL project.	WP 4-19 Line 19
13	**2022**	**1,160,578**	**1,030,125**	**12,612**	**15,388**	**25,300**	**77,153**		
14			481,901					**4.3 (MAT 08W)** Increase due to an increase in the forecast number of system hardening overhead and underground miles in 2023	WP 4-19 Line 3
15				2,757				**4.1** - SIPT going into steady state, weather stations are continuing to ramp down. **4.3** - Increase due to one-time licensing and deployment fee for Sensor IQ program	WP 4-19 Line 10
16					363			**4.3 (MAT 2AP)** Minor increase in costs due to standard escalation	WP 4-19 Line 13
17						0		**4.5** No change	WP 4-19 Line 16
18							(22,296)	**4.3 (MAT 49H)** Decrease due completion of PSPS MSO switches in 2022 **4.3 (MAT 49A)** Decrease due to three-fold reduction in unit cost from the 2022 elevated level (due to change in standard in 2022)	WP 4-19 Line 19
19	**2023**	**1,623,305**	**1,512,026**	**15,369**	**15,752**	**25,300**	**54,857**		
20			1,029,320					**4.3 (MAT 08W)** Increase due to an increase in the forecast number of system hardening overhead and underground miles in 2024.	WP 4-19 Line 3
21				(11,810)				**4.1** - weather stations initial installation commitment reached; moving in to steady state of maintenance and optimization. **4.3** - Decrease driven by completed implementation of Sensor IQ capital expenditures in 2023.	WP 4-19 Line 10
22					506			**4.3 (MAT 2AP)** Minor increase in costs due to standard escalation	WP 4-19 Line 13
23						0		**4.5** No change	WP 4-19 Line 16
24							(4)	**4.3 (MAT 49I)** Decrease due to completion of majority of IT spend (analytics and data) in 2023. 2024 costs are intended for solely hardware componenets and commissioning	WP 4-19 Line 19
25	**2024**	**2,641,315**	**2,541,346**	**3,559**	**16,257**	**25,300**	**54,853**		
26			477,304					**4.3 (MAT 08W)** Increase due to an increase in the forecast number of system hardening overhead and underground miles in 2025.	WP 4-19 Line 3
27				59				No significant change	WP 4-19 Line 10
28					520			**4.3 (MAT 2AP)** Minor increase in costs due to standard escalation	WP 4-19 Line 13
29						0		**4.5** No change	WP 4-19 Line 16
30							1,950	**4.3 (MAT 49I)** Increase due to EFD sesnors deployemnt increase of 2.5 feeders per year	WP 4-19 Line 19
31	**2025**	**3,121,148**	**3,018,650**	**3,618**	**16,777**	**25,300**	**56,803**		
32			405,112					**4.3 (MAT 08W)** Increase due to an increase in the forecast number of system hardening overhead and underground miles in 2026.	WP 4-19 Line 3

Workpaper Table 4-16
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Forecast Capital Walk by Major Work Category
(Thousands of Nominal Dollars)

Ln. No.	Year	Amount	MWC 08	MWC 21	MWC 2A	MWC 2F	MWC 49	Detailed Description/Explanation	Reference
33				113				No significant change	WP 4-19 Line 10
34					537			**4.3 (MAT 2AP)** Minor increase in costs due to standard escalation	WP 4-19 Line 13
35						0		**4.5** No change	WP 4-19 Line 16
36							2,705	**4.3 (MAT 49I)** Increase due to EFD sesnors deployemnt increase of 2.5 feeders per year	WP 4-19 Line 19
37	**2026**	**3,529,615**	**3,423,762**	**3,731**	**17,314**	**25,300**	**59,508**		

Workpaper Table 4-17
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Wildfire Capital Summary
(Thousands of Nominal Dollars)

Line No.		2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions	Reference
1	**MWC 08**													
2	4.3 - System Hardening, Enhanced Automation, and PSPS Impact Mitigations	$ -	$ 70	$ 23,670	$ 297,884	$ 484,916	$ 415,654	$ 1,030,125	$ 1,512,026	$ 2,541,346	$ 3,018,650	$ 3,423,762		WP 4-22
3	**Total MWC 08**	**$ -**	**$ 70**	**$ 23,670**	**$ 297,884**	**$ 484,916**	**$ 415,654**	**$ 1,030,125**	**$ 1,512,026**	**$ 2,541,346**	**$ 3,018,650**	**$ 3,423,762**		
4	**MWC 21**													
5	4.1 - Situational Awareness and Forecasting	$ -	$ -	$ 7,167	$ 10,368	$ 11,649	$ 9,451	$ 9,375	$ 4,601	$ 3,290	$ 3,341	$ 3,446		WP 4-20
6	4.2 - PSPS Operations - PSPS IT Equipment	$ -	$ -	$ -	$ 757	$ 1,376	$ 3,084	$ 2,981	$ -	$ -	$ -	$ -	(1)	WP 5-26
7	4.2 - PSPS Operations - CRC Preparedness	$ -	$ -	$ -	$ -	$ 1,021	$ -	$ 255	$ 262	$ 269	$ 277	$ 284		WP 4-71
8	4.3 - System Hardening, Enhanced Automation, and PSPS Impact Mitigations	$ -	$ -	$ -	$ 29	$ (30)	$ -	$ -	$ 10,507	$ -	$ -	$ -		WP 4-22
9	4.4 - Community Wildfire Safety Program PMO	$ -	$ -	$ (1)	$ 10	$ 0	$ -	$ -	$ -	$ -	$ -	$ -		WP 4-128
10	**Total MWC 21**	**$ -**	**$ -**	**$ 7,167**	**$ 11,164**	**$ 14,016**	**$ 12,535**	**$ 12,612**	**$ 15,369**	**$ 3,559**	**$ 3,618**	**$ 3,731**		
11	**MWC 2A**													
12	4.3 - System Hardening, Enhanced Automation, and PSPS Impact Mitigations	$ -	$ -	$ 0	$ 9,130	$ 7,847	$ 15,125	$ 15,388	$ 15,752	$ 16,257	$ 16,777	$ 17,314		WP 4-22
13	**Total MWC 2A**	**$ -**	**$ -**	**$ 0**	**$ 9,130**	**$ 7,847**	**$ 15,125**	**$ 15,388**	**$ 15,752**	**$ 16,257**	**$ 16,777**	**$ 17,314**		
14	**MWC 2F**													
15	4.5 - Information Technology for Wildfire Mitigations	$ -	$ -	$ 6,125	$ 18,349	$ 22,658	$ 25,300	$ 25,300	$ 25,300	$ 25,300	$ 25,300	$ 25,300		WP 4-33
16	**Total MWC 2F**	**$ -**	**$ -**	**$ 6,125**	**$ 18,349**	**$ 22,658**	**$ 25,300**	**$ 25,300**	**$ 25,300**	**$ 25,300**	**$ 25,300**	**$ 25,300**		
17	**MWC 49**													
18	4.3 - System Hardening, Enhanced Automation, and PSPS Impact Mitigations	$ -	$ -	$ 8,360	$ 63,986	$ 91,685	$ 89,226	$ 77,153	$ 54,857	$ 54,853	$ 56,803	$ 59,508		WP 4-22
19	**Total MWC 49**	**$ -**	**$ -**	**$ 8,360**	**$ 63,986**	**$ 91,685**	**$ 89,226**	**$ 77,153**	**$ 54,857**	**$ 54,853**	**$ 56,803**	**$ 59,508**		
20	**Total for Chapter 4**	**$ -**	**$ 70**	**$ 45,322**	**$ 400,513**	**$ 621,121**	**$ 557,840**	**$ 1,160,578**	**$ 1,623,305**	**$ 2,641,315**	**$ 3,121,148**	**$ 3,529,615**		

Forecast Assumptions and Details

(1) Forecast costs beginning in 2023 will be moved to base operations included in Chapter 5 (EP&R).

Workpaper Table 4-18
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Chapter 4.1: Situational Awareness and Forecasting Capital Forecast Details
(Thousands of Nominal Dollars)

Line No.		2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Notes	Reference
	MWC 21 - Miscellaneous Capital													
1	Advanced Fire Modeling	$ -	$ -	$ -	$ 198	$ 899	$ -	$ -	$ -	$ -	$ -	$ -		WP 4-51
2	WSOC	$ -	$ -	$ 1,997	$ 2,121	$ (34)	$ 1,542	$ 129	$ -	$ -	$ -	$ -		WP 4-61
3	Weather Stations	$ -	$ -	$ 3,772	$ 6,934	$ 8,315	$ 6,399	$ 6,377	$ 3,270	$ 1,122	$ 1,155	$ 1,189		WP 4-21
4	Partial Voltage Detection	$ -	$ -	$ 1,399	$ 391	$ 1,216	$ 331	$ 627	$ -	$ -	$ -	$ -		WP 4-38
5	Meteorology	$ -	$ -	$ -	$ -	$ -	$ 1,028	$ 1,055	$ 1,083	$ 1,890	$ 1,905	$ 1,967		WP 4-41
6	Safety Infrastructure Protection Teams	$ -	$ -	$ -	$ 642	$ 1,254	$ 152	$ 1,187	$ 248	$ 278	$ 281	$ 290		WP 4-58
7	Other Misc.	$ -	$ -	$ -	$ 82	$ -	$ -	$ -	$ -	$ -	$ -	$ -	(1)	
8	**MWC 21 Total**	**$ -**	**$ -**	**$ 7,167**	**$ 10,368**	**$ 11,649**	**$ 9,451**	**$ 9,375**	**$ 4,601**	**$ 3,290**	**$ 3,341**	**$ 3,446**		

Notes
(1) Other miscellaneous costs are various costs that are not forecasted.

Workpaper Table 4-19
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Unit Cost and Forecast Details: MAT 21A & AB6 - Weather Stations

Line No.

1	**MAT Code**	21A & AB6 - Weather Stations
2	**GRC Ch.**	4.1 - Situational Awareness and Forecasting
3	**MAT Code Definition**	21A and AB6 are shared MAT codes. The information in this workpaper is specific to work associated with weather stations. PG&E's weather station network provides continuous, localized weather information that facilitates improved understanding of weather conditions in localized areas and real-time awareness of wildfire danger. Additionally, the weather station data improves weather modeling capabilities, and contributes to the selection of the most accurate weather model configuration for PG&E's service territory.

	Risk ID	Type	Name
4	WLDFR-M07B	Mitigation	Situational Awareness and Forecasting Initiatives - Weather Station

5	**Program Area**	Risk Reduction
6	**Forecast Method**	Unit Cost (Capital)
7	**Unit of Measure**	Weather stations installed
8	**Unit Cost (2023)**	$ 21,800
9	**Unit Cost Forecast Basis**	Historic average costs for installations.
10	**Unit Forecast Basis**	2020-2022 units based on commitment to install 600 weather stations total by the end of 2022. 2023-2026 units based on replacements, location optimization and/or external agency requests.

	21A - Capital	Recorded Costs (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ -	$ -	$ 3,772,034	$ 6,933,675	$ 8,314,938	
12	**No. of Units**	-	-	-	-	-	
13	**Unit Cost**	$ -	$ -	$ -	$ -	$ -	

	21A - Capital	Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 6,398,910	$ 6,377,353	$ 3,270,045	$ 1,121,774	$ 1,154,914	$ 1,189,192	Calculated - Line 15 * Line 16
15	**No. of Units**	300	300	150	50	50	50	
16	**Unit Cost**	$ 21,330	$ 21,258	$ 21,800	$ 22,435	$ 23,098	$ 23,784	

	AB6 - Expense	Recorded Costs (A)				
	Year	**2016**	**2017**	**2018**	**2019**	**2020**
17	**Recorded Costs**	$ -	$ -	$ 28,565	$ 605,678	$ 111,209

	AB6 - Expense	Forecast Costs (Escalated) (A)					
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
18	**Forecast Costs**	$ 1,571,588	$ 1,640,893	$ 1,764,450	$ 1,889,958	$ 1,970,203	$ 2,110,323

	Total - 21A & AB6	Recorded Costs (A)					
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
19	**Recorded Costs**	$ -	$ -	$ 3,800,599	$ 7,539,353	$ 8,426,147	Calculated - Line 11 + Line 17

	Total - 21A & AB6	Forecast Costs (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
20	**Forecast Costs**	$ 7,970,498	$ 8,018,246	$ 5,034,495	$ 3,011,732	$ 3,125,117	$ 3,299,515	Calculated - Line 14 + Line 18

	Notes	
21	**(A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 4-20
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Chapter 4.3: System Hardening, Enhanced Automation, and PSPS Impact Mitigations Capital Forecast Details
(Thousands of Nominal Dollars)

Line No.	MAT Code	Project Category	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions	Reference
1	**MWC 08**														
3	08W	System Hardening	$ -	$ 70	$ 23,670	$ 281,066	$ 460,141	$ 374,120	$ 977,250	$ 1,457,955	$ 2,497,364	$ 2,991,542	$ 3,423,761		WP 4-27
4	08W	Community Rebuild	$ -	$ -	$ -	$ 16,818	$ 24,774	$ 41,534	$ 52,875	$ 54,072	$ 43,982	$ 27,107	$ -		WP 4-27
5	**Total**		**$ -**	**$ 70**	**$ 23,670**	**$ 297,884**	**$ 484,915**	**$ 415,654**	**$ 1,030,125**	**$ 1,512,026**	**$ 2,541,346**	**$ 3,018,650**	**$ 3,423,761**		
6	**MWC 2A**														
8	2AP	Non-exempt Equipment Replacement	$ -	$ -	$ 0	$ 9,130	$ 7,847	$ 15,125	$ 15,388	$ 15,752	$ 16,257	$ 16,777	$ 17,314		WP 4-29
9	**Total**		**$ -**	**$ -**	**$ 0**	**$ 9,130**	**$ 7,847**	**$ 15,125**	**$ 15,388**	**$ 15,752**	**$ 16,257**	**$ 16,777**	**$ 17,314**		
10	**MWC 21**														
12	21A	Sensor IQ	$ -	$ -	$ -	$ 29	$ (30)	$ -	$ -	$ 10,507	$ -	$ -	$ -		WP 4-116
13	**Total**		**$ -**	**$ -**	**$ -**	**$ 29**	**$ (30)**	**$ -**	**$ -**	**$ 10,507**	**$ -**	**$ -**	**$ -**		
14	**MWC 49**														
16	49A	Automation and Protection	$ -	$ -	$ 7,668	$ 6,789	$ 1,456	$ 6,990	$ -	$ -	$ -	$ -	$ -		WP 4-85
17	49H	Sectionalizing Devices	$ -	$ -	$ 0	$ 51,094	$ 69,441	$ 42,890	$ 20,919	$ 11,933	$ 12,255	$ 12,586	$ 12,926		WP 4-30
18	49I	Line Sensors	$ -	$ -	$ -	$ 2,764	$ 2,272	$ 12,369	$ 23,036	$ 22,653	$ 21,711	$ 22,696	$ 24,405		WP 4-31
19	49M	Temporary Distribution Microgrids	$ -	$ -	$ 692	$ 3,283	$ 13,718	$ 16,448	$ 13,559	$ -	$ -	$ -	$ -		WP 4-108
20	49R	Rapid Earth Fault Current Limiter Distribution Pilot Program	$ -	$ -	$ -	$ 57	$ 4,798	$ 8,224	$ 16,876	$ 17,331	$ 17,800	$ 18,280	$ 18,774		WP 4-119
21	49T	Single Phase Recloser Installations	$ -	$ -	$ -	$ -	$ -	$ 2,305	$ 2,764	$ 2,940	$ 3,087	$ 3,241	$ 3,403		WP 4-32
22	**Total**		**$ -**	**$ -**	**$ 8,360**	**$ 63,986**	**$ 91,685**	**$ 89,226**	**$ 77,153**	**$ 54,857**	**$ 54,853**	**$ 56,803**	**$ 59,508**		
23		**Total Capital**	**$ -**	**$ 70**	**$ 32,030**	**$ 371,030**	**$ 584,417**	**$ 520,005**	**$ 1,122,667**	**$ 1,593,142**	**$ 2,612,456**	**$ 3,092,230**	**$ 3,500,584**		

Workpaper Table 4-21
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
System Hardening Completed Work in 2019 (MAT 08W)
(Thousands of Dollars)

Line No.	Order	Description	MAT	Area	Planned Miles	2019 Completed Miles	2019 Recorded	OH/UG/Removal	Poles Retired (Quantity)	Poles Installed (Quantity)	Covered OH Conductor - Tree Wire (Feet)
1	35113109	CWSP - Los Gatos 1106 - LB44 - Ph 3.2 Beardsley	08W	Bay Area/Peninsula	0.13	0.13	$ 270	OH	5	9	681
2	35113104	CWSP - Los Gatos 1106 - LB44 - Phase 1.2	08W	Bay Area/Peninsula	0.25	0.25	$ 402	OH	9	9	1,324
3	35030654	TW ON WOODSIDE1101 N/O 7573	08W	Bay Area/Peninsula	1.00	1.00	$ 1,411	OH	20	26	5,271
4	35113103	CWSP - Los Gatos 1106 - LB44 - Phase 1.3	08W	Bay Area/Peninsula	0.22	0.22	$ 301	OH	7	7	1,152
5	35103324	CWSP - Rossmoor 1102 OCB	08W	Bay Area/Peninsula	0.77	0.46	$ 1,819	OH	14	11	2,407
6	74021963	Oakland K 1102	08W	Bay Area/Peninsula	2.76	2.48	$ 7,142	OH	74	93	13,070
7	35103065	Moraga 1101	08W	Bay Area/Peninsula	2.39	2.32	$ 4,895	OH	15	77	12,230
8	74021961	MIRABEL 1102 /MONTE RIO 13 - LR 652	08W	North Coast	4.77	4.77	$ 21,565	OH	80	119	25,170
9	35042719	CWSP DEMO: ANGWIN (Silverado) Steel	08W	North Coast	0.24	0.24	$ 961	OH	16	0	1,275
10	35089880	PIH - SILVERADO 2104 - ANGWIN UG_PH 2	08W	North Coast	0.40	0.40	$ 1,720	UG	4	1	
11	35085393	CWSP Silverado 2104 1B	08W	North Coast	0.35	0.35	$ 1,517	OH	15	15	1,871
12	35072146	Silverado 2105 WIRE DOWN OH	08W	North Coast	0.70	0.70	$ 2,117	OH	16	17	3,684
13	35061709	Silverado 2104	08W	North Coast	1.52	1.52	$ 4,209	OH	32	39	8,003
14	31334292	Austin Creek Rd	08W	North Coast	0.47	0.47	$ 1,244	OH	9	11	2,493
15	35040742	DEMO - CWSP - 2018 MONTE RIO 1112 OH TO UG DEMO	08W	North Coast	0.53	0.53	$ 330	UG	1	3	
16	31389447	PUEBLO 1105 RECONDUCTOR PROJECT	08W	North Coast	1.27	1.27	$ 2,636	OH	35	36	6,706
17	31319444	Rincon 1103	08W	North Coast	0.24	0.24	$ 620	OH	6	7	1,279
18	31209950	Potter Valley 1105	08W	North Coast	0.57	0.57	$ 1,454	OH	11	18	3,008
19	31290145	San Rafael 1107	08W	North Coast	0.15	0.15	$ 375	OH	5	5	801
20	31082393	Cherry Ridge Road	08W	North Coast	0.25	0.25	$ 587	OH	4	4	1,345
21	35052718	Silverado 2104 (UG)	08W	North Coast	0.43	0.43	$ 621	UG	9	0	
22	74022040	CALISTOGA 1101	08W	North Coast	1.26	1.26	$ 1,814	OH	24	36	6,677
23	31289238	Fruitland 1142-2	08W	North Coast	1.19	1.19	$ 2,306	OH	25	43	6,271
24	31275658	Dunbar 1102	08W	North Coast	0.49	0.49	$ 848	OH	11	11	2,580
25	35085533	CWSP Silverado 2104 1D	08W	North Coast	1.02	1.02	$ 1,792	OH	31	31	5,365
26	35060229	Fruitland 1142	08W	North Coast	1.24	1.24	$ 1,989	OH	28	29	6,529
27	35094390	CWSP Konocti-1102-LR 532 PH 3	08W	North Coast	0.55	0.55	$ 837	OH	12	14	2,881
28	74022387	MIDDLETOWN 1101-TS 1079	08W	North Coast	3.97	3.97	$ 5,533	OH	101	130	20,962
29	35085536	CWSP Silverado 2104 1G	08W	North Coast	1.33	1.33	$ 1,739	OH	29	30	7,010
30	31290147	Olema 1101	08W	North Coast	0.60	0.60	$ 760	OH	13	13	3,174
31	74024171	Calistoga 1101 - Petrified Forest Rd.	08W	North Coast	2.61	2.61	$ 3,261	OH	55	58	13,781
32	35085532	CWSP Silverado 2104 1C:Harden OH In Place	08W	North Coast	1.13	1.13	$ 1,405	OH	11	27	5,948
33	35094388	CWSP Konocti-1102-LR 532 PH 1	08W	North Coast	0.42	0.42	$ 446	OH	1	13	2,241
34	35111500	RECONDUCTOR UPPER LAKE 01 HUNTERS PT RD	08W	North Coast	0.35	0.35	$ 363	OH	0	7	1,850
35	35039002	DEMO - 2018 CALISTOGA 1101 WILDFIRE DEMO Comp	08W	North Coast	1.14	1.14	$ 380	OH	23	1	6,007
36	35043299	Eel River 1102 - 3	08W	North Coast	1.21	1.21	$ 1,200	OH	27	34	6,376
37	35043303	Eel River 1102 - 2	08W	North Coast	1.54	1.54	$ 1,495	OH	37	46	8,140
38	35085681	SILVERADO 2105 WIRE DOWN PH 4	08W	North Coast	0.56	0.56	$ 426	OH	8	10	2,934
39	35094392	CWSP Konocti-1102-LR 532 PH 5	08W	North Coast	0.37	0.37	$ 264	OH	13	14	1,956
40	35072362	Eel River 1102	08W	North Coast	2.71	2.71	$ 1,845	OH	45	57	14,292
41	35113871	Silverado 2104 - 2 Phase 2 (UG)	08W	North Coast	0.12	0.12	$ 56	UG	3	4	
42	35080227	Calistoga 1101 - Legal Hold	08W	North Coast	0.36	0.36	$ 92	OH	0	0	1,876
43	35112076	CWSP - FULTON 1107 - MARK WEST SPR RD.	08W	North Coast	2.20	0.17	$ 1,498	OH	39	36	890
44	35085534	CWSP Silverado 2104 1E:Harden OH InPlace	08W	North Coast	0.79	0.07	$ 362	OH	20	20	368
45	35085537	CWSP Silverado 2104 1H	08W	North Coast	0.71	0.59	$ 1,089	OH	17	17	3,124
46	35085538	SILVERADO 2105 WIRE DOWN PH 1 OH	08W	North Coast	1.99	0.96	$ 1,453	OH	27	31	5,086
47	35085539	SILVERADO 2105 WIRE DOWN PH 2 OH	08W	North Coast	1.94	1.11	$ 1,271	OH	9	27	5,855
48	35120949	BUCOCAMP - SKYWAY CHICO PARADISE TIE PH2 (UG)	08W	Sacramento Valley	1.92	1.92	$ 11,420	UG	0	4	
49	35095165	Volta 1102 LR 1648 Ph 3.1	08W	Sacramento Valley	0.69	0.69	$ 3,083	OH	19	24	3,666
50	35032266	Apple Hill 1104 - 2	08W	Sacramento Valley	0.17	0.17	$ 439	OH	7	7	877
51	74021960	BRUNSWICK 1105 (LR 32536)	08W	Sacramento Valley	5.88	5.88	$ 15,246	OH	185	224	31,023
52	74021903	BRUNSWICK 1105 LR-1030 ZONE	08W	Sacramento Valley	4.77	4.77	$ 11,705	OH	145	180	25,191
53	74022382	Columbia Hill 1101	08W	Sacramento Valley	2.35	2.35	$ 4,901	OH	51	58	12,389
54	35098578	CWSP-COLUMBIA HILL 1101-LR 2212 Ph 2	08W	Sacramento Valley	1.80	1.80	$ 3,451	OH	0	59	9,480
55	35109543	CWSP - El Dorado 2101 - 19752 - PHASE 1.5	08W	Sacramento Valley	1.69	1.69	$ 3,219	OH	39	50	8,922
56	35066745	Big Bend 1102 - Bloomer Hill	08W	Sacramento Valley	1.69	1.69	$ 3,118	OH	55	55	8,900
57	35057017	CWSP - EL DORADO 2101 - 19752 - PHASE 3.1	08W	Sacramento Valley	1.71	1.71	$ 2,815	OH	36	64	9,006
58	31326119	Weimar 1101	08W	Sacramento Valley	0.57	0.57	$ 914	OH	18	18	2,990
59	35040225	Higgins 1110	08W	Sacramento Valley	1.63	1.63	$ 2,626	OH	32	42	8,584
60	35098622	CWSP-COLUMBIA HILL 1101-LR 2212 Ph 5	08W	Sacramento Valley	2.48	2.48	$ 3,886	OH	52	79	13,101
61	35031139	Shady Glen 1102	08W	Sacramento Valley	1.52	1.52	$ 2,277	OH	28	31	8,016
62	35018787	Halsey 1101	08W	Sacramento Valley	0.54	0.54	$ 802	OH	18	22	2,854
63	35098579	CWSP-COLUMBIA HILL 1101-LR 2212 Ph 3	08W	Sacramento Valley	1.43	1.43	$ 2,020	OH	36	43	7,573
64	35018788	Apple Hill 1104	08W	Sacramento Valley	1.16	1.16	$ 1,560	OH	33	41	6,121
65	35109542	CWSP - El Dorado 2101 - 19752 - PHASE 1.4	08W	Sacramento Valley	1.83	1.83	$ 2,085	OH	31	53	9,673

Workpaper Table 4-21
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
System Hardening Completed Work in 2019 (MAT 08W)
(Thousands of Dollars)

Line No.	Order	Description	MAT	Area	Planned Miles	2019 Completed Miles	2019 Recorded	OH/UG/Removal	Poles Retired (Quantity)	Poles Installed (Quantity)	Covered OH Conductor - Tree Wire (Feet)
66	31286573	Apple Hill 2102	08W	Sacramento Valley	0.66	0.66	$ 548	OH	4	5	3,492
67	35106265	CWSP - Volta 1102 - LR 1648 - Ph1.3	08W	Sacramento Valley	1.80	0.09	$ 1,885	OH	47	54	456
68	35112427	CWSP - El Dorado 2101 - OCB Zone - Ph 1.4	08W	Sacramento Valley	0.99	0.07	$ 706	OH	12	16	377
69	35109737	CWSP - Volta 1102 - LR 1648 - Ph 2.2	08W	Sacramento Valley	2.14	0.37	$ 3,247	OH	54	71	1,968
70	35110442	CWSP - Volta 1102 - LR 1648 - Ph 3.2	08W	Sacramento Valley	1.36	1.32	$ 5,653	OH	26	37	6,993
71	35106042	CWSP - Volta 1102 - LR 1648 - Ph1.2	08W	Sacramento Valley	1.82	0.73	$ 2,974	OH	31	59	3,879
72	35110444	CWSP - Volta 1102 - LR 1648 - Ph 3.4	08W	Sacramento Valley	1.47	0.79	$ 3,070	OH	46	57	4,149
73	35109555	CWSP - El Dorado 2101 - 19752 - PHASE 4.3	08W	Sacramento Valley	2.24	0.75	$ 2,824	OH	58	70	3,976
74	35109549	CWSP - El Dorado 2101 - 19752 - PHASE 3.2	08W	Sacramento Valley	1.34	0.68	$ 2,358	OH	33	45	3,616
75	35110443	CWSP - Volta 1102 - LR 1648 - Ph 3.3	08W	Sacramento Valley	1.26	1.10	$ 3,633	OH	31	39	5,785
76	35058905	Volta 1102 LR 1648 Ph 4.1	08W	Sacramento Valley	2.11	1.36	$ 3,995	OH	50	71	7,174
77	35109739	CWSP - Volta 1102 - LR 1648 - Ph 2.4	08W	Sacramento Valley	2.51	1.24	$ 3,494	OH	54	92	6,537
78	35110445	CWSP - Volta 1102 - LR 1648 - Ph4.2	08W	Sacramento Valley	1.64	1.45	$ 4,039	OH	48	55	7,660
79	35109551	CWSP - El Dorado 2101 - 19752 - PHASE 3.4	08W	Sacramento Valley	1.44	1.09	$ 2,715	OH	35	45	5,769
80	35109552	CWSP - El Dorado 2101 - 19752 - PHASE 3.5	08W	Sacramento Valley	2.14	1.83	$ 4,524	OH	54	74	9,684
81	35112426	CWSP - El Dorado 2101 - OCB Zone - Ph 1.3	08W	Sacramento Valley	1.81	1.71	$ 4,033	OH	16	47	9,038
82	35109550	CWSP - El Dorado 2101 - 19752 - PHASE 3.3	08W	Sacramento Valley	1.91	1.62	$ 3,071	OH	43	63	8,574
83	35109553	CWSP - El Dorado 2101 - 19752 - PHASE 3.6	08W	Sacramento Valley	2.67	1.41	$ 2,545	OH	67	89	7,469
84	35081748	Rob Roy 2105-SO28CC1119	08W	South Coast Valley	0.16	0.16	$ 597	OH	8	11	850
85	35023687	Ben Lomond 0401	08W	South Coast Valley	1.33	1.33	$ 3,870	OH	47	63	7,044
86	31278200	OCEANO 1102 S HALCYON & PINE RDGE	08W	South Coast Valley	0.39	0.39	$ 428	OH	12	12	2,059
87	35060582	SLO 1107 Recon 3,836 ft of 4ar to 2cu in corrosion zone	08W	South Coast Valley	0.74	0.74	$ 864	OH	13	13	3,884
88	35064793	LP CABRILLO 1104 S006CC102	08W	South Coast Valley	2.30	2.30	$ 2,470	OH	39	65	12,142
89	31215474	Reconductor Rob Roy 2104 McDonald	08W	South Coast Valley	0.51	0.51	$ 516	OH	17	19	2,693
90	35008479	Auberry 1101 Reconductor	08W	South Coast Valley	0.31	0.31	$ 277	OH	7	9	1,637
91	35019006	Rob Roy 2104 CO11865	08W	South Coast Valley	1.80	1.80	$ 1,056	OH	13	39	9,525
92	31232280	ZACA 1102 LONG CYN RD, SANTA YNEZ	08W	South Coast Valley	1.11	1.11	$ 617	OH	24	40	5,851
93	31269259	ZACA 1101 FOXEN CYN RD, LOS OLIVOS	08W	South Coast Valley	1.21	1.21	$ 611	OH	20	36	6,386
94	35072720	Gabilan 1101 17-0077248	08W	South Coast Valley	2.22	2.22	$ 1,009	OH	26	59	11,745
95	35024926	MARTELL 1101 RECONDCUTOR 3,700FT	08W	Tri-Valley	0.13	0.13	$ 528	OH	7	9	686
96	31360766	FROGTOWN 1701 RECOND 1080FT TO 2AR	08W	Tri-Valley	0.22	0.22	$ 429	OH	9	9	1,162
97	35043291	CWSP- PINE GROVE 1102 LR9145 WFH LEVEL 1	08W	Tri-Valley	2.87	2.87	$ 2,624	OH	73	93	15,171
98	**System Hardening Projects Completed in 2019 Recorded to 08W**			**Subtotals**	**131.6**	**113.2**	**$ 237,502**		**2,805**	**3,766**	**579,739**
99	**Additional System Hardening Projects Completed in 2019 (Not Included in 08W)**			**Subtotals**	**58.0**	**58.0**					
100				**Total Miles Completed in 2019**		**171.2**					
101	**System Hardening 2019 In Progress Projects**					**Subtotal**	**$ 43,564**				
102				**TOTAL SYSTEM HARDENING 2019 COSTS (08W)**			**$ 281,066**				

Workpaper Table 4-22
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
System Hardening Completed Work in 2020 (MAT 08W)
(Thousands of Dollars)

Line No.	Order	Program	Description	Planned Miles	2020 Completed Miles	Underground Miles	2020 Recorded	Poles Retired (Quantity)	Poles Installed (Quantity)	Covered Conductor Feet
1	31343500	SH	CWSP ORINDA 401 HIGH SPLICE COUNT	1.51	1.51		$ 2,695	69	75	7,973
2	31098626	SH	CLARKSVILLE 2104 RECONDUCTOR -PH 3 Y2018	1.52	1.53		$ 754	23	27	8,078
3	31207090	SH	MVWF VIEWPOINT RD TENNVLY CNTY ALTO 1125	1.80	1.80		$ 3,329	66	66	9,504
4	35058905	SH	CWSP - VOLTA 1102 - LR 1648 -PH 4.1	2.11	0.75		$ 707	50	71	3,960
5	35095166	SH	CWSP - EL DORADO 2102 - LR19562 - PH 1.0	1.43	1.40		$ 2,104	56	49	7,392
6	35103325	SH	CWSP - MORAGA 1102 & 1104 - OCB	1.31	1.31	0.71	$ 3,141	26	22	3,162
7	35106265	SH	CWSP - VOLTA 1102 - LR 1648 - PH1.3	1.80	1.71		$ 1,663	47	54	9,029
8	35061213	SH	CWSP-BRUNSWICK 1103 LR50070 ZONE-PH3	1.34	1.34		$ 2,321	75	61	7,075
9	35085538	SH	SILVERADO 2105 WIRE DOWN - PH 1	1.97	1.01		$ 1,322	53	31	5,333
10	35094394	SH	OCGC CWSP-KONOCTI 1102-LR 532 PH 7	1.47	1.47		$ 1,474	71	38	7,762
11	35109545	SH	CWSP - EL DORADO 2101 - 19752 -PHASE 2.2	2.43	2.43		$ 3,255	90	84	12,830
12	35109552	SH	CWSP - EL DORADO 2101 - 19752 -PHASE 3.5	2.12	0.28		$ (76)	101	74	1,478
13	35109548	SH	CWSP - EL DORADO 2101 - 19752 -PHASE 2.5	2.85	2.85		$ 4,972	159	133	15,048
14	35109550	SH	CWSP - EL DORADO 2101 - 19752 -PHASE 3.3	1.91	0.29		$ (222)	74	63	1,531
15	35106042	SH	CWSP - VOLTA 1102 - LR 1648 - PH1.2	1.82	1.08		$ 1,066	35	59	5,702
16	35107689	SH	OCGC CWSP - PINE GROVE 1102 - LR1222 -	2.03	2.09		$ 3,452	61	85	11,035
17	35109554	SH	CWSP - EL DORADO 2101 - 19752 -PHASE 4.2	1.26	1.26		$ 2,030	37	39	6,653
18	35110440	SH	CWSP-VOLTA 1102-LR 1648-PH2.5	2.64	2.64		$ 1,843	60	100	13,939
19	35110447	SH	CWSP-VOLTA 1102-LR 1648-PH4.4	1.17	1.17		$ 1,995	27	39	6,178
20	35112076	SH	OCGC FULTON 1107-OH TO UG MARK W SPG	2.20	2.03	0.69	$ 4,089	39	36	7,061
21	35103323	SH	CWSP - MORAGA 1101 - LR 108540 - PH 2	1.11	1.11		$ 2,939	45	48	5,861
22	35103324	SH	CWSP - ROSSMOOR 1102 - OCB	0.77	0.31		$ 667	14	18	1,637
23	35106331	SH	CWSP - VOLTA 1102 - LR 1648 - PH1.4	2.33	2.33		$ 2,827	61	79	12,302
24	35109540	SH	CWSP-EL DORADO 2101-19752- PHASE 1.2	1.34	1.34		$ 1,793	28	35	7,075
25	35110443	SH	CWSP-VOLTA 1102-LR 1648-PH3.3	1.26	0.16		$ 79	31	39	845
26	35110444	SH	CWSP-VOLTA 1102-LR 1648-PH3.4	1.47	0.69		$ 523	46	57	3,643
27	35112433	SH	CWSP - EL DORADO 2102 - LR19562 - PH 1.3	2.00	2.00		$ 2,689	51	69	10,560
28	35113101	SH	CWSP - WEST POINT 1101 -LR 13444- PH 2.5	2.05	2.05		$ 1,179	45	56	10,824
29	35114043	SH	CWSP - PINE GROVE 1102 - LR1222 - PH 1.5	1.05	1.05		$ 837	32	39	5,544
30	35115147	SH	CWSP-BRUNSWICK 1103 LR50070 ZONE-PH 3.2	1.23	1.23		$ 1,585	38	54	6,494
31	35115149	SH	CWSP-BRUNSWICK 1103 LR50070 ZONE-PH 3.4	1.27	1.27		$ 2,740	58	52	6,706
32	35116802	SH	CWSP-MIWUK 1702-LR 6018-PHASE 1.4	2.41	2.22		$ 2,455	73	86	11,722
33	35109556	SH	CWSP - EL DORADO 2101 - 19752 -PHASE 4.4	0.31	0.31		$ 209	17	13	1,637
34	35110441	SH	CWSP-VOLTA 1102-LR 1648-PH2.6	2.23	2.23		$ 2,876	58	78	11,774
35	35110442	SH	CWSP-VOLTA 1102-LR 1648-PH3.2	1.36	0.03		$ (1,257)	26	37	158
36	35112431	SH	CWSP - EL DORADO 2102 - LR19562 - PH 1.1	1.54	1.54		$ 2,512	41	51	8,131
37	35112432	SH	CWSP - EL DORADO 2102 - LR19562 - PH 1.2	2.51	2.51		$ 3,191	87	73	13,253
38	35114104	SH	XCWSP - CAMP EVERS 2106 - LR5020 -PH 2.6	1.47	1.47		$ 1,945	58	60	7,762
39	35112426	SH	CWSP - EL DORADO 2101 - OCBZONE - PH 1.3	1.72	0.01		$ (8)	41	47	53
40	35112437	SH	CWSP - EL DORADO 2102 - LR19562 - PH 1.7	2.76	2.67		$ 2,876	130	86	14,098
41	35113105	SH	CWSP - LOS GATOS 1106 - LB44 - PHASE 1.4	0.72	0.72		$ 1,225	30	21	3,802
42	35109738	SH	CWSP-VOLTA 1102-LR 1648-PH2.3	2.08	2.08		$ 2,119	53	73	10,982
43	35112428	SH	CWSP - EL DORADO 2101 - OCBZONE - PH 1.5	1.62	1.62		$ 2,180	79	54	8,554
44	35112435	SH	CWSP - EL DORADO 2102 - LR19562 - PH 1.5	1.33	1.12		$ 2,380	57	59	5,914
45	35115150	SH	CWSP-BRUNSWICK 1103 LR50070 ZONE-PH 3.5	1.18	1.18		$ 1,099	47	43	6,230
46	35116390	SH	CWSP - MIWUK 1701 - LR 8060 - PH 1.7	0.90	0.90		$ 700	23	31	4,752
47	35053033	SH	CWSP - TASSAJARA 2112 - FUSE 18053	5.90	5.90		$ 8,546	112	113	31,152
48	35114102	SH	CWSP - CAMP EVERS 2106 - LR5020 - PH 2.4	0.74	0.16		$ 585	16	22	845
49	35115155	SH	CWSP-BRUNSWICK 1103 LR50070 ZONE-PH 1.2	1.78	1.78		$ 2,960	77	65	9,398
50	35115156	SH	CWSP-BRUNSWICK 1103 LR50070 ZONE-PH 1.3	1.90	1.90		$ 2,897	50	74	10,032
51	35116391	SH	CWSP - MIWUK 1702 - OCB - PH 1.2	2.07	1.38		$ 1,532	64	62	7,286
52	35116442	SH	CWSP-MIWUK 1702-LR 38218-PH 1.3	2.10	1.79		$ 1,847	70	86	9,451
53	35115157	SH	CWSP-BRUNSWICK 1103 LR50070 ZONE-PH 1.4	1.98	1.79		$ 3,798	64	84	9,451
54	35116393	SH	CWSP - MIWUK 1702 - OCB - PH 1.3	2.57	2.57		$ 3,491	132	95	13,570
55	35116394	SH	CWSP - MIWUK 1702 - OCB - PH 1.4	1.68	1.68		$ 1,696	85	52	8,870
56	35117444	SH	CWSP - VOLTA 1102 LR 1648 PH 2.1	2.40	2.40		$ 3,167	69	93	12,672
57	35119401	SH	CWSP - CAMP EVERS 2106 - 5020 - PHASE 2	1.08	1.08		$ 1,583	43	40	5,702
58	35119969	SH	CWSP - LOS GATOS 1106 - LB44 - PH 4.2	1.28	1.28		$ 1,663	42	28	6,758
59	35107688	SH	CWSP - VOLTA 1102 - LR 1648 -PH1.1	1.63	1.63		$ 1,684	48	57	8,606
60	35109553	SH	CWSP - EL DORADO 2101 - 19752 -PHASE 3.6	2.67	1.25		$ 1,286	127	89	6,600
61	35112427	SH	CWSP - EL DORADO 2101 - OCBZONE - PH 1.4	0.96	0.89		$ 1,143	25	32	4,699
62	35112429	SH	CWSP - EL DORADO 2101 - OCBZONE - PH 1.6	1.39	1.39		$ 2,097	79	65	7,339
63	35112434	SH	CWSP - EL DORADO 2102 - LR19562 - PH 1.4	1.53	1.50		$ 2,234	71	49	7,920
64	35112436	SH	CWSP - EL DORADO 2102 - LR19562 - PH 1.6	1.80	1.80		$ 2,620	94	65	9,504
65	35114101	SH	CWSP - CAMP EVERS 2106 - LR5020 - PH 2.3	1.30	1.30		$ 1,277	33	34	6,864
66	35119966	SH	CWSP - LOS GATOS 1106 - LB44 - PH 2.6F	0.82	0.82		$ 811	17	18	4,330
67	35113102	SH	CWSP - WEST POINT 1101 -LR 13444- PH 2.6	2.18	2.18		$ 1,122	44	58	11,510
68	35052820	SH	CWSP - MIWUK 1702 - OCB - PH 1.1	2.01	2.01		$ 3,224	95	75	10,613
69	35119970	SH	CWSP - LOS GATOS 1106 - LB44 - PH 4.3	0.59	0.59		$ 1,818	38	22	3,115
70	35135864	SH	CWSP - GRAYS FLAT 401 FUSE 3079 ZONE	1.76	1.75		$ 124	0	2	9,240
71	35098621	SH	CWSP-COLUMBIA HILL 1101-LR 2212 PH4	1.07	0.34		$ 1,628	35	10	1,795
72	35109551	SH	CWSP - EL DORADO 2101 - 19752 -PHASE 3.4	1.44	0.34		$ (28)	55	45	1,795

Workpaper Table 4-22
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
System Hardening Completed Work in 2020 (MAT 08W)
(Thousands of Dollars)

Line No.	Order	Program	Description	Planned Miles	2020 Completed Miles	Underground Miles	2020 Recorded	Poles Retired (Quantity)	Poles Installed (Quantity)	Covered Conductor Feet
73	35112425	SH	CWSP - EL DORADO 2101 - OCBZONE - PH 1.2	1.30	1.30		$ 2,111	77	41	6,864
74	35114431	SH	CWSP - MORAGA 1101 - LR108540 - PH5	1.44	1.44	0.03	$ 3,832	66	68	7,437
75	35110445	SH	CWSP-VOLTA 1102-LR 1648-PH4.2	1.64	0.19		$ 543	49	55	1,003
76	35109555	SH	CWSP - EL DORADO 2101 - 19752 -PHASE 4.3	2.21	1.46		$ 807	117	70	7,709
77	35114042	SH	OCGC PINE GROVE 1102 - LR1222 - PH 1.4	1.35	1.17		$ 1,293	45	53	6,178
78	74022388	SH	OCGC CWSP: X-1104 OH RECOND SKYLINE	0.85	0.72	0.72	$ 3,874	23	23	-
79	74022390	SH	CWSP - SILVERADO 2104- LR722-PH 1A	0.97	0.97		$ 2,252	42	34	5,122
80	74028021	SH	CWSP - MIRABEL 02/MONTE RIO 13-LR652 PH2	1.84	1.84		$ 3,483	94	114	9,715
81	35116804	SH	CWSP-MIWUK 1702-LR 6018-PHASE 1.6	1.03	1.02		$ 1,450	54	38	5,386
82	35085535	SH	CWSP - SILVERADO 2104 - LR722 PH 1F	1.67	1.67		$ 1,979	52	30	8,818
83	35085534	SH	CWSP - SILVERADO 2104 - LR722 PH 1E	0.79	0.72		$ 1,317	38	20	3,802
84	35103065	SH	CWSP - MORAGA 1101 - LR 108540 PH 1	2.39	0.07		$ 227	77	77	370
85	35109547	SH	CWSP - EL DORADO 2101 - 19752 -PHASE 2.4	1.53	1.53		$ 2,777	94	71	8,078
86	35109549	SH	CWSP - EL DORADO 2101 - 19752 -PHASE 3.2	1.34	0.65		$ 380	61	45	3,432
87	35114044	SH	CWSP - PINE GROVE 1102 - LR1222 - PH 1.6	1.16	0.08		$ 1,071	44	52	422
88	35115148	SH	CWSP-BRUNSWICK 1103 LR50070 ZONE-PH 3.3	2.14	2.01		$ 3,388	61	73	10,613
89	35116801	SH	CWSP-MIWUK 1702-LR 6018-PHASE 1.3	1.28	0.37		$ 1,385	27	41	1,954
90	35058273	SH	CWSP- EL DORADO 2101 OCB ZONE PHASE 1	1.18	1.18		$ 3,029	39	39	6,230
91	74021963	SH	CWSP - OAKLAND K 1102 OCB ZONE	2.76	0.29		$ 779	75	93	1,531
92	35031662	SH	CWSP - LOS GATOS 1106 - LB44 - PHASE 2.1	0.56	0.56	0.10	$ 976	22	13	2,446
93	35115158	SH	CWSP-BRUNSWICK 1103 LR50070 ZONE-PH 1.5	2.15	2.15		$ 3,384	107	76	11,352
94	35085539	SH	SILVERADO 2105 WIRE DOWN - PH 2	1.94	0.83		$ 1,100	27	27	4,382
95	35109739	SH	CWSP-VOLTA 1102-LR 1648-PH2.4	2.34	1.10		$ 1,801	54	92	5,808
96	31248532	SH	CWSP HALF MOON BAY 1101 LS CO4063	0.74	0.74		$ 1,473	17	24	3,907
97	35116800	SH	CWSP-MIWUK 1702-LR 6018-PHASE 1.2	1.37	0.74		$ 1,310	40	49	3,907
98	35085537	SH	CWSP - SILVERADO 2104 - LR722 PH 1H	0.71	0.12		$ 157	30	17	634
99	35094393	SH	OCGC KONOCTI - 1102 - LR 532 PH 6 (OH)	2.02	2.02		$ 1,795	124	58	10,666
100	35109737	SH	CWSP-VOLTA 1102-LR 1648-PH2.2	2.20	1.83		$ 1,316	54	72	9,662
101	35110446	SH	CWSP-VOLTA 1102-LR 1648-PH4.3	2.16	2.16		$ 2,533	64	65	11,405
102	35110448	SH	CWSP-VOLTA 1102-LR 1648-PH4.5	1.99	1.99		$ 2,599	75	88	10,507
103	35114049	SH	CWSP - PINE GROVE 1102 - LR1222 - PH 2.4	1.59	0.71		$ 1,037	41	49	3,749
104	35115855	SH	CWSP-SALT SPRINGS 2102-LR3142L491-PH 1.4	1.12	1.08		$ 1,544	35	71	5,702
105	74022384	SH	CWSP - FITCH MOUNTAIN 1113 LR 24918	5.55	0.96		$ 3,832	108	195	5,069
106			**Subtotals**	**178.61**	**141.27**	**2.3**	**$ 199,909**	**6,006**	**5,932**	**734,015**
107	**System Hardening Fire Rebuild Completed Projects**									
108	35193574	Fire Rebuild	SR-CC-SANTA CRUZ-08-16-20 CZU AUG FIRE	10.05	10.04		$ 12,254	925	830	53,011
109	31272374	Fire Rebuild	CWSP PT. MORETTI FROM 5043 TO 5955	6.97	6.66		$ 2,236	86	94	35,165
110	35194522	Fire Rebuild	SR-CC-SANTA CRUZ-08-16-20 CZU COMPLEX	0.51	0.51	0.51	$ 4	0	0	-
111	31511571	Fire Rebuild	NR-NB-NAPA- 8/17/20-LNU COMPLEX FIRE OH	28.28	27.29		$ 84,351	487	493	144,113
112	35193618	Fire Rebuild	NR-SO-SONOMA 8/17/20-LNU COMPLEX FIRES	13.86	13.86		$ 5,181	364	370	73,169
113	35193614	Fire Rebuild	EP 9265 ALHAMBRA AVE MORADA	14.06	13.07		$ 9,808	680	697	69,002
114	35193585	Fire Rebuild	SR-CC-MONTEREY-08-16-20 RIVER/CARMEL/DOL	1.14	0.94		$ 2,873	142	139	4,965
115	35194291	Fire Rebuild	NO-SA-SOLANO-8/18/20-LNU LIGHTNING FIRE	7.90	7.77		$ 5,720	344	352	41,004
116	35199565	Fire Rebuild	NO-NV-BUTTE 9/8/20- N. CMPLX FIRE SYS H	30.10	28.23	1.47	$ 56,823	1243	1166	141,268
117	35199649	Fire Rebuild	CV-YO-MADERA - 9/10/20 CREEK FIRE SYS H	0.96	0.96		$ 1,551	281	24	5,058
118	35199922	Fire Rebuild	CV-FR - CREEK 9/13/20 - CREEK FIRE SYS H	18.60	17.63	0.40	$ 5,606	508	521	90,974
119	35204298	Fire Rebuild	NO-HB-TRINITY-9/10/20-LOW GAP FIRE SYS H	2.50	2.50		$ 2,508	57	57	13,204
120	35204191	Fire Rebuild	NO-NV- SHASTA 9/27/20 ZOGG FIRE SYS HRDN	11.32	11.03		$ 52	295	319	58,221
121	35204446	Fire Rebuild	NR-NB-NAPA- 9/28/20- GLASS FIRE SYS HARD	22.43	20.25		$ 9,658	467	380	106,920
122	35204225	Fire Rebuild	NR-SO-SONOMA- 9/28/20- GLASS FIRE SYS H	35.21	33.44		$ 6,558	585	626	176,563
123			**Subtotals**	**203.88**	**194.17**	**2.38**	**$ 205,183**	**6,464**	**6,068**	**1,012,638**
124	**Additional System Hardening Projects Completed in 2020 (Not Included in 08W)**			**7.01**	**6.70**					
125				**Total Miles Completed**	**342.14**					
126	**System Hardening In Progress Projects**					**Subtotal**	**$ 55,049**			
127						**TOTAL SYSTEM HARDENING 2020 COSTS (08W)**	**$ 460,141**			

Workpaper Table 4-23
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
System Hardening Forecast Details
(Nominal Dollars)

Line No.		MAT Code	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions	Reference
1	System Hardening - Overhead Miles	08W	180	305	170	50	50	50		
2	Cost per Overhead Mile	08W	$ 1,600,000	$ 1,200,000	$ 1,561,040	$ 1,630,140	$ 1,678,364	$ 1,728,036		
3	*Total Overhead Hardening Cost*	08W	$ 288,000,000	$ 366,000,000	$ 265,376,800	$ 81,506,979	$ 83,918,200	$ 86,401,800		
4	System Hardening - Underground Miles	08W	20	163	357.3	763.5	976.1	1200		
5	Cost per Underground Mile	08W	$ 4,306,000	$ 3,750,000	$ 3,337,750	$ 3,164,187	$ 2,978,818	$ 2,781,133		
6	*Total Underground Hardening Cost*	08W	$ 86,120,000	$ 611,250,000	$ 1,192,578,075	$ 2,415,856,775	$ 2,907,624,250	$ 3,337,359,600		
7	***Total System Hardening Cost***	08W	**$ 374,120,000**	**$ 977,250,000**	**$ 1,457,954,875**	**$ 2,497,363,753**	**$ 2,991,542,450**	**$ 3,423,761,400**	(1)	
8	Community Rebuild - Circuit Miles	08W	9.7	14.1	16.2	13.9	9.1	0	(3)	
9	***Total Community Rebuild Cost***	08W	**$ 41,534,000**	**$ 52,875,000**	**$ 54,071,550**	**$ 43,982,199**	**$ 27,107,244**	**$ -**	(2)	
10	**Total 08W Program Cost**	**08W**	**$ 415,654,000**	**$ 1,030,125,000**	**$ 1,512,026,425**	**$ 2,541,345,952**	**$ 3,018,649,694**	**$ 3,423,761,400**		WP 4-88

11 **Forecast Assumptions and Details**

(1) PG&E is making a fundamental shift in its system hardening strategy to focus on undergrounding as the primary initiative and now plans to install fewer miles of overhead system hardening and more miles of underground system hardening.

(2) Unit cost is not used to calculate budgets for the Community Rebuild Program. PG&E determines the total program cost using a risk model developed by the Enterprise Project Committee.

(3) Miles represent overhead line miles, 2022-2025 miles shown in testimony have been converted to underground circuit miles using a factor of 1.5747 for every 1.0 of relocated overhead circuit mile.

Workpaper Table 4-24
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Unit Cost and Forecast Details: MAT 08W

Line No.		
1	**MAT Code**	08W
2	**GRC Ch.**	4.3 - System Hardening, Enhanced Automation and PSPS Impact Mitigations
3	**MAT Code Definition**	Wires Down Generated Projects and System Hardening Wildfire Resiliency Projects – Performing targeted HFTDs site specific primary conductor replacement, secondary conductor replacement, replacement of non-exempt equipment, replacement of OH electric distribution line transformers, replacement of existing wood poles with more resilient poles, upgrades to electrical protective devices and systems through equipment replacements and device programming. Prior to 2018, this MAT was used for overhead conductor replacements associated with PG&E's wires-down program; this work has been moved to MAT 08J. Units measured: Number of circuit miles. This program relates directly to safety, reliability, and maintenance because the work can be initiated based on: (1) deteriorated conductor identification, (2) fire-risk ignition modeling, (3) bundling of electric corrective tags identified as part of the WSIP, or (4) PSPS mitigation; and is completed in compliance with PG&E's Fire Rebuild Design Guidance for System Hardening.

	Risk ID	Type	Name
4	DOVHD-M002	Mitigation	System Hardening
5	WLDFR-M002	Mitigation	System Hardening
6	WLDFR-M10D	Mitigation	Additional System Automation and Protection - DTS FAST

7	**Program Area**	Risk Reduction
8	**Forecast Method**	Unit cost, multiple
9	**Unit of Measure**	Circuit Miles of Conductor
10	**Unit Cost (2023)**	-
11	**Unit Cost Forecast Basis**	Recent historic costs for overhead and underground work.
12	**Unit Forecast Basis**	Committed number of overhead and underground miles hardened.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
13	**Recorded Costs**	$ -	$ 69,914	$ 23,669,520	$ 297,883,949	$ 484,915,413	
14	**No. of Units**	-	-	-	-	**(B)**	
15	**Unit Cost**	$ -	$ -	$ -	$ -	$ -	

	Overhead	Forecast Costs & Units (Escalated) (A) (C)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
16	Forecast	$ 288,000,000	$ 366,000,000	$ 265,376,800	$ 81,506,979	$ 83,918,200	$ 86,401,800	Calculated - Line 17 * Line 18
17	Units (Miles)	180	305	170	50	50	50	
18	Unit Cost	1,600,000	1,200,000	1,561,040	1,630,140	1,678,364	1,728,036	

	Underground	Forecast Costs & Units (Escalated) (A) (C)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
19	Forecast	$ 86,120,000	$ 611,250,000	$ 1,192,578,075	$ 2,415,856,775	$ 2,907,624,250	$ 3,337,359,600	Calculated - Line 20 * Line 21
20	Units (Miles)	20	163	357	764	976	1,200	
21	Unit Cost	$ 4,306,000	$ 3,750,000	$ 3,337,750	$ 3,164,187	$ 2,978,818	$ 2,781,133	

	Butte Rebuild	Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
22	Forecast	$ 41,534,000	$ 52,875,000	$ 54,071,550	$ 43,982,199	$ 27,107,244	$ -	Calculated - Line 23 * Line 24
23	Units (Miles)	10	14	16	14	9	-	
24	Unit Cost	$ 4,281,856	$ 3,750,000	$ 3,337,750	$ 3,164,187	$ 2,978,818	$ -	

	Total	Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
25	Forecast	$ 415,654,000	$ 1,030,125,000	$ 1,512,026,425	$ 2,541,345,952	$ 3,018,649,694	$ 3,423,761,400	Calculated - Line 16 + Line 19 + Line 22
26	Units (Miles)	210	482	544	827	1,035	1,250	Calculated - Line 17 + Line 20 + Line 23

Notes

27 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.
28 **(B)** Recorded system hardening units for 2020 are: 330.8 overhead miles; 4.6 underground miles;16.38 Butte County rebuild miles.
29 **(C)** There is a slight difference between the overhead and underground forecast split in control file and numbers presented above, however the total forecast dollars tie.

Workpaper Table 4-25
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Unit Cost and Forecast Details: MAT 2AP

Line No.

1	**MAT Code**	2AP
2	**GRC Ch.**	4.3 - System Hardening, Enhanced Automation and PSPS Impact Mitigations
3	**MAT Code Definition**	OH Capital Projects – Major OH projects, defined as jobs costing more than $100,000 per location. This program relates to safety and maintenance because it includes replacement of non-exempt fuses with exempt equipment types which is a wildfire mitigation.

	Risk ID	Type	Name
4	DOVHD-M004	Mitigation	Expulsion Fuse Replacement
5	WLDFR-M004	Mitigation	Expulsion Fuse Replacement

6	**Program Area**	Risk Reduction
7	**Forecast Method**	Unit cost
8	**Unit of Measure**	# of Locations
9	**Unit Cost (2023)**	$ 13,281
10	**Unit Cost Forecast Basis**	Implied based on planned units and forecast.
11	**Unit Forecast Basis**	Planned installations during GRC period. Includes approx. 1,200 units per year.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
12	**Recorded Costs**	$ -	$ -	$ 318	$ 9,130,304	$ 7,846,531	Calculated - Line 13 * Line 14
13	**No. of Units**	-	-	-	707	643	
14	**Unit Cost**	$ -	$ -	$ -	$ 12,914	$ 12,203	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
15	**Forecast Costs**	$ 15,124,923	$ 15,388,477	$ 15,751,717	$ 16,257,250	$ 16,777,228	$ 17,314,355	Calculated - Line 16 * Line 17
16	**No. of Units**	1,200	1,190	1,186	1,192	1,198	1,204	
17	**Unit Cost**	$ 12,604	$ 12,932	$ 13,281	$ 13,640	$ 14,008	$ 14,386	

18 **Notes**
(A) Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 4-26
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Unit Cost and Forecast Details: MAT 49H

Line No.

1	**MAT Code**	49H
2	**GRC Ch.**	4.3 - System Hardening, Enhanced Automation and PSPS Impact Mitigations
3	**MAT Code Definition**	PSPS SCADA Sectionalizing Device Install/Replace – Units measured: Number of SCADA Secitionalizing devices. This program relates to safety, reliability, or maintenance because it directly funds the installation of automated electrical equipment designed to isolate faulted lines, limit line reclosing, and facilitate the remote opening and closing of switches necessary to efficiently implement PSPS.

	Risk ID	Type	Name
4	WLDFR-M006	Mitigation	PSPS Impact Reduction Initiatives - Sectionalizer Device Install/Replace

5	**Program Area**	Risk Reduction
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	Number of SCADA Secitionalizing devices
8	**Unit Cost (2023)**	$ 119,326
9	**Unit Cost Forecast Basis**	Implied based on planned units and forecast.
10	**Unit Forecast Basis**	Planned installations during GRC period. Includes 190 devices in 2022, and 100 each year 2023-2026.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ -	$ -	$ 452	$ 51,093,720	$ 69,440,765	Calculated - Line 12 * Line 13
12	**No. of Units**	-	-	-	232	603	
13	**Unit Cost**	$ -	$ -	$ -	$ 220,232	$ 115,159	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 42,890,115	$ 20,918,670	$ 11,932,627	$ 12,255,375	$ 12,586,050	$ 12,925,785	Calculated - Line 15 * Line 16
15	**No. of Units**	250	190	100	100	100	100	
16	**Unit Cost**	$ 171,560	$ 110,098	$ 119,326	$ 122,554	$ 125,861	$ 129,258	

Notes

17 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 4-27
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Unit Cost and Forecast Details: MAT 49I

Line No.		
1	**MAT Code**	49I
2	**GRC Ch.**	4.3 - System Hardening, Enhanced Automation and PSPS Impact Mitigations
3	**MAT Code Definition**	OH Fault Indicators/Line Sensors Install/Replace – Install new OH fault indicators or line sensors to improve reliability. Units measured: Number of devices. This program relates to safety, reliability, or maintenance because it provides funding to support the installation of devices which assist with quickly identifying faulted lines leading to improved electric reliability to customers.

	Risk ID	Type	Name
4	WLDFR-M011	Mitigation	Situational Awareness and Forecasting Initiatives - EFD
5	WLDFR-M07A	Mitigation	Situational Awareness and Forecasting Initiatives - Line Sensors
6	WLDFR-M012	Mitigation	Situational Awareness and Forecasting Initiatives - DFA

7	**Program Area**	Risk Reduction
8	**Forecast Method**	Unit cost, multiple
9	**Unit of Measure**	ECCVM sensors, RF Radio, Line Sensors
10	**Unit Cost (2023)**	-
11	**Unit Cost Forecast Basis**	Bottom-up forecast estimate.
12	**Unit Forecast Basis**	Workplan for installing new sensors based on plans to address high-risk circuits.

		Recorded Costs & Units					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
13	**Recorded Costs**	$ -	$ -	$ -	$ 2,763,890	$ 2,272,431	
14	**No. of Units**	-	-	-	-	-	
15	**Unit Cost**	$ -	$ -	$ -	$ -	$ -	

	Line Sensors	Forecast Costs & Units (Escalated)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
16	Forecast	$ 7,356,999	$ 8,037,499	$ 8,253,730	$ 6,474,382	$ 5,964,393	$ 6,125,139	Calculated - Line 17 * Line 18
17	Units (Sensors Installed)	900	900	900	900	900	900	
18	Unit Cost	$ 8,174	$ 8,931	$ 9,171	$ 7,194	$ 6,627	$ 6,806	

	Early Fault Detection Sensors	Forecast Costs & Units (Escalated)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	Calculated - Line 19 * Line 20
19	Forecast	$ 1,417,978	$ 4,647,411	$ 5,434,485	$ 6,234,073	$ 7,485,962	$ 8,785,806	
20	Units (Sensors Deployed)	50	150	250	300	350	400	
21	Unit Cost	$ 28,360	$ 30,983	$ 21,738	$ 20,780	$ 21,388	$ 21,965	

	Distribution Fault Anticipation Technology	Forecast Costs & Units (Escalated)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	Calculated - Line 22 * Line 23
22	Forecast	$ 3,593,732	$ 10,350,735	$ 8,965,259	$ 9,002,113	$ 9,245,308	$ 9,494,517	
23	Units (Installed)	44	116	116	116	116	116	
24	Unit Cost	$ 81,676	$ 89,230	$ 77,287	$ 77,604	$ 79,701	$ 81,849	

	Total	Forecast Costs & Units (Escalated)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
25	Forecast	$ 12,368,708	$ 23,035,645	$ 22,653,474	$ 21,710,568	$ 22,695,663	$ 24,405,462	Calculated - Line 16 + Line 19 + Line 22
26	Units	994	1,166	1,266	1,316	1,366	1,416	Calculated - Line 17 + Line 20 + Line 23

	Notes	
27	**(A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 4-28
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Unit Cost and Forecast Details: MAT 49T

Line No.

1	**MAT Code**	49T
2	**GRC Ch.**	4.3 - System Hardening, Enhanced Automation and PSPS Impact Mitigations
3	**MAT Code Definition**	Electric Distribution Single-Phase Cutout-Mounted Recloser – Install new FuseSaver equipment with gang tripping to prevent backfeed for single-phase wire down conditions. The FuseSavers installed as part of chapter 4.3 for wildfire locations will have SCADA. Units measured: FuseSavers installed. This program relates to safety, reliability, or maintenance because it directly funds the installation of electrical overhead equipment designed to isolate faulted lines, limit the scope of electrical outages, and improve electric service reliability.

	Risk ID	Type	Name
4	DOVHD-C014	Control	Additional System Automation and Protection - FuseSaver
5	WLDFR-M10B	Control	Additional System Automation and Protection - FuseSaver
6	WLDFR-M10B	Mitigation	Additional System Automation and Protection - FuseSaver

7	**Program Area**	Risk Reduction / Asset Management and Reliability
8	**Forecast Method**	Unit cost
9	**Unit of Measure**	FuseSavers installed
10	**Unit Cost (2023)**	$ 36,880
11	**Unit Cost Forecast Basis**	Based on historic costs.
12	**Unit Forecast Basis**	Locations identified based on risk model analysis.

		Recorded Costs & Units (A) (B)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
13	**Recorded Costs**	$ -	$ -	$ -	$ -	$ -	
14	**No. of Units**	-	-	-	-	-	
15	**Unit Cost**	$ -	$ -	$ -	$ -	$ -	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
16	**Forecast Costs**	$ 2,304,747	$ 2,764,442	$ 2,940,000	$ 3,087,000	$ 3,241,000	$ 3,403,000	Calculated - Line 17 * Line 18
17	**No. of Units**	66	77	80	82	83	85	
18	**Unit Cost**	$ 35,000	$ 35,910	$ 36,880	$ 37,877	$ 38,899	$ 39,949	

Notes

19 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

20 **(B)** Recorded costs are shown in Chapter 13

Workpaper Table 4-29
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Chapter 4.5: Information Technology for Wildfire Mitigations Capital Forecast Details
(Thousands of Nominal Dollars)

Line No.		2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Notes	Reference
	MWC 2F													
1	Asset Management & Risk Analysis	$ -	$ -	$ 2,824	$ 2,968	$ 199	$ 5,000	$ 8,500	$ 8,500	$ 8,500	$ 8,000	$ 8,000		WP 4-131
2	Customer Service	$ -	$ -	$ 299	$ 1,118	$ 6,584	$ 2,600	$ 2,000	$ 2,000	$ 3,000	$ 3,000	$ 3,300		WP 4-134
3	Data Enablement	$ -	$ -	$ -	$ (4)	$ 12	$ 2,500	$ 3,300	$ 3,800	$ 5,300	$ 6,300	$ 6,500		WP 4-138
4	Event Management	$ -	$ -	$ 3,002	$ 8,306	$ 9,669	$ 10,200	$ 8,000	$ 8,000	$ 6,000	$ 6,000	$ 6,000		WP 4-142
5	Field Work Management	$ -	$ -	$ -	$ 5,961	$ 4,627	$ 5,000	$ 3,500	$ 3,000	$ 2,500	$ 2,000	$ 1,500		WP 4-148
6	Other	$ -	$ -	$ -	$ -	$ 1,566	$ -	$ -	$ -	$ -	$ -	$ -	(1)	
7	**MWC 2F Total**	$ -	$ -	$ 6,125	$ 18,349	$ 22,658	$ 25,300	$ 25,300	$ 25,300	$ 25,300	$ 25,300	$ 25,300		
8	**Capital Total**	**$ -**	**$ -**	**$ 6,125**	**$ 18,349**	**$ 22,658**	**$ 25,300**	**$ 25,300**	**$ 25,300**	**$ 25,300**	**$ 25,300**	**$ 25,300**		

Notes
(1) These recorded costs are attributed to a cybersecurity project designed to protect PG&E data and assets in the cloud.

Workpaper Table 4-30
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Expense Wildfire Mitigation Costs Including Balancing / Memorandum Account

Line No.	Mitigation Number	Mitigation Name	MAT	Chapter	Balancing/ Memorandum Account	2021	2022	2023
1	WLDFR-M008	Safety and Infrastructure Protection Teams	AB6	4.1	WMBA (A)	$ 30,303,768	$ 24,899,010	$ 25,866,737
2	WLDFR-M07B	SA&FI (B) - Weather Station	AB6	4.1	WMBA	$ 1,571,588	$ 1,640,893	$ 1,764,450
3	WLDFR-M07C	SA&FI - WSOC	AB6	4.1	WMBA	$ 9,139,296	$ 7,180,706	$ -
4	WLDFR-M07D	SA&FI - Cameras	AB6	4.1	WMBA	$ 9,385,275	$ 11,531,860	$ 8,233,734
5	WLDFR-M07E	SA&FI - Satellite Fire Detection	AB6	4.1	WMBA	$ 340,660	$ 351,090	$ 362,079
6	WLDFR-M07G	SA&FI - Partial Voltage Detection	AB6	4.1	WMBA	$ -	$ 84,855	$ 232,759
7	WLDFR-M07H	SA&FI - SOPP Improvements	AB6	4.1	WMBA	$ 1,968,861	$ 2,029,107	$ -
8	WLDFR-M07I	SA&FI - Advance Fire Modeling	AB6	4.1	WMBA	$ 5,969,350	$ 6,152,022	$ 6,344,581
9	WLDFR-M07J	SA&FI - Meteorology	AB6	4.1	WMBA	$ 514,608	$ 530,773	$ 437,526
10	WLDFR-M07K	SA&FI - Fire Potential Index	AB6	4.1	WMBA	$ 154,380	$ 159,104	$ 173,790
11	**Total WMBA**					**$ 59,347,786**	**$ 54,559,420**	**$ 43,415,656**
12								
13	WLDFR-M005	Public Safety Power Shutoff - PSPS Event (Distribution)	AB6	4.2	WMBA	$ 82,741,000	$ 70,782,443	$ 72,997,934
14	WLDFR-M006	EP&R Field Operations	AB6	4.2	WMBA	$ 9,973,977	$ -	$ -
15	WLDFR-M006	EP&R Field Ops Tech Expense	AB6	4.2	WMBA	$ 102,920	$ 106,069	$ -
16	WLDFR-M006	PSPS - EP&R Field Ops Tech Expense	AB6	4.2	WMBA	$ 205,842	$ 212,139	$ -
17	WLDFR-M006	PSPS Collateral/Segment Creations Exp	AB6	4.2	WMBA	$ 102,934	$ 106,069	$ 109,389
18	WLDFR-M006	PSPS EP&R Field Ops Misc.	AB6	4.2	WMBA	$ 257,309	$ 265,173	$ -
19	WLDFR-M006	PSPS Field Exercise Dist. Exp	AB6	4.2	WMBA	$ 2,469,957	$ 2,545,664	$ 2,625,344
20	WLDFR-M006	PSPS Increased Helicopter EU (Dist)	AB6	4.2	WMBA	$ 7,976,004	$ 14,943,700	$ 15,411,438
21	WLDFR-M006	PSPS PMO	AB6	4.2	WMBA	$ 5,532,972	$ 4,501,918	$ 4,642,828
22	WLDFR-M006	PSPS PMO Projects	AB6	4.2	WMBA	$ 1,543,797	$ 1,591,040	$ 1,640,840
23	WLDFR-M006	PSPS Pre-flights Expense	AB6	4.2	WMBA	$ 1,080,618	$ 1,113,728	$ 1,148,588
24	WLDFR-M006	Wildfire Public Engagement Team	AB6	4.2	WMBA	$ 1,158,082	$ 956,692	$ 986,582
25	WLDFR-M006	EP&R Field Operations (Includes Tech, Training and Other Misc.)	AB6	4.2	WMBA	$ -	$ 6,902,959	$ -
26	WLDFR-M006	CRC Preparedness Program	AB6	4.2	WMBA	$ 14,774,124	$ 15,226,255	$ 15,702,837
27	**Total WMBA**					**$ 127,919,536**	**$ 119,253,849**	**$ 115,265,780**
28								
29								
30								
31	WLDFR-M006	Generation Enablement and Deployment PMO	AB#	4.3	WMBA	$ -	$ 2,063,003	$ 1,957,478
35	WLDFR-M006	Generation Enablement and Deployment PMO	IG#	4.3	WMBA	$ 3,030,986	$ -	$ -
33	WLDFR-M07A	SA&FI - Line Sensors	FZA	4.3	WMBA			$ 3,436,991
37	WLDFR-M07A	SA&FI - Line Sensors	HG#	4.3	WMBA	$ -	$ -	$ -
34	WLDFR-M07F	SA&FI - Sensor IQ	AB#	4.3	WMBA		$ -	$ 3,782,683
32	WLDFR-M017	System Hardening - Remote Grid	AB#	4.3	WMBA	$ 1,382,468	$ 1,422,646	$ 1,464,187
36	WLDFR-M017	System Hardening - Remote Grid	KAT	4.3	WMBA	$ -	$ 617,438	$ 953,200
37	**Subtotal WMBA**					$ 4,413,454	$ 4,103,087	$ 11,594,539
38								
39	WLDFR-M07A	SA&FI - Line Sensors	FZA	4.3	Base Distribution	$ 2,344,000	$ 2,575,749	$ -
40	WLDFR-M07F	SA&FI - Sensor IQ	AB#	4.3	FRMMA (C)	$ 145,274	$ -	$ -
41	**Subtotal FRMMA and Base Distribution**					$ 2,489,274	$ 2,575,749	$ -
44	**Total Chapter 4.3**					**$ 6,902,728**	**$ 6,678,836**	**$ 11,594,539**
42								
43	WLDFR-M009	Community Wildfire Safety Program PMO	AB#	4.4	WMBA	$ 15,438,004	$ 14,994,327	$ 13,459,809
44	**Subtotal WMBA**					$ 15,438,004	$ 14,994,327	$ 13,459,809
45								
46	WLDFR-M009	Community Wildfire Safety Program PMO	AB6, IG#	4.4	FRMMA	$ 12,363,517	$ -	$ -
47	**Subtotal FRMMA**					$ 12,363,517	$ -	$ -
48	**Total Ch. 4.4**					**$ 27,801,521**	**$ 14,994,327**	**$ 13,459,809**
49								
50	WLDFR-M020	WMBA - Electric	Various	4.6	WMBA	$ -	$ -	$ 132,588,053
51	WLDFR-M020	Customer Care	IG#	4.6	WMBA	$ -	$ -	$ 18,540,711
52	**Subtotal WMBA**					$ -	$ -	$ 151,128,764
53								
54	WLDFR-M020	FRMMA - Electric	Various	4.6	FRMMA	$ 17,711,092	$ 134,833,000	$ -
55	WLDFR-M020	Customer Care	IG#	4.6	FRMMA	$ 491,944	$ 14,088,000	$ -
56	**Subtotal FRMMA**					$ 18,203,036	$ 148,921,000	$ -
57	**Total Ch. 4.6**					**$ 18,203,036**	**$ 148,921,000**	**$ 151,128,764**
58								
59		Subtotal WMBA Chapter 4 Mitigations				$ 207,118,780	$ 192,910,683	$ 334,864,548
60		Subtotal FRMMA and Base Distribution Chapter 4 Mitigations				$ 33,055,827	$ 151,496,749	$ -
61		**Total Chapter 4 Mitigations**				**$ 240,174,607**	**$ 344,407,432**	**$ 334,864,548**
62								
63								
64	Other Forecast Wildfire Mitigation Costs							
65	N/A	Information Technology for Wildfire Mitigations	IG#	4.5	WMBA	$ 35,700,000	$ 35,700,000	$ 35,700,000
66	WLDFR-M006	PSPS and Wildfire Communications		Exh. 6, Ch. 11	WMBA	$ 15,700,000	$ 15,700,000	$ 9,550,000
67	**Total WMBA**					**$ 51,400,000**	**$ 51,400,000**	**$ 45,250,000**
68								
69	WLDFR-M001	Enhanced Vegetation Management	IGJ	9	VMBA	$ 535,951,926	$ 916,600,000	$ 118,022,400
70	**Total VMBA**					**$ 535,951,926**	**$ 916,600,000**	**$ 118,022,400**
71								
72		**Total WMBA Forecast Wildfire Mitigation Costs**				$ 258,518,780	$ 244,310,683	$ 380,114,548
73		**Total FRMMA, VMBA, and Base Distribution Wildfire Mitigation Costs**				$ 569,007,753	$ 1,068,096,749	$ 118,022,400
74		**Total Wildfire Mitigation Costs**				**$ 827,526,533**	**$ 1,312,407,432**	**$ 498,136,948**

75 Notes
76 (A) Wildfire Mitigation Balancing Account
77 (B) Situational Awareness and Forecasting Initiatives
78 (C) Fire Risk Mitigation Memorandum Account
79 (D) Vegetation Management Balancing Account
80 (E) There are differences in the 2021 and 2022 WMBA forecast costs shown on line 60 when compared to the WMBA forecast costs shown on Exhibit (PG&E-4), Table 4-5, line11.
81 Table 4-5 does not segregate the 2021 and 2022 FRMMA and Base Distribution amounts (line 48) but rather includes them in the WMBA total for those years.

Workpaper Table 4-31
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Capital Wildfire Mitigation Costs Including Balancing / Memorandum Account

Line No.	Mitigation Number	Mitigation Name	MAT	Chapter	Balancing/ Memorandum Account	2021	2022	2023	2024	2025	2026
1	WLDFR-M008	Safety and Infrastructure Protection Teams (Capital)	21A	4.1	WMBA (B)	$ 151,527	$ 1,186,531	$ 247,791	$ 278,200	$ 280,736	$ 290,291
2	WLDFR-M07B	SA& (A) - Weather Station	21A	4.1	WMBA	$ 6,398,910	$ 6,377,353	$ 3,270,045	$ 1,121,774	$ 1,154,914	$ 1,189,192
3	WLDFR-M07C	SA&FI - WSOC	21A	4.1	WMBA	$ 1,542,003	$ 128,624	$ -	$ -	$ -	$ -
4	WLDFR-M07G	SA&FI - Partial Voltage Detection	21A	4.1	WMBA	$ 331,014	$ 627,166	$ -	$ -	$ -	$ -
5	WLDFR-M07I	SA&FI - Advance Fire Modeling	21A	4.1	WMBA	$ 1,028,004	$ -	$ -	$ -	$ -	$ -
6	WLDFR-M07J	SA&FI - Meteorology	21A	4.1	WMBA	$ -	$ 1,055,360	$ 1,082,717	$ 1,889,566	$ 1,905,209	$ 1,966,972
7	**Total WMBA**					**$ 9,451,458**	**$ 9,375,034**	**$ 4,600,553**	**$ 3,289,540**	**$ 3,340,859**	**$ 3,446,455**
8											
9	WLDFR-M006	PSPS Field Ops Tech Capital	21A	4.2	WMBA	$ 1,028,000	$ 994,093	$ -	$ -	$ -	$ -
10	WLDFR-M006	PSPS Reduction Initiatives - PSPS Capital Equipment	21A	4.2	WMBA	$ 2,056,000	$ 1,987,190	$ -	$ -	$ -	$ -
11	WLDFR-M006	CRC Preparedness Program	21A	4.2	WMBA	$ -	$ 255,254	$ 261,723	$ 269,226	$ 276,740	$ 284,285
12	**Total WMBA**					**$ 3,084,000**	**$ 3,236,537**	**$ 261,723**	**$ 269,226**	**$ 276,740**	**$ 284,285**
13											
14	WLDFR-M002	System Hardening	08W	4.3	WMBA	$ 375,440,297	$ 977,250,000	$ 1,457,954,875	$ 2,497,363,753	$ 2,991,542,807	$ 3,423,761,588
15	WLDFR-M002	System Hardening - Butte	08W	4.3	WMBA	$ 40,213,703	$ 52,875,000	$ 54,071,550	$ 43,982,199	$ 27,107,247	$ -
16	WLDFR-M004	Expulsion Fuse Replacement	2AP	4.3	WMBA	$ 15,124,923	$ 15,388,477	$ 15,751,717	$ 16,257,250	$ 16,777,228	$ 17,314,355
17	WLDFR-M006	PSPS Reduction Initiatives - Sectionalizer Device Install/Replace	49H	4.3	WMBA	$ 42,890,115	$ 20,918,670	$ 11,932,627	$ 12,255,375	$ 12,586,050	$ 12,925,785
18	WLDFR-M006	PSPS Reduction Initiatives - Temporary Distribution Microgrids	49M	4.3	WMBA	$ 16,447,871	$ 13,558,896	$ -	$ -	$ -	$ -
19	WLDFR-M011	SA&FI - EFD	49I	4.3	WMBA	$ -	$ -	$ 5,434,485	$ 6,234,073	$ 7,485,962	$ 8,785,806
20	WLDFR-M012	SA&FI - DFA	49I	4.3	WMBA	$ -	$ -	$ 8,965,259	$ 9,002,113	$ 9,245,308	$ 9,494,517
21	WLDFR-M07A	SA&FI - Line Sensors	49I	4.3	WMBA	$ -	$ -	$ 8,253,730	$ 6,474,382	$ 5,964,393	$ 6,125,139
22	WLDFR-M07F	SA&FI - Sensor IQ	21A	4.3	WMBA	$ -	$ -	$ 10,506,738	$ -	$ -	$ -
23	WLDFR-M10A	Additional System Automation and Protection	49A	4.3	WMBA	$ 6,990,247	$ -	$ -	$ -	$ -	$ -
24	WLDFR-M10B	Additional System Automation and Protection - FuseSaver	49T	4.3	WMBA	$ 2,304,747	$ 2,764,442	$ 2,940,000	$ 3,087,000	$ 3,241,000	$ 3,403,000
25	WLDFR-M10C	Additional System Automation and Protection - REFCL	49R	4.3	WMBA	$ -	$ -	$ 17,331,258	$ 17,800,026	$ 18,280,307	$ 18,773,747
26	**Subtotal WMBA**					$ 499,411,902	$ 1,082,755,485	$ 1,593,142,239	$ 2,612,456,171	$ 3,092,230,302	$ 3,500,583,937
27											
28	WLDFR-M011	SA&FI - EFD	49I	4.3	FRMMA (C)	$ -	$ 4,647,411	$ -	$ -	$ -	$ -
29	WLDFR-M012	SA&FI - DFA	49I	4.3	FRMMA	$ -	$ 10,350,735	$ -	$ -	$ -	$ -
28	WLDFR-M07A	SA&FI - Line Sensors	49I	4.3	FRMMA	$ 12,368,708	$ 8,037,499	$ -	$ -	$ -	$ -
29	WLDFR-M10C	Additional System Automation and Protection - REFCL	49R	4.3	FRMMA	$ 8,223,933	$ 16,875,648	$ -	$ -	$ -	$ -
30	**Subtotal FRMMA**					$ 20,592,641	$ 39,911,293	$ -	$ -	$ -	$ -
31	**Total Chapter 4.3**					**$ 520,004,544**	**$ 1,122,666,778**	**$ 1,593,142,239**	**$ 2,612,456,171**	**$ 3,092,230,302**	**$ 3,500,583,937**
32											
33											
34		Subtotal WMBA Chapter 4 Mitigations				$ 511,947,360	$ 1,095,367,056	$ 1,598,004,515	$ 2,616,014,937	$ 3,095,847,901	$ 3,504,314,677
35		Subtotal FRMMA and Base Distribution Chapter 4 Mitigations				$ 20,592,641	$ 39,911,293	$ -	$ -	$ -	$ -
36		**Total Chapter 4 Mitigations**				**$ 532,540,002**	**$ 1,135,278,349**	**$ 1,598,004,515**	**$ 2,616,014,937**	**$ 3,095,847,901**	**$ 3,504,314,677**
37											
38	Other Forecast Wildfire Mitigation Costs										
39	N/A	Information Technology for Wildfire Mitigations	IG#	4.5	WMBA	$ 25,300,000	$ 25,300,000	$ 25,300,000	$ 25,300,000	$ 25,300,000	$ 25,300,000
40	WLDFR-M003	Non-Exempt Surge Arrester Replacement	2AR	11	WMBA	$ 84,688,708	$ 16,804,435				
41	WLDFR-M014	Community Rebuild Program	95F	23	WMBA	$ -	$ -	$ 88,450,375	$ 71,510,626	$ 44,086,512	$ -
42	**Subtotal WMBA**					$ 109,988,708	$ 42,104,435	$ 113,750,375	$ 96,810,626	$ 69,386,512	$ 25,300,000
43											
44	WLDFR-M003	Non-Exempt Surge Arrester Replacement	2AR	11	FRMMA	$ 4,170,681	$ -				
45	WLDFR-M013	Pole Programs - Replace Tree Attachments	07C	12	Base Distribution	$ -	$ 3,302,843	$ 3,296,417	$ 3,499,935	$ 3,709,013	$ 3,923,933
46	**Subtotal FRMMA and Base Distribution**					$ 4,170,681	$ 3,302,843	$ 3,296,417	$ 3,499,935	$ 3,709,013	$ 3,923,933
47											
48		**Total WMBA Forecast Wildfire Mitigation Costs**				$ 621,936,068	$ 1,137,471,491	$ 1,711,754,890	$ 2,712,825,563	$ 3,165,234,413	$ 3,529,614,677
49		**Total FRMMA and Base Distribution Wildfire Mitigation Costs**				$ 24,763,322	$ 43,214,136	$ 3,296,417	$ 3,499,935	$ 3,709,013	$ 3,923,933
50		**Total Wildfire Mitigation Costs**				**$ 646,699,391**	**$ 1,180,685,627**	**$ 1,715,051,307**	**$ 2,716,325,498**	**$ 3,168,943,426**	**$ 3,533,538,610**
51											
52	Notes										
53	(A) Situational Awareness and Forecasting Initiatives										
54	(B) Wildfire Mitigation Balancing Account										
55	(C) Fire Risk Mitigation Memorandum Account										

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT 4 – ELECTRIC DISTRIBUTION, CHAPTER 4.1, SITUATIONAL AWARENESS AND FORECASTING PROGRAM SUMMARY – WILDFIRE CAMERAS

Project Title: Wildfire Cameras
Major Work Categories: AB6
Planning Order Numbers: 5046512
Project Start Date: June 1, 2018
Project Completion Date: 12/31/2022, Ongoing
Operative Date (only applies to Capital): N/A

Project Description

PG&E has been developing systems for early fire detection over the last several years as part of its Wildfire Mitigation Plan. To improve its ability to detect and monitor wildfires, PG&E has utilized an outside vendor since 2018 to install a public access HD camera system similar to those used by CAL FIRE, SoCal Edison and San Diego Gas & Electric. PG&E has committed to installing up to 600 cameras between 2018 and 2022 to achieve visual coverage of approximately 90 percent of the Tier 2 (elevated risk) and Tier 3 (extreme risk) areas of the California Public Utilities Commission's High Fire Threat District (HFTD) map in its service territory. PG&E has budgeted for approximately 10 additional cameras each year from 2023-2026 to aid in optimization efforts. Wildfire cameras improve overall situational awareness and are a valuable tool for assisting the Wildfire Safety Operations Center, first responders, and fire agencies. Wildfire cameras are used by CAL FIRE, Cal OES, USFS, PG&E, and other local agencies to identify, confirm, and track wildfires and general conditions in real-time, from ignition to containment.

PG&E's Wildfire Safety Operations Center, as well as first responders and external agencies such as CAL FIRE and the USFS, have the ability to remotely control the cameras (pan/tilt/zoom) and gain immediate situational awareness within high fire risk areas. Video feeds near the threatened areas provide critical information about the prevailing conditions both prior to and during a wildfire, allowing PG&E analysts to deliver more accurate assessments and reports for key decision makers. In the event of a wildfire, the camera network will further enhance situational awareness, which will be critical to notifying employees and others in or near the impacted area and will allow them to take appropriate personal safety precautions. Live feeds and time-lapse data from this camera network are available to the public at http://www.alertwildfire.org.

PG&E has contracted with the Alert Wildfire consortium, UCSD and University of Nevada Reno to program manage this effort. They will provide and install the cameras, maintain the cameras, including hardware and software, and maintain a fully redundant data center.

The sheer number of cameras makes it impossible to manually monitor each camera feed. Currently PG&E addresses this by leveraging other information such as satellite fire detections and Integrated Reporting Wildfire Information (IRWIN) to help determine which camera(s) should be viewed. PG&E will explore opportunities for improved functionality and automation of the cameras. This may include (AI) early fire detection software, and visualization techniques to display 360° imagery from spinning cameras, allowing cameras to automatically rotate and zoom to view emerging incidents.

Justification

Although there are no financial or avoided costs benefits, this project is intended to reduce the risk associated with catastrophic fires. By utilizing a commercial camera technology, PG&E gains valuable visual intelligence and potential early warning of wildfires that could impact customers, communities and PG&E's electric, gas and IT facilities. The camera system will continue to provide Agency Partners and PG&E with

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT 4 – ELECTRIC DISTRIBUTION, CHAPTER 4.1,
SITUATIONAL AWARENESS AND FORECASTING
PROGRAM SUMMARY – WILDFIRE CAMERAS

additional information to take response actions. In addition, PG&E will provide employees with real time situational awareness to initiate personal safety actions and response.

Wildfire cameras are a mitigation for the wildfire risk (WLDFR-M07D).

Cost

PG&E installed nine cameras in 2018 for a pilot project which tested out the cameras in operation at a forecasted and recorded cost of $0.7 million. PG&E's expense forecast for Wildfire Cameras is $9.4 million in 2021, $11.5 million in 2022, and $8.2 million in 2023. The forecast covers installation and on-going operations and maintenance expenses. PG&E's 2023 forecast is $1.3 million higher than its 2020 recorded costs of $7.0 million. The primary reason for the increase is on-going operations and maintenance expenses.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
EXPENSE												
MWC AB6, 5046512	-	-	692	2,063	6,956	9,385	11,532	8,234				38,862
Expense Total	**-**	**-**	**692**	**2,063**	**6,956**	**9,385**	**11,532**	**8,234**	**-**	**-**	**-**	**38,862**
TOTAL PROJECT COST	**-**	**-**	**692**	**2,063**	**6,956**	**9,385**	**11,532**	**8,234**	**-**	**-**	**-**	**38,862**

Benefits

- Heightened awareness of lightning strikes and wildfire status;
- Ability to more quickly scale wildfire response based on wildfire intelligence provided by the camera network;
- Quicker and detailed understanding of wildfire behavior will allow PG&E to reconfigure its electric and gas systems for safety and to maintain gas and electric reliability
- Quicker and more detailed understanding of wildfire behavior will allow PG&E to position response resources to take damage mitigation actions and safety precautions leading to increased public and employee safety.

Alternatives Considered

- No camera network: Maintain current post-event analysis and response efforts. This option is not recommended because of the benefits the camera system will provide for agencies and PG&E.
- Establishing a network of PG&E proprietary camera equipment and data processing systems. This option was not selected because PG&E determined that the Alert Wildfire Network was the most viable solution due to timeliness and cost reasons. Alert Wildfire also houses CAL FIRE, USFS, SCE, and SDG&E cameras.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.1, SITUATIONAL AWARENESS AND FORECASTING
PROJECT SUMMARY – PARTIAL VOLTAGE DETECTION

Project Title: Partial Voltage Detection
Major Work Categories: IG, 21
Planning Order Numbers: 5046515 (recorded EXP), 5530200 (recorded CAP), 5052539 (EXP), 5539544 (CAP)
Project Start Date: June 1, 2018
Project Completion Date: June 30, 2021
Operative Date (only applies to Capital): Operative as installed

Project Description

As a key component of its Community Wildfire Safety Program initiatives, PG&E is taking a more proactive approach in detecting wires down. Prior to implementing SmartMeter™ technology, Control Center Operators and Dispatch were not provided with information on partial voltage conditions which indicate loss of phase/conductor on the distribution circuit. In addition, SmartMeters™ only informed Control Center Operators of full power out conditions. PG&E is deploying an internally developed Partial Voltage Detection system (formerly referred to as Enhanced Wires Down), which utilizes notifications from SmartMeters™. To support the internally developed system, PG&E has contracted its SmartMeter™ vendor, Itron/SSN, to implement the special functionality to detect Partial Voltage conditions which are indicative of a wire down into the SmartMeters'™ firmware and send the immediate alerts.

PG&E has now enabled this technology on single-phase SmartMeters™. Detection of partial voltage conditions allows Control Center Operators to dispatch field personnel to locations where equipment may be in a condition that increases wildfire risk. This enhanced situational awareness technology will help PG&E detect and locate a wire down condition within minutes, instead of relying on a customer phone call or employee assessment to provide notification of a wire down. This may reduce the amount of time a line is down (where it can cause an ignition) and allow first responders to more quickly extinguish wire down-related ignitions, should they occur.

The initial phase was deployed in 2019 to 4.5 million single-phase SmartMeters™ which provided detection to send real-time alarms occurring in the Distribution Management System under partial voltage conditions (25%-75% of nominal voltage) on three wire distribution circuits (approximately 80% of PG&E circuits). The second phase (which began in 2020 and will continue in 2021) will deploy the technology to 365,000 three-phase meters. The technology will provide more resolution by showing partial (25% -75% of nominal) or complete loss of phase on three-phase meters on three wire distribution circuits, and the addition of detecting loss of phase in three phase meters on four wire distribution circuits (~20% of PG&E circuits and not covered in initial phase).

Partial Voltage Detection is a mitigation for the Wildfire risk: WLDFR-M07G.

Justification

Partial voltage detection is a mitigation for the wildfire risk. The partial voltage detection capability will provide operations with increased situational awareness, and information on open jumper or wire down location versus a complete outage, which will enable better and faster response to these conditions. This technology should allow PG&E to detect and respond to wire down conditions faster than a response based on receiving a call on the wire down condition. The faster response time to a wire down condition may help mitigate a potential fire risk and increase customer safety.

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EXHIBIT (PG&E-4), CHAPTER 4.1, SITUATIONAL AWARENESS AND FORECASTING
PROJECT SUMMARY – PARTIAL VOLTAGE DETECTION

Cost

Due to unforeseen issues with contract negotiations and software issues discovered in testing, the completion date for this project has been revised to June 2021. This deployment schedule change was described in PG&E's December 11, 2020 Change Order Report. The CPUC Wildfire Safety Division approved PG&E's Change Order on January 28, 2021. The project will be complete after the second phase. After 2021, costs will be tied to ongoing operation and maintenance (steady state) unless additional modifications (e.g., new proposed equipment, continuous process improvements) are necessary.

2020 recorded costs ($3.5 thousand) were significantly less than forecast ($0.2 million) due to a delay in phase 2 deployment, and operational costs were less than expected due to minimal maintenance-related expenses. This covers expenses related to corrective and preventative maintenance, software updates, and monitoring which are necessary to continue to operate the program at maximum efficiency. Expense forecasts are expected to be $0.1 million in 2022, $0.2 million in 2023, $0.2 million in 2024, $0.2 million in 2025, and $0.3 million in 2026. PG&E's 2023 forecast is $0.2 million higher than its 2020 recorded costs of $0.004 million. The primary reason for the increase is to cover additional meters and software maintenance to installed meters.

Capital costs may be incurred for phase 2 deployment, including software and continuous improvement. Capital forecasts are expected to be $0.3 million in 2021, and $0.6 million in 2022. Recorded capital dollars for this program was $1.2 million in 2020. Capital expenditures in 2020 covered final software installments, configuration, testing, implementation, monitoring, and system tuning, all of which comprise of development and deployment efforts. The increases in capital in 2021 and 2022 covers any new meters which may be installed with customer care. In the event additional meters go into production, additional rounds of technology updates will be required. There are currently no capital forecast dollars from 2023-2026.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded			Forecast						
	2018	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**Total**
EXPENSE										
MWC IG PO 5046515, 5052539	-	-	4	-	85	233	-	-	-	322
Expense Total	-	-	4	-	85	233	-	-	-	322
CAPITAL										
MWC 21 PO 5530200, 5539544	1,399	391	1,216	331	627	-	-	-	-	3,964
Capital Total	1,399	391	1,216	331	627	-	-	-	-	3,964
TOTAL PROGRAM COST	**1,399**	**391**	**1,220**	**331**	**712**	**233**	**-**	**-**	**-**	**4,286**

Benefits

The benefits of this project include:

- Provide alerts and locational information for wire down and open phase conditions.
- Increase situational awareness of potential wire down conditions for DCCs and WSOC.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.1, SITUATIONAL AWARENESS AND FORECASTING
PROJECT SUMMARY – PARTIAL VOLTAGE DETECTION

- Improve decision making in responding to situations posing wildfire and safety risks
- Reduce response time
- More efficient deployment of field resources

Alternatives Considered

1) Use Special Additional Software to Automatically Send Notifications of Potential Wire Down Conditions: This alternative requires a higher level of vendor effort and cost. System integration would be complex (requires meters to be reprogrammed) and more resource intensive (requires significant IT and operational support) than the recommended option. This option was not recommended because it would have increased risk to the project schedule.

2) Polling Meter State to Identify and Wirelessly Communicate Potential Wire Down Conditions: This alternative requires a high level of developmental resources to implement the solution. Additionally, the solution would add a significant level of traffic to the SmartMeter™ network, taxing the existing applications. This option is not recommended

In view of the technical, cost, and resource constraints, PG&E has decided to proceed with the current proposal.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.1, SITUATIONAL AWARENESS AND FORECASTING
PROGRAM SUMMARY – WILDFIRE DETECTION METEOROLOGY PROJECTS

Program Title: Wildfire Detection Meteorology Projects
Major Work Categories: AB, 21
Planning Order Numbers:
Weather Stations - 5045654, 5531503
SOPP – 5049149, 5052650, 5058322 (CH 5)
Satellite Fire Detection – 5048070
Project Start Date: June 1, 2018
Project Completion Date: 12/31/2022, on-going
Operative Date (only applies to Capital): Operative as installed

Program Description

This program summary describes three separate projects / mitigations described in PG&E's Wildfire Mitigation Program as well as the 2020 RAMP filing: (1) Expanded Weather Station Deployment; (2) Numerical Weather Prediction and SOPP Model Automation; and (3) Satellite Fire Detection System.

Expanded Weather Station Deployment (WLDFR-M07B):
To bolster wildfire prevention and emergency response efforts, PG&E has expanded its weather monitoring capability by installing a network of PG&E-owned and operated weather stations across the service area. The goal of the PG&E weather station program is multi-faceted. There is a benefit to weather stations both from a real time situational awareness perspective and a predictive perspective. Both perspectives benefit not only PG&E but also agency partners like the NWS, CAL FIRE, national and state forests, and other agencies. PG&E's meteorology team embarked on its overall plan to install approximately 1,300 weather stations across its service territory between 2018 and 2022, with project management help from EP&R, IT, and other organizations. PG&E plans to install and/or optimize location of 150 weather stations in 2023, and install an additional 50 weather stations each year from 2024-2026 to fill in data gaps and better support PSPS operations.

Station siting is performed by the Meteorology Department using Google Earth. Weather stations are sited in mostly Tier 2 and Tier 3 HFTDs. The locations are chosen based on accessibility and location from a meteorological standpoint in order to obtain critical fire weather observations at sites with the greatest exposure to offshore Diablo wind events that prompt catastrophic wildfire risk and possible PSPS events. A 3 kilometer (km) by 3 km high-resolution 30-year climatology study is used to develop a detailed historical view of the highest-risk fire weather areas across the service territory. This 3km hi-resolution climatological analysis is currently being re-run with the latest hi-resolution model upgrade to 2km (essentially more than doubling the 3km granularity). This analysis is used as a guide to align weather station placement with highest meteorological risk on and off the PG&E grid. By the end of 2021, there will be a PG&E weather station roughly every 20 circuit miles in Tier 2 and Tier 3 HFTDs.

Critical fire weather conditions persist across the state, far away from PG&E assets and outside of Tier 2 and Tier 3 HFTDs. These areas still need observation from a situational awareness perspective. For example, PG&E may not have assets across portions of the far northern edges of its service territory, however having weather stations alerts meteorologists that conditions are materializing upstream of forecast risk areas. This essentially signals that weather is starting and tracking with forecast models for that place/time and will translate accordingly, downstream to areas planned for PSPS. This is also true for agencies like the NWS that

are monitoring conditions as they materialize and use those observations to adjust critical fire weather forecasts. These observations also help in remote fire response; both as a tool for decision making (e.g., assessing wind conditions and knowing where to place crews or, in the case of CALFIRE, where to place brigades safely). These observations are also incorporated into our fire spread and consequence modeling.

PG&E's robust weather station network provides continuous, localized weather information that facilitates improved understanding of weather conditions in localized areas and real-time awareness of wildfire danger. Additionally, the weather station data improves weather modeling capabilities, and contributes to the selection of the most accurate weather model configuration for PG&E's service territory. This program is a Wildfire mitigation referred to as Situational Awareness and Forecasting Initiatives - Weather Station (WLDFR-M07B).

The weather stations provide various data (e.g., temperature, humidity, wind speed) which are key inputs in PG&E's Advanced Fire Modeling system. Weather stations also help validate and select the best model configuration of our next-generation high (2 kilometer (km)) weather models (discussed below) and the weather station data collected can be used to deploy more accurate weather models in future years.

From 2018 to 2019, PG&E developed an internal web application that presents real-time weather station data from multiple networks (PG&E, NWS, Removal Action Work (RAWS)), and color codes the observations based on the Fosberg Fire Weather Index (FFWI) being observed. The FFWI is an evaluation of fire weather conditions based on wind speed, temperature, and relative humidity. Meteorologists can interact with the data and view data from individual stations or click on a Fire Index Area (FIA) to see a summary of conditions from each weather station in the FIA over the past 24 hours. This real-time information is crucial to PG&E's determining when the 'all clear' can begin following Public Service Power Shutoff (PSPS) patrol and restoration.

Weather station data is foundational to the PSPS program and helps facilitate operational decision-making during PSPS events, both during the de-energization and re-energization (all clear) decision-making phases of a PSPS event. The data collected during PSPS events also helps validate why PSPS may have been required in certain areas.

Each weather station will include a suite of weather instruments that measure temperature, wind speed and humidity, a DCP/RTU (Data Collection Platform/Remote Terminal Unit), a battery and a solar panel. These weather stations will be in Tier 2 and 3 areas of the California Public Utilities Commission's High Fire Threat District map. The initial selection criteria for the weather station installations will be:

- Locations generally above 500' elevation (above 1500' in the Sierras)
- South facing slope or ridge top
- Good exposure, lack of local vegetation, good "wind fetch"
- Suitable pole: class 5 or better, no third-party cable/phone if possible
- Bucket truck accessible

In 2021, PG&E started a project to employ machine learning and statistical techniques to more accurately forecast wind gust speeds in various areas throughout PG&E's territory. Weather models typical forecast sustained winds. But the sustained-wind forecasts need to be translated to wind-gust forecasts by utilization of gust factors or other techniques. We plan to continue to utilize and improve these wind gust models, if

possible, during the 2023–2026 timeframe. More accurate forecasting, both in terms of the magnitude and timing of peak winds, will provide benefits to the PSPS program and storm outage modeling program.

From 2023-2026, PG&E plans to continue to optimize and install additional weather stations as needed to fill in data gaps and support PSPS operations in order to gain a better understating of meteorological conditions in local areas with the ultimate goal of supporting a reduction in PSPS events as observations and forecasting trends more granular.

Lastly, PG&E needs to continue to operate and maintain the current network which requires an annual calibration by a technician and replacement of equipment as needed. These costs scale to the size of the network as each weather station requires calibration to ensure data fidelity for PSPS purposes.

Numerical Weather Prediction and SOPP Model Automation (WLDFR-M07H):
PG&E Meteorology remains committed to advancing its weather forecasting capabilities by working with external numerical weather prediction experts. Weather model data is foundational and informs many operational decisions throughout PG&E to prepare for forecasted conditions and mitigate risk, including PSPS. PG&E has rigorously tested and deployed high-resolution models and built high-resolution historical datasets. These datasets and forecasts drive outage potential and fire potential index models, which are the main inputs into PG&E's decision-making framework. More accurate forecasts and historical datasets may lead to smaller and more targeted PSPS events as well as improved ability to communicate the potential of a PSPS event to customers and all stakeholders.

PG&E first deployed the PG&E Operational Mesoscale Modeling System (POMMS) in 2014, upgraded the system to POMMS 2.0 in 2018 and upgraded again to the third version of the model called POMMS V3.0 in 2020. POMMS is a customized version of the National Center for Environmental Prediction (NCEP) Weather Research and Forecast (WRF) model that is run at 2 x 2 km resolution across Northern and Central California. PG&E will continue operating the foundational numerical weather prediction program in 2021– 2026 and plans to improve the model's capabilities in future years, consistent with the historical advancements described above. Advancements in future years are expected to keep pace with advancements in weather prediction technology and increases in forecast granularity.

The 2020 POMMS V3.0 prediction suite is comprised of the following:

- A deterministic 2 x 2 km weather model (the Weather Research and Forecasting Model) that provides weather forecasts (e.g., wind, temperature, relative humidity) out 105 hours. This model is run 4 times per day.
- A 2 x 2 km Ensemble Prediction System (EPS) run twice per day. The POMMS EPS is comprised of 8 ensemble members.
- Experimental 0.67 x 0.67 km forecasts that can be run on-demand during high risk events.
- A historical climatology that contains 30 years (1989 – April 2020) of hourly weather data at 2 x 2 km resolution. This climatology was built using the same model configuration as used in forecast mode for fidelity between historical and forecast data.
- The POMMS V3.0 suite is entirely run and processed using the Amazon Web Services cloud

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PG&E developed the Storm Outage Prediction Project (SOPP) Model in 2008i to forecast storm damage. Developed, maintained and operated by PG&E's Meteorology Department, the SOPP Model is the primary tool utilized to forecast the magnitude and timing of unplanned outage activity on the distribution and transmission system that may occur to any weather event (wind, rain, snow, heat, etc.).

In addition, this model provides key input to PG&E's operational staffing and logistical decisions to support PG&E's planning for upcoming weather/storm emergency events. The primary goal of this program is to be prepared for storms and reduce customer outages to the extent possible. For example, the model informs PG&E's decisions regarding whether to open the Emergency Operations Center, and if the storm is severe enough, execute PG&E's mutual aid and mutual assistance agreements in advance of storms. SOPP mitigates operational risk and reduces customer outage times arising from weather events that create high unplanned outage volumes.

The SOPP model is comprised of multiple sub-models that predict the wind-to-outage, heat-to-outage, and snow-to-outage relationships by geographic area. PG&E plans to continue to improve certain aspects of these sub-models in future years to improve the overall SOPP model and PG&E's operational decisions based on the model. From 2020–2022, PG&E plans to develop, improve, and automated Outage Producing Wind (OPW) model that predicts the probability of outages based on the forecasted windspeed. This model was constructed by analyzing every planned and momentary outage and the wind speed associated with it. PG&E also plans to improve the heat-outage prediction model by evaluating historical temperatures, electric load, outages, and other datasets that may yield predictive skill.

PG&E is also developing more advanced analog forecasting techniques using pattern matching and pressure gradient comparison techniques. Analog forecasting allows meteorologists to quickly study past similar storms to help understand how a future storm may impact PG&E. Since PG&E has robust outage data going back to 1995, meteorologists can typically find at least one storm, if not more, in the historical record that is similar to an upcoming event.

To aide with analog forecasting techniques, PG&E developed an automated analog matching tool, which matches the Global Forecast System (GFS) forecasts for the next 7 days against PG&E's historical datasets using seven atmospheric fields: 500- and 700-hPa geopotential height, 250- and 500-hPa winds, 700-hPa temperature, precipitable water, and sea-level pressure. The tool returns the most similar 20 matches back to 1995 and the outages that occurred for each PG&E geographic region. Each match can then be reviewed in detail by PG&E meteorologists, who ultimately develop and disseminate the SOPP forecast. The SOPP forecast is produced 365 days per year and multiple times per day during inclement weather.

In 2023–2026 PG&E plans to continue the SOPP model program and plans to upgrade modules of the SOPP forecast, such as the snow-outage model and heat-outage model. PG&E also plans to continue improving its analog forecasting techniques by exploring machine learning or other statistical techniques.

This overall initiative will improve PG&E's weather prediction capabilities, help PG&E make better weather-risk informed decisions, and be better positioned and staffed to respond to any storm event.

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Satellite Fire Detection System (WLDFR-M07E):

With customer safety in mind, PG&E needs to be situationally aware of all wildfire activity occurring within our territory regardless of causation. Satellite fire detections provide valuable timely information to PG&E regarding new fires and the spread of existing fires. This information can be used to ensure the safety of customers and utility workers in the area, help identify assets at risk, and provide situational awareness as to the burn severity and rate of spread.

The project involves continued operations of and improvements to a fully operational satellite-based fire detection and alert system. As of December 31, 2020, the system ingested and reconciled fire detection data from two Geosynchronous Satellites (GOES-West, GOES-East), and four polar orbiting satellites (MODIS-AQUA, MODIS-TERRA, SUOMI- NPP, NOAA-20). PG&E developed the system to incorporate new fire detection data feeds as they become available and will plan to incorporate new satellite feeds from 2023 – 2026 as more satellites are deployed by NOAA and NASA.

NOAA currently plans to launch additional polar orbiting satellites in their new polar-orbiting generational fleet with the next satellite launch presently scheduled for 2022. PG&E may incorporate additional fire detection data into the suite once available. PG&E may also evaluate adding other public and proprietary data sources as they become known or available.

PG&E will continue to work with industry-leading fire detection algorithm developers and experts from the Space Science and Engineering Center (SSEC) at the University of Wisconsin-Madison to procure customized feeds of satellite fire detection data with the lowest latency available.

To visualize and interact with the fire detection data, PG&E developed a proprietary application in-house in 2019 and an external application available to the public in 2020 that combines and displays fire detection alerts as they arrive. PG&E plans to continue to operate the data APIs that are needed to support these websites and will make incremental improvements through 2023–2026. The internal web application also disseminates new fire detection alerts via the internal web-app and email. The web application displays each location where a wildfire was detected. Based on this information, PG&E meteorologists or analysts with the WSOC can quickly review live feeds from the nearest wildfire cameras to confirm fire and/or smoke in an area. The satellite data also measures the fire intensity, referred to as Fire Radiative Power (FRP). FRP is an Internet-based application that PG&E, customers, and other parties can use to retrieve an FRP timeseries in order to track the intensity of fires in each location. The applications also display current incidents available from CAL FIRE as well as fire perimeters from federal agencies. PG&E is actively sharing these fire alerts with CAL FIRE through the California National Guard and with numerous county and local fire departments. PG&E is also sharing this data with other California utilities and CAL FIRE through Technosylva's Wildfire Analyst Enterprise software.

PG&E is committed to sharing this data with interested stakeholders and the general public. This tool helps the PG&E respond to new and emerging events quickly and make faster operational decisions.

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LiDAR Wind Measurements

Although much can be learned about the atmosphere's meteorological conditions from a network of weather stations on the ground, these networks cannot provide information regarding conditions in certain areas of the atmosphere, most notably the Planetary Boundary Layer (PBL). The PBL is defined as the lowest portion of the atmosphere, and its behavior is directly influenced by its contact with the planetary surface. Understanding the PBL is not only important for current situational awareness, but if readily measured, it will improve our understanding, and our ability to forecast the timing and severity of extreme weather events.

Instrumentation to measure the PBL continues to evolve, and with the emergence of renewable wind energy over the last two decades, entities have started to move away from erecting large meteorological towers to collect data, in favor of ground-based LiDAR and/or microwave radiometers. These instruments continuously sample vertical profiles of temperature, humidity, and winds from the surface to around 1-3 km in the air. In comparison, entities like the National Weather Service only measure this part of the atmosphere with weather balloons twice a day. The continuous sampling of meteorological conditions in the PBL with LiDAR will provide a more complete, and three-dimensional, understanding of current conditions.

In 2021-2023, PG&E plans to investigate instrument options to continuously measure wind conditions with LiDAR. The project will include selecting test locations and evaluating the performance of LiDAR instrumentation. During the evaluation period, PG&E will plan additional LiDAR deployments, design support tools, and establish partnerships for modeling efforts. PG&E's long-term plan for 2024–2026 will be to design and establish a network of LiDAR instruments. The information provided by the LiDAR network will support the company's situational awareness and operational decision making.

The project has the potential to greatly improve PG&E meteorology forecasts, while also providing additional information to track and study weather events. With new machine learning applications, the information from these instruments should significantly improve the accuracy and lead times for forecasting large scale changes in local and surface winds. The ultimate end goal will be to reduce PG&E's operational costs, continue to reduce our PSPS footprint, and reduce other negative reliability impacts.

At this time, PG&E is unable to predict a forecast for this project. PG&E will seek to recover costs for this program through the Wildfire Mitigation Balancing Account (WMBA).

<u>Justification</u>

Expanded Weather Station Deployment

This project is necessary so that PG&E can gather data to:

- facilitate improved understanding, modeling and prediction of localized weather conditions and potential fire danger via input into PG&E's Advanced Fire Modeling system
- create better awareness of fire danger conditions and support the real-time fire danger monitoring and modeling system
- support the PSPS program and associated decision factors
- support public agency partners such as Cal Fire and Cal OES with critical real-time fire weather data

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Numerical Weather Prediction and SOPP Model Automation (WLDFR-M07H):

Numeric Weather Prediction:

This portion of the project is necessary because weather model data is foundational and informs many operational decisions throughout PG&E to prepare for forecasted conditions and mitigate risk, including PSPS. These high-resolution historical datasets and forecasts drive outage potential and fire potential index models, which are the main inputs into PG&E's decision-making framework. More accurate forecasts and historical datasets may lead to smaller and more targeted PSPS events as well as improved ability to communicate the potential of a PSPS event to customers and all stakeholders.

SOPP:

This model provides input to PG&E's operational staffing and logistical decisions to support PG&E's planning and response for upcoming weather/storm emergency events. The primary goal of this program is to be prepared for storms and reduce customer outages to the extent possible.

Satellite Fire Detection System (WLDFR-M07E):

As noted previously, PG&E needs to be situationally aware of all wildfire activity occurring within our territory regardless of causation. Satellite fire detections provide valuable timely information to PG&E regarding new fires and the spread of existing fires. This information can be used to more quickly respond to and identify assets at risk, and provide situational awareness as to the burn severity and rate of spread in support of safety of customers and utility workers in the area. The satellite-based fire detection system is monitoring 24 hours a day, 7 days week. The fixed-wing patrols were done once a day. Only one plane remained in 2019, and by 2020 the fixed-wing patrols discontinued altogether.

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Cost

Expanded Weather Station Deployment:

Expense
PG&E's expense forecast for Expanded Weather Station Deployment is $1.6 million in 2021, $1.6 million 2022, and $1.8 million in 2023. PG&E's 2023 forecast is $1.7 million higher than its 2020 recorded costs of $0.1 million. The primary reason for the increase is growth in on-going operations and maintenance costs as the size of the network increases.

Capital
PG&E's capital expenditure forecast for Expanded Weather Station Deployment is $6.4 million per year in 2021 and 2022, $3.3 million in 2023, $1.1 million in 2024, $1.2 million in 2025 and $1.2 million in 2026. PG&E's 2023 forecast is $5 million lower than its 2020 recorded expenditures of $8.3 million. The reason for this decrease is that PG&E plans to install fewer weather stations in 2023 than it did in 2020 as the program is keeping on pace with its installation commitments. The capital forecast for weather stations covers material and labor costs.

SOPP Model Automation/Enhancement:

PG&E's forecast for Numerical Weather Prediction and SOPP Model Automation in chapter 4.1 is approximately $2.0 million in 2021 and $2.0 million in 2022. The forecast covers continued advancements of the OPW, improvements to the heat-outage prediction model, and other developments described in more detail above. PG&E's 2020 recorded costs were $1.6 million, which is $0.4 million less than the 2023 forecast. The reason for this increase is due to annual enhancements and improvements to the program. Beginning with 2023, forecasts for this program are discussed in chapter 5 (Emergency Preparedness and Response) of the exhibit to reflect the fact that this program is intended to be applicable to other emergencies in addition to wildfires (e.g., storms).

Satellite Fire Detection System:
PG&E's expense forecast for the Satellite Fire Detection System is $0.3 million in 2021, $0.4 million in 2022, and $0.4 million in 2023. This forecast covers internal labor and vendor costs. 2020 recorded costs associated with Satellite Fire Detection were $0.1 million. The increase from 2020-2023 supports increased labor and increased integrations in other data systems throughout PG&E. This also supports additional enhancements such as migrating the fire detection data pipelines and visualizations from on-premise infrastructure to Amazon Web Services. In addition, new satellites with Fire Detection capabilities are expected to come online in the 2023-2026 timeline and will need to be evaluated and incorporated into the system. An example is the NOAA – Joint Polar Satellite System program, where 2 additional satellites are expected to be launched into orbit from late 2022-2026.

It is also worth noting that 2020 recorded dollars for Satellite Fire Detection were primarily charged to the Vegetation Management program, thus are not reflected in the same PO as Satellite Fire Detection's current and future forecasts.

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Cost – Additional Note

Meteorology IT Support dollars are ***not*** included in these forecasts or the cost table below as it is too early to determine specifically what percentage will be allocated to each Meteorology project or program.

For more information about Meteorology IT Support's role and funding of various Meteorology programs and projects, please reference the Project Summary Workpaper for Advanced Fire Modeling.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast							
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	Workpaper Reference
EXPENSE													
Expanded Weather Station Deployment MWC AB, PO 5045654	-	-	29	606	111	1,572	1,641	1,764				5,723	WP 4-6 Line 5
SOPP Model Automation/Enhancements MWC AB, PO 5049149, 5052650, 5058322	-	-	-	-	1,627	1,969	2,029	2,093				7,718	WP 4-6 Line 7 WP 5-5 Line 8
Satellite Fire Detection System MWC AB, PO 5048070	-	-	-	-	-	341	351	362				1,054	WP 4-6 Line 8
Expense Total	**-**	**-**	**29**	**606**	**1,738**	**3,882**	**4,021**	**4,219**	**-**	**-**		**14,495**	
CAPITAL													
Expanded Weather Station Deployment MWC 21, PO 5531503	-	-	3,772	6,934	8,315	6,399	6,377	3,270	1,122	1,155	1,189	38,533	WP 4-20 Line 3
Capital Total	**-**	**-**	**3,772**	**6,934**	**8,315**	**6,399**	**6,377**	**3,270**	**1,122**	**1,155**	**1,189**	**38,533**	
TOTAL PROJECT COST	**-**	**-**	**3,801**	**7,540**	**10,053**	**10,281**	**10,398**	**7,489**	**1,122**	**1,155**	**1,189**	**53,028**	

Benefits

- The weather stations, SOPP model upgrade and satellite fire detection system will further support PG&E's wildfire risk mitigation strategies. The weather stations and SOPP model upgrade will also support PG&E's emergency response to winter storms.
- Weather stations allow real-time awareness of current fire danger conditions, which is vital to maintaining the proper risk mitigation posture.
- The satellite fire detection system should allow PG&E to more quickly respond to fire ignitions.
- Current system and project leverages considerable existing in-house expertise in meteorological monitoring and data handling.

Alternatives Considered

- Expanded Weather Station Deployment: Continue with status quo. No substitute for actual field observations for weather stations was identified.

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- SOPP Model Automation/Enhancement: 1) Continue with status quo, or use a third party off-the-shelf solution to update the SOPP model. The existing SOPP model does not allow for the incorporation of weather station data to allow PG&E to give field personnel real-time updates and advance notice of weather changes that may indicate an increase in fire danger. Any commercially available solutions would require considerable expense and time as there are no existing systems that provide the same functionality as the SOPP modeling system
- Satellite Fire Detection System: 1) Continue with status quo. Existing public sources of data and tools for fire detection will not be as timely as the proposed satellite fire detection system, and do not provide visibility into the potential spread of new fires once ignited. The satellite fire detection system will also have the capability to send alerts of new fires

In view of the evolving environmental conditions, and to facilitate PG&E's wildfire risk mitigation activities, ATS-Meteorology will continue the project to install 1,300 weather stations across PG&E's service territory between 2018 and 2022. PG&E will also continue to develop, deploy and maintain the automated tools and supporting algorithms that utilize state-of-the-art satellite technology to detect new fires as they occur, issue alerts about new fires, as well as simulate the potential spread of new and existing fires. PG&E will enhance the existing damage prediction model, SOPP, with automation features that enable more accurate and timely outage predictions in support of PSPS.

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PROJECT SUMMARY – ADVANCED FIRE MODELING

Project Title: Advanced Fire Modeling
Major Work Categories: 21, AB6
Planning Order Numbers: 5536294 (CAP, recorded only), 5045829 (EXP), 5052651 (EXP),5048170 (EXP), 5053530[1] (EXP)
Project Start Date: June 1, 2018
Project Completion Date: On-going
Operative Date (only applies to Capital): N/A

Project Description

The projects that fall under the Advanced Fire Modeling (WLDFR-M07I) program are foundational to the Public Safety Power Shutoff (PSPS) program and daily mitigation activities that reduce the risk of utility caused ignition. The main goals of the program are to improve, deploy and maintain operational models that help PG&E predict the consequence and risk of fires. This program supports the following projects:

- Dead and Live Fuel Moisture Modeling
- PG&E Fire Potential Index or "FPI" (WLDFR-M07K)
- Fire Spread Modeling

The Advanced Fire Modeling programs contain some historical components, including creating datasets across PG&E's weather climatology to create a history of dead and live fuels and fire spread simulations, in order to calibrate and train FPI and PSPS models. The projects are discussed in more detail below.

Dead and Live Fuel Moisture Sampling

The moisture content in living and dead vegetation is a critical input to PG&E's FPI and the National Fire Danger Rating System used by state and federal fire agencies. PG&E meteorologists remain committed to advancing models utilized to simulate fuel moistures in dead and living vegetation, called Dead Fuel Moisture (DFM) and Live Fuel Moisture (LFM).

In 2020, PG&E partnered with Atmospheric Data Solutions (ADS) and Technosylva to develop the next generation of LFM and DFM models deployed at PG&E. In 2020, PG&E deployed a DFM model on the PG&E-Amazon Web Services (AWS) cloud capable of predicting the moisture content of multiple DFM fuel classes (i.e., DFM 1hr, DFM 10hr, DFM 100hr, DFM 1000hr) at 2 x 2 km resolution. The DFM model PG&E deployed is a customized version of the Nelson DFM model utilized in the National Fire Danger Rating System 2016 model version. These models provide hourly DFM forecasts out four days for the four DFM classes described above.

PG&E also deployed 2 x 2 km LFM models for Chamise as well as Manzanita plant species. These are machine-learning models developed by ADS using National Fuel Moisture Database (NFMDB) observations.

In addition to creating new forecast models, PG&E also created a 30-year climatology of DFM and LFM output at 2 x 2 km resolution. These robust historical datasets allow PG&E meteorologists and data scientists to evaluate the fuel conditions present during historical fires.

[1] Stand-alone planning order for Fire Potential Index (WLDFR-M07K)

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In 2023–2026 PG&E plans to continue to operate the DFM and LFM models operationally as they are foundational to PG&E's FPI, Fire Spread Modeling, and PSPS programs. Each year, PG&E plans to add to its existing weather and fuels climatology such that additional studies to recalibrate and improve FPI predictions are possible.

PG&E Fire Potential Index (FPI)

To understand the potential for large fires to occur across the PG&E territory, PG&E developed the FPI in 2015 and significantly enhanced the model in 2018 and 2019. The current FPI is modeled on historical fires using PG&E's 30-year downscaled climatology, DFM and LFM models, fire weather indices, and other models and data.

In 2018, PG&E studied the conditions contributing to large and catastrophic fires. PG&E combined a USFS fire occurrence dataset with fires in the PG&E territory from 1992 – 2018 with PG&E's robust high-resolution climatology of weather and fuels. For each fire, PG&E extracted weather, fuel moisture and land-type and ruggedness features from the climatology and other GIS datasets. When constructing the FPI model, PG&E wanted to understand which variables and variable combinations provided the most predictive skill. To that end, PG&E developed and evaluated over 4,000 FPI models using different combinations of weather components, fire weather indices (Fosberg Fire Weather index, the Hot-Dry-Windy Index, the Santa Ana Wildfire Threat weather index), outputs from NFDRS, Nelson DFM model, a machine-learning derived LFM model, and 'containment' and 'land characteristic' features such as road density, distance to nearest fire station, land-use type among several others.

Later, in 2019, PG&E incorporated other weather parameters into the FPI, including wind speed, temperature, and relative humidity; dead and live fuel moisture data; and land use type. The PG&E FPI is run at 2 x 2 km resolution using PG&E's high-resolution weather and fuels coupled models and provides hourly forecasts out 4 days currently. The PG&E FPI model outputs the probability from 0 – 100% of observing a large fire (>1000 acres), given an ignition.

In 2021, a recurring process will be established that will provide new patches to both production and non-production systems used for fire modeling. From 2022-2026, there will be a focus on scaling the computing infrastructure that is needed to support the operation of its models and inform daily fire mitigations and PSPS (utilizing FPI). The enablement of regular asset data updates by integrating GIS data into the POMMS system will also be addressed. Lastly, there will be development of new model pipelines to support new/emerging data streams, as well as a more granular weather prediction model, and support the enablement of PG&E to transition to a 1km weather model starting in 2024 that will increase the granularity of its fire weather modeling. These efforts for years 2021-2026 are also described / supported by the Meteorology IT department (see Cost section).

Fire Spread Modeling

It is critical to understand the impact and potential consequences of an ignition via fire spread technology. Some ignitions may have minimal impact on the surrounding area and communities, while other ignitions could create significant risks including loss of life and property damage, as well as other wildfire related impacts such as air quality impacts.

PG&E has developed several new models to better understand the impact of ignitions on surrounding areas and communities. In 2019 – 2020, PG&E partnered with an external expert, Technosylva, in the

wildfire modeling field to test and deploy cloud-based wildfire spread model capabilities to better understand the technology and to test integration into current decision support framework, such as PSPS. Each day, PG&E delivers high-resolution 2 x 2 km weather and DFM model data sets to Technosylva, who performs over 100 million fire spread simulations every three hours out 3 days. These simulations provide fire spread outputs (e.g., potential number of acres burned, and population impacted) and can be visualized per overhead circuit in forecast mode to determine the highest risk circuits every 3 hours.

PG&E also has the ability, through a Technosylva application called Wildfire Analyst Enterprise (WFA), to simulate fires on-demand across historical, real-time, and future time horizons. This involves selecting a location on a map, the start time of ignition and the simulation duration in hours. The Technosylva wildfire spread model uses the dynamic weather forecast of wind and fuel moisture to model how the wildfire may spread. The model framework and technology is also utilized by other Investor-Owned Utilities in California, as well as California Department of Forestry and Fire Protection (CAL FIRE). The technology allows PG&E to forecast ~100 million virtual fires daily across the PG&E territory in forecast mode, simulate fires on demand as they start, simulate hypothetical fires based on PSPS damage and hazard reports, as well as simulate fires in past weather scenarios.

Finally, PG&E has also developed a Wildfire Consequence Model using the Technosylva fire simulations. This model, in combination with wildfire ignition probability models, are used in the 2021 Wildfire Distribution Risk Model for producing Multi-Attribute Value Function (MAVF)-calibrated risk scores. These scores can then be used to inform initiatives such as Enhanced Vegetation Management and System Hardening.

In 2020, PG&E and Technosylva made considerable improvements to the Technosylva wildfire spread model, which are outlined below.

1. Detailed Fuels Mapping for PG&E Service Territory

    - The fuel model map utilized in the fire spread model was significantly enhanced to fix known issues in the United States Forest Service LANDFIRE dataset; provide more granularity in the Wildland Urban Interface; and include recent fire scars through 2020.

2. Updated Weather Forecast 2km Data Integration

    - The PG&E Operational Mesoscale Modeling System (POMMS) 2 km weather forecast data was fully integrated into the wildfire spread model.

3. Territory wide risk

    - Another mode was developed to evaluate the fire risk not just as it pertains to PG&E's assets but the risk across the entire footprint of PG&E's territory.

4. Woody and Herbaceous LFM Remote Sensing Methods Analysis and Integration

    - Technosylva developed and integrated new LFM models that simulate the moisture available in the LFM woody and herbaceous fuels using remote sensing techniques.

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PROJECT SUMMARY – ADVANCED FIRE MODELING

5. Climatological Risk Assessment

    - Technosylva completed a historical analysis from 2000-2020 and simulated over a billion fires over the worst 571 fire risk days. This analysis will help inform where the highest risk areas are across PG&E's service territory.

6. Integration with PG&E Fire Detection and Alert System

    - Data generated from PG&E's fire detection and alert system are delivered to Technosylva via an API and are now integrated into WFA. These detections are being shared with multiple parties including CAL FIRE and the utilities that also use WFA in California.

7. Integration with PG&E Amazon Web Services (AWS) cloud

    - Results from each Technosylva simulation are available on the PG&E cloud. This allows PG&E scientists to evaluate the results of every single simulation out of the millions produced daily.

In 2021, PG&E will continue to evaluate and test a methodology to incorporate fire spread model outputs into PSPS decision making and expand the forecast horizon from three to four days. We will also work with Technosylva to update the fuel model layers on an annual basis. This includes modeling new vegetation growth in recently burned areas as well as accounting for recent fire disturbances.

From 2023-2026 PG&E plans to continue using this technology, which will undergo annual improvements. These improvements involve an annual update to the fuels mapping datasets, updates to incorporate recent fire disturbances (fire scars), updates to building and population datasets, and updates to the core fire spread model engine and output risk outputs and metrics.

<u>Justification</u>

The Advanced Fire Modeling program helps mitigate PG&E's Wildfire risk.

The fire danger modeling system operated by ATS-Meteorology Operations facilitates the following key components:

- Real-time monitoring of fire danger conditions from PG&E's Wildfire Safety Operations Center (WSOC) / (transitioning to All Hazards Center)
- Daily recloser disabling operations when fire danger is very high or extreme
- Curtailment of field activities in very high and extreme fire danger conditions as outlined in utility standard, TD-1464S
- PSPS

<u>Cost</u>

Capital

There is currently no forecast for capital expenditures past 2020.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.1, SITUATIONAL AWARENESS AND FORECASTING
PROJECT SUMMARY – ADVANCED FIRE MODELING

Expense

PG&E's expense forecast for Advanced Fire Modelling (not including FPI dollars) is $6.0 million in 2021, $6.2 million in 2022, and $6.3 million in 2023. This forecast supports the various programs/projects which are discussed above. PG&E's 2023 forecast is $0.8 million higher than its 2020 recorded costs of $5.5 million. The primary reason for the increase is escalation. Cost drivers for Advanced Fire Modelling are POMMS/NFDRS wildfire danger modeling system enhancements and operations, WSOC support costs, GFS and ECM Wildfire Model labor costs, High Performance Computing labor costs, and hardware and software costs.

In addition to the expense forecast applicable to Advanced Fire Modelling as a whole, Fire Potential Index (a sub-project under Advanced Fire Modelling) has its own small expense budget. Forecast expense dollars for Fire Potential Index are $0.2 million in 2021, $0.2 million in 2022, and $0.2 million in 2023. These dollars cover costs associated with continued evaluation and testing, updates to file model layers, annual improvements to datasets and technology. PG&E's 2023 Fire Potential Index (only) 2023 forecast is $0.08 million more than its 2020 recorded costs of $0.1 million. This small increase was due to incremental improvements to datasets and technology.

<u>Cost Continued - Meteorology IT Support</u>

Overview:

Meteorology IT Support dollars are not included in the forecast or the cost table below as it is too early to determine specifically what percentage will be allocated to each Meteorology project or program.

In addition, 2020 recorded costs were not separately tracked for the various Meteorology projects and programs that were supported; they are woven into each respective project or program's recorded dollars.

The funds in Meteorology IT Support will support improvements and initiatives across several meteorology projects and programs. As mentioned in previous sections, the data processing, computing, and storage environments required by meteorology have increased significantly as weather model output has become more granular and hundreds of millions of fire spread simulations are performed each day. Each day meteorology processes several terabytes of data. In order to process and store these vast quantities of weather model data, as well as to run internal models such as the Fire Potential Index and Outage Producing Wind model, a robust computing infrastructure and IT support structure will need to continue to be improved.

Meteorology IT Support will also support the continued migration of the Meteorology Department's web applications into PG&E's AWS cloud. This will include the implementation of new connectivity required to enable those applications, the development of interfaces for any systems that require access to the migrated applications and any networking of firewall updates to support the migration of those applications.

PG&E deployed its upgraded POMMS v3.0 into AWS in 2020. PG&E will continue to mature its POMMS system by (1) updating the data transfer and storage policies; (2) improving the patching process; and (3) implementing improved data lifecycling policies to drive more cost-effective data storage and archival costs while remaining in compliance with data retention requirements. Starting in 2021, Meteorology IT Support will update the data transfer and storage policies within AWS Doing this will allow the POMMS system to minimize

the copies of data that are required from the processing of POMMS data and thus reduce future AWS usage costs.

With on-premise infrastructure, PG&E has an existing patching process that helps to keep PG&E systems secure and up to date, but this process is not yet applied within AWS. In 2021, Meteorology IT Support will establish a recurring process that will provide new patches to both production and non-production systems.

From 2022-2026, Meteorology IT Support will focus on scaling the computing infrastructure that is needed to support the operation of its models and inform daily fire mitigations and PSPS (utilizing FPI). As it continues to develop the next generation of PSPS forecast models, Meteorology IT Support will enable regular asset data updates by integrating GIS data into the POMMS system. Work will also focus on developing new model pipelines to support new/emerging data streams, as well as a more granular weather prediction model. Meteorology IT Support will enable PG&E to transition to a 1km weather model starting in 2024 that will increase the granularity of its fire weather modeling.

Expense (MWC AB6, PO 5053990)

Meteorology IT Support expense costs primarily entail labor activities such as planning and data migration/conversion, certain third-party contracts as well as incremental AWS costs resulting from new development activities that are necessary to deliver the technology solutions primarily used within Advanced Fire Modeling and the SOPP Numerical Weather Prediction Program.

Meteorology IT Support is a Wildfire mitigation (WLDFR-M07J) referred to as Situational Awareness and Forecasting Initiatives – Meteorology.

PG&E's expense forecast to support these various projects and programs is $0.5 million in 2021, $0.5 million in 2022, and $0.4 million in 2023

Capital (MWC 21, POs 5540824, 5795513)

Capital dollars will focus on scaling the computing infrastructure that is needed to support the operation of its model and inform daily fire mitigations and PSPS (utilizing FPI). Work will also focus on new model pipelines to support new/emerging data streams, as well as a more granular weather prediction model.

PG&E's capital expenditures associated with these various Meteorology initiatives are forecasted to be $1.0 million in 2021, $1.3 million in 2022, $1.1 million in 2023, $1.9 million in 2024, $1.9 million in 2025, and $2.0 million in 2026.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.1, SITUATIONAL AWARENESS AND FORECASTING
PROJECT SUMMARY – ADVANCED FIRE MODELING

Major Project Spending Estimates

(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
EXPENSE												
MWC AB6, 5045829, 5052651, 5048170, 5053530, 5053990			979	4,026	5,635	6,638	6,842	6,956				31,076
												-
Expense Total	**-**	**-**	**979**	**4,026**	**5,635**	**6,638**	**6,842**	**6,956**	**-**	**-**	**-**	**31,076**
CAPITAL												
MWC 21, PO 5536294				198	899							1,097
Capital Total	**N/A**	**N/A**	**N/A**	**198**	**899**	**-**	**-**	**-**	**-**	**-**	**-**	**1,097**
TOTAL PROJECT COST	**-**	**-**	**979**	**4,224**	**6,534**	**6,638**	**6,842**	**6,956**	**-**	**-**	**-**	**32,173**

Benefits

- PG&E wildfire risk mitigation strategies are dependent on this technology. Wildfire risk mitigation is the primary benefit.
- Current system and project leverages considerable existing in-house expertise in fire danger modeling.

Alternatives Considered

- Continue to utilize to PG&E's existing fire danger modeling capabilities.

PG&E benchmarked with SOCAL Edison (SCE) and San Diego Gas & Electric (SDG&E) on their systems. SDG&E has advanced fire danger modeling, which was developed in house, since there was no off the shelf product available. PG&E encountered the same issue and determined that information was also not available from government sources. Based on these factors and considering that PG&E has existing in house fire danger modeling expertise, it was decided to undertake further development of the existing in-house system.

In view of the evolving environmental conditions, and to facilitate PG&E's wildfire risk mitigation activities, ATS-Meteorology will undertake this project to facilitate several upgrades to PG&E's fire danger modeling capabilities.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.1, SITUATIONAL AWARENESS AND FORECASTING
PROGRAM SUMMARY – SAFETY AND INFRASTRUCTURE PROTECTION TEAMS

Program Title: Safety and Infrastructure Protection Teams
Major Work Categories: 21, AB
Planning Order Numbers: Capital: 5535720, Expense: 5052132, 5056579 (recorded expense only: 5045651, 5049812)
Program Start Date: December 2018
Program Completion Date: Ongoing
Operative Date (only applies to Capital): N/A

Program Description

In 2018 PG&E utilized contractors to perform fire protection services as a result of Senate Bill (SB) 901. This work and these teams were funded through Catastrophic Event Memorandum Account Application A.18-03-015. Beginning in 2019, PG&E staffed these teams with PG&E employees.

PG&E established Safety and Infrastructure Protection Teams (SIPT) in 2019 to support its field workforce while work is being conducted in areas with high fire risks. PG&E has 40 crews available to support routine and emergency work throughout PG&E's service territory, focusing on Tier 2 (elevated risk) and Tier 3 (extreme risk) areas on the California Public Utility Commission's High Fire Threat District (HFTD) map. The purpose of this program is to further enhance fire-related safety, primarily by: (1) protecting critical PG&E infrastructure, including poles, power lines, and other electrical equipment in the event of a wildland fire; (2) working alongside utility crews to promote safe work practices, especially in high fire danger areas during fire season; and (3) performing fire prevention related work such as fuel reduction around PG&E infrastructure and conducting defensible space inspections on PG&E properties.

SIPT crews consist of two to three-person crews composed of IBEW-represented employees who are trained and certified Safety Infrastructure Protection Personnel. They provide standby resources for PG&E crews performing work in high fire hazard areas, pre-treatment of PG&E assets during an ongoing fire, fire protection to PG&E assets, and emergency medical services. SIPT crews perform high priority fire mitigation work, protect PG&E assets, and gather critical data to help prepare for and manage wildfire risk.

SIPT crews perform both routine and emergency work. SIPT's routine work includes:

- Fuel hazard reduction at worksites to reduce fire risk;
- Application of fire retardant to minimize ignition potential;
- Defensible space inspections;
- Fuel hazard assessment at PG&E facilities;
- Safety protection standby (during "hot work") at PG&E work sites;
- Medical response standby at our work sites;
- Safety patrols on our properties;
- Asset protection planning for our construction projects; Minor flagging support; and
- Labor support.

As authorized by the Agency Having Jurisdiction (AHJ) for a wildfire, SIPT's emergency work includes:

- Asset protection through the application of fire retardant during wildfires;
- Fire protection at PG&E-owned facilities during wildfires, as authorized by the AHJ;
- Mop up of fire damaged PG&E assets, as authorized by the AHJ; and
- Accompanying vegetation management crews during wildfire recovery to suppress incidental ignitions.

While SIPT crews do not respond to wildfires without AHJ approval, they can help suppress any potential ignition at the work site when protecting our crews and assets. When first responders arrive on scene,

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PROGRAM SUMMARY – SAFETY AND INFRASTRUCTURE PROTECTION TEAMS

SIPT crews follow the Incident Command System established by the responding AHJ. SIPT crews may also perform non-wildfire related emergency response work and charge their time for these responses to the appropriate accounts (e. g., CEMA, MEBA, Base).

During PSPS events, SIPT crews are deployed to collect real-time weather and field conditions data to report to the WSOC. This data is used to inform and validate the PG&E Meteorology team's PSPS decision making process. Fire Index Areas receive a Fire Potential Index (FPI) rating, with a range of R1 (lowest risk) to R5-Plus (highest risk). The potential for R5-Plus conditions, for example, can indicate a need to initiate a PSPS sooner than expected or delay the expiration of one. Following a PSPS event, SIPT crews provide information to support "all clear" conditions necessary to authorize restoration activities, and patrol sections of re-energized lines.

SIPT crews also gather fuel samples at regular intervals at 30 locations across the service territory, which then get analyzed for their live moisture content. This important information is utilized by PG&E Meteorology as a key input to their advanced fire modelling.

Justification

The project is targeted at mitigating Wildfire risk by reducing the consequences of wildfire ignitions in PG&E's service territory and ensuring the safety of PG&E crews while working in high fire danger areas.

Per Senate Bill (SB) 901, utilities are required to employ "highly skilled and apprenticed personnel to perform fire safety and prevention, mitigation, or maintenance services in direct defense of utility infrastructure in collaboration with public agency fire departments having jurisdiction" to their maximum effort.

As part of the SIPT program in 2019 and 2020, PG&E employees:

- Developed a custom SIPT engine design based on existing PG&E fleet vehicles;
- Designed custom built pumps capable of applying fire retardant;
- Acquired and outfitted temporary engines;
- Specified and acquired firefighting tools, radios, and personal protective equipment;
- Supported development of software applications for monitoring SIPT resource locations, scheduling, and documenting work activities;
- Developed a three-week new employee training program and adopted procedures to ensure maintenance of Emergency Medical Technician (EMT) certification;
- Established routine and emergency operational procedures; and
- Implemented a comprehensive change management program to integrate SIPT crews with our field operations.

For these reasons, SIPT crews will continue to be a part of PG&E's workforce, with its primary focus on risk mitigation efforts. SIPT is a mitigation for the Wildfire risk (WLDFR-M008).

Cost

Expense:

PG&E's expense forecast for SIPT is $30.3 million in 2021, $24.9 million in 2022, and $25.9 million in 2023. Costs include labor-related costs for field, support, and leadership employees. PG&E's 2023 forecast is $10.5 million higher than its 2020 recorded costs of $15.3 million. The primary reason for this increase was for additional headcount to support improved geographical coverage, reduced response times, and additional depth of resources for large scale wildfires (including engines). In 2020, SIPT program funding supported 40 crews along with administrative and leadership support for a total headcount of 108 personnel. Starting in 2022 and carrying over through 2026, forecasts reflect increased staffing by approximately 30 FTE.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.1, SITUATIONAL AWARENESS AND FORECASTING
PROGRAM SUMMARY – SAFETY AND INFRASTRUCTURE PROTECTION TEAMS

Capital:
PG&E's capital expenditure forecast for SIPT is $0.15 million in 2021, $1.2 million in 2022, $0.3 million in 2023, $0.3 in 2024, $0.3 million in 2025, and $0.3 million in 2026. PG&E's 2023 forecast is $1.0 million less than its 2020 recorded capital expenditures of $1.3 million. The reason for this decrease is that there were start-up vehicle-related (engine) costs in 2020 which were not present in later years. Capital investments will include replacement pumps and additional safety equipment. In 2022, the capital forecast includes costs for 5 additional engines and equipment to support the additional crews. Costs for 2023 to 2026 are for a dedicated SIPT facility (2023) and equipment upgrades.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
EXPENSE												
MWC AB, POs 5045651, 5049812, 5052132, 5056579			15,770	12,918	15,342	30,304	24,899	25,867				125,100
												-
Expense Total	**-**	**-**	**15,770**	**12,918**	**15,342**	**30,304**	**24,899**	**25,867**	**-**	**-**	**-**	**125,100**
CAPITAL												
MWC 21, PO 5535720				642	1,254	152	1,187	248	278	281	290	4,332
Capital Total	**N/A**	**N/A**	**-**	**642**	**1,254**	**152**	**1,187**	**248**	**278**	**281**	**290**	**4,332**
TOTAL PROJECT COST	**-**	**-**	**15,770**	**13,560**	**16,596**	**30,456**	**26,086**	**26,115**	**278**	**281**	**290**	**129,432**

Alternatives Considered
In 2018, PG&E utilized an outside contractor (Capstone) to support PG&E's wildfire safety efforts. In late 2018, Senate Bill 901 (SB-901)[1] was passed. In light of the bill's passage, PG&E decided to meet the efforts and guidelines outlined by creating an in-house workforce to continue its wildfire safety and risk mitigation efforts beginning in 2019.

[1] SB-901 was a senate bill which provided guidelines for wildfire protection for investor-owned utilities, as well as other outlines for

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.1, SITUATIONAL AWARENESS AND FORECASTING
PROGRAM SUMMARY – WILDFIRE SAFETY OPERATIONS CENTER / HAZARD AWARENESS WARNING CENTER

Program Title: Wildfire Safety Operations Center / Hazard Awareness Warning Center
Major Work Categories: AB, 21
Planning Order Numbers: Chapter 4.1 – 5531501 (CAP), 5531502 (CAP recorded), 5536059 (CAP recorded), 5046509 (EXP), 5049810 (EXP) 5048171 (EXP 2020); Chapter 5 – 5545502 (CAP), 5058184 (EXP)
Program Start Date: May 2018
Program Completion Date: Ongoing
Operative Date (only applies to Capital): N/A

Project Description

PG&E opened the Wildfire Safety Operations Center (WSOC) in May 2018 to serve as a physical hub for coordination, facilitation, and communications of wildfire activities. The WSOC plays a key role in PG&E's plan for addressing the challenges of climate driven extreme weather events and customer and community safety, with a plan to provide "All Hazards" monitoring in the coming years. The WSOC currently monitors 24-hours a day, seven days a week, for fire ignitions across PG&E's service area in real-time, leveraging PG&E and publicly available weather information, wildfire camera data, and first responder (local and state) data.

The WSOC is staffed with highly qualified personnel knowledgeable in electric operations, safety, engineering, meteorology, and other areas. The WSOC partners with PG&E's field Public Safety Specialists (PSS) who perform trainings for first responders and local agencies about how to safely respond to fires associated with electric and gas facilities, and who serve as liaisons to those entities in the event of a fire. The team in the WSOC communicates with field teams, and monitors information from PG&E weather stations and live video feeds, as well as databases, fire detection satellite feeds, social media, and emergency alert systems from agencies such as CAL FIRE, the National Weather Service, and local public safety authorities.

In the event of a potential fire threat in one of the communities in PG&E's service area, the WSOC notifies the appropriate PG&E control centers, PSS team, and other entities as necessary to ensure awareness and response to the incident. Close coordination with the PSS team ensures continued awareness of the status of the incident through their contact and coordination with local and state authorities. These response efforts may involve some of the new and enhanced safety measures PG&E is implementing as additional precautionary measures intended to further reduce the risk of future wildfires, including – as a last resort – temporarily turning off electric power lines in high fire-threat areas when extreme fire conditions are present.

In 2021, PG&E will pursue transitioning the WSOC into the Hazards Awareness and Warning Center (HAWC)[1]. This center will remain staffed 24/7 with employees monitoring and reporting on broader real-time events. It will act as a centralized hub for emergency and hazard communications and intelligence to internal stakeholders. PG&E's All Hazards Center would not replace existing communication processes within the respective lines of businesses, but rather it would be a one-stop resource for real-time situational awareness and intelligence to all impacted stakeholder groups.

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[1] The control name associated with the WSOC as well as its future state (HAWC) will remain "WSOC" across Chapter 4.1 and Chapter 5

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.1, SITUATIONAL AWARENESS AND FORECASTING
PROGRAM SUMMARY – WILDFIRE SAFETY OPERATIONS CENTER / HAZARD AWARENESS WARNING CENTER

Core capabilities for the HAWC will include monitoring, assessment, and communication of pertinent information for emergency events. The center will monitor internal and external information sources for issues and emerging risks and develop and maintain updates to real time dashboards accessible to all key stakeholders. Regarding communications, the center will produce periodic situational awareness reports and briefing documents, initiate two-way communication processes with key LOB groups to share and receive intelligence information, and initiate notifications per established protocols. Lastly, there will be communications requirements with external entities. Based on agreed upon criteria, the HAWC will escalate issues for resolution as appropriate by engaging with the Emergency Operations Center (EOC) Commander, the EP&R Strategy and Execution Director, and other key points of contact.

PG&E plans to implement phase one of the HAWC in 2021, and further stabilize and mature the center in 2022. By 2023, the transition to the HAWC will be near completion.

Justification

The WSOC is in place to provide 24 hours a day 7 days a week monitoring and oversight of PG&E's service territory. The WSOC monitors, assesses, and directs specific wildfire prevention and response efforts throughout its service territory. The WSOC is in place to provide early understanding of fires threatening PG&E assets and the associated communities. Leveraging leading technologies such as camera feeds, social media tools, outage management screens, and weather satellite imagery allows the WSOC to provide information that allows PG&E to make better decisions for its employees and customers. This increase in situational awareness positively impacts PG&E's customers, employees, and assets.

The WSOC is a single point of contact with company field responders during a wildfire threat, accelerating our ability to respond and make timely decisions. PG&E's field operating units may also engage sooner with public agencies.

The WSOC is a mitigation for the wildfire risk (WLDFR-M07C).

Cost

PG&E has forecasted capital and expense dollars from 2021-2026. The WSOC will remain in Chapter 4 (Wildfire Risk Mitigations) under section 4.1 (Situational Awareness and Forecasting) through 2022. By the end of 2022, the WSOC is expected to complete its shift to an All Hazards Center (HAWC). Because the center will no longer exclusively support wildfire risk, capital and expense dollars will then shift to Chapter 5 (Emergency Preparedness and Response) to better reflect the nature of the center starting in 2023. The forecast tables below reflect dollars for this mitigation that span Chapter 4.1 (2018-2022) as well as Chapter 5 (2023-2026).

PG&E's forecasted expenditures mainly represent staffing and operating costs. 2020 recorded costs were $4.3 million. PG&E's expense forecast is $9.1 million in 2021, and $7.1 million in 2022. Costs include labor-related costs for field, support and leadership employees. Forecast for 2023 is $7.4 million, which is $3.1 million higher than 2020 driven by increased resources needed to expand to an All Hazards Center (HAWC). PG&E's capital forecast is $1.5 million in 2021, $0.1 million in 2022, $0.1 million in 2023, $0.2 million in 2024, $0.2 million in 2025, and $0.2 million in 2026. Chapter 5 will handle capital forecast dollars from 2023-2026.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.1, SITUATIONAL AWARENESS AND FORECASTING
PROGRAM SUMMARY – WILDFIRE SAFETY OPERATIONS CENTER / HAZARD AWARENESS WARNING CENTER

The capital forecasts will cover potential costs related to relocation, as well as equipment costs and other technical upgrades. 2020 recorded capital had a credit ($0.03 million) due to invoicing true-ups.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast							
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	Workpaper Reference
EXPENSE													
MWC AB PO 5046509, 5049810, 5058184, 5048171			1,491	4,708	4,348	9,139	7,181	7,405				34,272	WP 4-6 Line 1; WP 5-5 Line 7
												-	
Expense Total	**-**	**-**	**1,491**	**4,708**	**4,348**	**9,139**	**7,181**	**7,405**	**-**	**-**	**-**	**34,272**	
CAPITAL													
MWC 21, PO 5531501, 5531502, 5536059, 5545502			1,997	2,121	(34)	1,542	129	108	188	191	196	6,438	WP 4-20 Line 2; WP 5-12 Line 5
Capital Total	**N/A**	**N/A**	**1,997**	**2,121**	**(34)**	**1,542**	**129**	**108**	**188**	**191**	**196**	**6,438**	
TOTAL PROJECT COST	**-**	**-**	**3,488**	**6,829**	**4,314**	**10,681**	**7,310**	**7,513**	**188**	**191**	**196**	**40,710**	

Benefits

There are no quantifiable cost savings or avoided costs associated with this program. The WSOC's main objective is to be a foundational element of PG&E's fire-related risk reduction efforts by providing situational-based information to company operating units and others who engage with our public partner. As the center expands to all-hazards, the contributions made regarding situational awareness of risks (including but not limited to wildfires) and public safety will only increase in value.

Alternatives Considered

- Maintain Status Quo: Not providing 24 hours a day 7 days a week monitoring and oversight through the WSOC would result in delayed understanding of fires threatening PG&E assets and the associated communities. Without the WSOC in place PG&E would not have a single point of contact with its field responders during a wildfire threat, hindering the ability to respond and make timely decisions. PG&E's field operating units may also be delayed engaging with public agencies.
    - Technology: The WSOC houses camera feeds, social media tools, outage management screens, and weather satellite imagery. The combination of these tools and fire response expertise in a single facility allows PG&E to make better decisions for its employees and customers.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – PSPS EVENTS

Project Title: PSPS Events
Major Work Categories: AB
Planning Order Numbers: 5263132, 5052752, 5049889, 5049890, 5049989, 5050649, 5050710, 5050863, 5050864, 5050865, 5050866, 5051226, 5054511, 5054512, 5054513, 5056100, 5056101, 5056264, 5056854
Project Start Date: Various
Project Completion Date: Various
Operative Date (only applies to Capital): N/A

Project Description

PG&E's PSPS program evaluates whether to proactively de-energize a portion of PG&E's electric system in the interest of public safety as a measure of last resort to prevent an ignition during high wind weather patterns. De-energization may be necessary when a combination of winds and location-specific factors, such as vegetation dryness, are forecast to present a statistically high likelihood of damage or disruption to PG&E's above-ground power lines, suggesting a heightened risk of catastrophic wildfire.

The PSPS program encompasses PG&E electric lines in High Fire Threat District (HFTD) areas, including both distribution and transmission lines. The most common electric lines considered for de energization are those in Tier 2 or Tier 3 HFTD areas. Often, lines that traverse Tier 2 or Tier 3 HFTD areas also feed customers outside those areas, meaning customers could be impacted by the risk associated with lines many miles away. While customers in HFTD areas are more likely to be affected by a PSPS event, any of PG&E's more than five million electric customers could have their power shut off if their community relies upon a line that passes through a HFTD area.

As described in PG&E's testimony in the Order Instituting Rulemaking (OIR) to Examine Electric Utility De Energization of Power Lines in Dangerous Conditions (PSPS OIR, or Rulemaking (R.) 18 12 005), the wildfire risk in northern California has changed dramatically in the past several years. As of 2012, only 15 percent of PG&E's service area was designated as having an elevated wildfire risk on the fire threat maps recognized by the CPUC at that time. Today, more than 50 percent of PG&E's service territory is in designated Tier 2 or Tier 3 fire threat areas according to the CPUC's designated HFTD Map.

In 2020, the first version of the High Fire Risk Area (HFRA) map was developed to identify approximately 115 additional areas that are not included in the HFTD areas that will be included in our PSPS scope. Many of these areas do not contain high number of customers of PG&E assets and are in rural, hard to access locations where fire could grow and spread rapidly. The purpose of developing the HFRA map is to ensure all areas of catastrophic wildfire risk are fully captured in PG&E's PSPS program. PG&E will continue to evaluate the inclusion of additional areas requiring wildfire reduction activity.

PSPS event occurs when PG&E is expecting to de-energize and the cost includes the following:

- EOC Support – The EOC is comprised of a multi-disciplinary team of PG&E employees who assume emergency response positions consistent with the Incident Command System;
- IT – Coordinates the response of PG&E's IT resources and systems in support of all stages of PSPS;
- Aviation Services – These include the flight cost to patrol PG&E equipment after determination it is safe to do so during a PSPS event;

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – PSPS EVENTS

- Customer Outreach – During PSPS events, PG&E's Customer teams provide the following key support to customers and partner agencies:
  - Coordinating with local, state, and/or federal agencies to provide real-time situational updates and coordinate local needs (e.g., regular operational briefing calls, PSPS portal access, Geographic Information System Analyst support, and securing approvals of CRC site locations by jurisdiction);
  - Issuing distribution and transmission-level notifications to potentially impacted customers consistent with the CPUC's recommended notification timeline, which includes direct notifications to potentially impacted customers via calls, text messaging, and e-mail;
  - Providing direct support and real-time situational intelligence to communications providers, Community Choice Aggregators, transmission-level customers and other critical customers;
  - Maintaining an online presence and update PG&E's webpage and social media channels including Facebook, Twitter, and NextDoor;
  - Coordinating directly with the media, including providing press releases to multi-cultural news outlets to provide translated communications to their viewers/listeners/readers, and providing news briefings;
  - Managing intake requests for backup power and customer escalations; and
  - Managing in-person visits to medical baseline customers who did not confirm receipt of their automated notifications.
- Electric Distribution Operations – The Electric Distribution Operations Branch coordinates with the Electric Distribution Emergency Center in connection with the de-energization, recovery, and restoration of PG&E's electric distribution system. The branch also provides information on customer outages and field operational challenges to the EOC. Electric Distribution Operations responsibilities during a PSPS event include:
  - Providing "grid awareness" when a PSPS event is forecasted, which can include any work in progress (planned and unplanned), Critical Operating Equipment, Supervisory Control and Data Acquisition health, abnormal switching, load-at-risk, protection studies, and manual capabilities;
  - Developing and executing the resource plans for pre-PSPS assessment staging/repair work, field observations, de-energizing, patrols, and restoration;
  - Dispatching Medical Baseline door-knock resources to ensure successful notification when required; and
  - Visually inspecting thousands of miles of power lines to assess damage and the progress of repairs, and reporting patrol progress.
- Mutual Assistance – Re-energizing electrical lines after a major wind event may require a significant number of line workers who can patrol and inspect the lines and specialized equipment, have technical gas service recovery expertise, and other related capabilities. Electric utilities implementing a PSPS may turn to the industry's mutual assistance network—a voluntary partnership of electric and gas companies from across the state and region to help speed restoration. PG&E has agreements with other utilities to both request and provide assistance by furnishing personnel, equipment and/or expertise in a specific manner according to size and scale of the emergency.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – PSPS EVENTS

- CRCs – To minimize public safety impacts during a PSPS event, PG&E opens CRCs in potentially impacted counties and tribal communities. CRCs provide customers and residents a safe location to meet their basic power needs, such as charging medical equipment and electronic devices. PG&E uses four CRC designs: (1) mobile Customer Support Units, which are large vans deployed locally in smaller or more rural regions; (2) outdoor locations which include several pop-up tents tables and chairs (3) indoor locations; and (4) large, wedding-style tents.
  At each of these locations, PG&E provides customers with PSPS event information, snacks, water, restrooms, and WiFi. At indoor locations, PG&E provides tables, chairs, and power strips to meet basic charging needs including for cell phones, laptops, and small medical devices. At outdoor and micro sites, the tables, chairs, and power strips are reserved for medical device charging only.
- Vegetation Management – Beginning in 2020, PG&E began investigating whether vegetation mitigation work can occur to prevent de-energization of a line during a PSPS event. This cost is for expedited vegetation work to avoid de-energizing a line.
- Other – Includes various categories with small dollars to support PSPS events such as, Hydro Support to Provide EOC leads with a list of potentially impacted PG&E Power Generation managed facilities and business continuity plans as a result of a PSPS event; and staging and mobilizing response resources as necessary.

PSPS Event is a Wildfire mitigation (WLDFR-M005).

Justification

Increased number of dead trees, drought, hotter temperatures, and higher winds due to climate change have radically increased the risk of a significant wildfire in the event of an ignition. As a result, PG&E have been and will continue lean on PSPS to mitigate the wildfire risk as a measure of last resort. PG&E were forced execute nine PSPS events in 2019 and six events in 2020. The 2020-2021 rainfall totals have been disappointing, and PG&E will need to be prepared for any potential PSPS events in the near future. Charts below show various PSPS events that occurred in 2019 and 2020 and the associated cost and information for each event.

	2019 Event	Jun 8-9	Sep 23-26	Oct 5-6	Oct 9-12	Oct 23-25	Oct 26-Nov 1	Nov 20-21	Total
Event	Event Days	2	4	2	4	3	7	2	24
	Cost per Event	$ 6,813	$ 5,339	$ 1,711	$ 38,674	$ 30,885	$ 78,793	$ 16,536	$ 178,751
	Max Wind Gust	63 mph	58 mph	51 mph	77 mph	80 mph	102 mph	75 mph	
	Damages/Hazards	5	4	2	116	26	554	15	722
	First out-to-last restored Duration	35 hrs	65 hrs	17 hrs	89 hrs	52 hrs	151 hrs	39 hrs	
	Counties Impacted	6	7	3	35	17	37	11	116
	Avg. Restore Dur. (CAIDI from all clear)	5 hrs	7 hrs	4 hrs	25 hrs	5 hrs	22 hrs	10 hrs	
	Avg. Outage Duration (CAIDI)	16 hrs	16 hrs	14 hrs	38 hrs	25 hrs	56 hrs	25 hrs	
Customer	Customers Impacted	22,474	49,113	11,609	735,440	178,809	967,754	49,203	2,014,402
	MBL Door Knocks	599	1,396	180	5,080	881	4,158	674	12,968
	CRCs Open	4	9	3	33	28	77	34	188
Operations	Distribution Circuits	22	61	17	442	146	1,021	57	1,766
	Distribution Miles (Tier 1)	-	670	70	7,290	903	11,508	634	21,075
	Distribution Miles (Tier 2/3)	-	3,433	812	16,087	7,239	33,797	2,918	64,286
	Distribution Miles (Total)	-	4,103	882	23,377	8,142	45,305	3,552	85,361
	Restoration Helicopters	17	16	12	44	42	46	45	222

Note Distribution Miles data not available for June 8-9 event

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – PSPS EVENTS

	2020 Event	Sep 7-10	Sep 27-29	Oct 14-16	Oct 21-23	Oct 25-28	Dec 2-3	Total
Event	Event Days	4	3	3	3	4	2	
	Cost per Event	$ 15,032	$ 11,452	$ 10,587	$ 10,184	$ 28,522	$ 305	$ 76,081
	Max Wind Gust	66 mph	72 mph	73 mph	56 mph	89 mph	72 mph	
	Damages/Hazards	83	11	28	8	126	1	257
	First out-to-last restored Duration	153 hrs	38 hrs	89 hrs	46 hrs	84 hrs	24 hrs	
	Counties Impacted	22	15	19	7	35	1	99
	Avg. Restore Dur. (CAIDI from all clear)	11 hrs	5 hrs	6 hrs	8 hrs	10 hrs	4 hrs	
	Avg. Outage Duration (CAIDI)	37 hrs	22 hrs	37 hrs	19 hrs	37 hrs	21 hrs	
Customer	Customers Impacted	168,594	64,298	40,574	30,154	345,470	617	649,707
	MBL Door Knocks	10,383	4,358	2,431	2,477	22,124	33	41,806
	CRCs Open	50	29	40	19	106	1	245
Operations	Transmission Circuits	18	3	1	1	3	-	26
	Transmission Miles	1939	221	166	75	1,249	-	3,650
	Distribution Circuits	140	64	90	41	343	5	683
	Distribution Miles (Tier 1)	826	334	349	309	2,067	7	3,892
	Distribution Miles (Tier 2/3)	7,244	3,613	2,921	1,909	15,823	41	31,551
	Distribution Miles (Total)	8,070	3,947	3,270	2,218	17,889	48	35,442
	Restoration Helicopters	28	50	47	14	65	3	207

Cost

PG&E's expense forecast for PSPS events is $82.7 million in 2021, $70.8 million in 2022, and $73.0 million in 2023. This initiative began in 2018 and did not incur any expenses prior to 2017.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast				
	2016	2017	2018	2019	2020	2021	2022	2023	Total	Workpaper Reference
EXPENSE										
MWC AB PO 5049889				6,813	172				6,985	
MWC AB PO 5049890				1	2,031				2,031	
MWC AB PO 5049989				5,339	36				5,375	
MWC AB PO 5050649				1,711	38				1,748	
MWC AB PO 5050710				38,674	(67)				38,607	
MWC AB PO 5050863				31,406	(7,375)				24,031	
MWC AB PO 5050864				47,387	4,390				51,777	
MWC AB PO 5050865				30,885	1,087				31,972	
MWC AB PO 5050866				16,536	87				16,623	
MWC AB PO 5051226				79	1				80	
MWC AB PO 5052752					1,549	82,741	70,782	72,998	228,070	
MWC AB PO 5054511					15,032				15,032	
MWC AB PO 5054512					11,452				11,452	
MWC AB PO 5054513					10,587				10,587	
MWC AB PO 5056100					10,184				10,184	
MWC AB PO 5056101					28,522				28,522	
MWC IG PO 5056264					305				305	
MWC IG PO 5056854					2,662				2,662	
MWC AB PO 5263132			4,971	38	15				5,024	
Expense Total	**-**	**-**	**4,971**	**178,868**	**80,706**	**82,741**	**70,782**	**72,998**	**491,066**	**WP 4-8 Line 2**
TOTAL PROJECT COST	**-**	**-**	**4,971**	**178,868**	**80,706**	**82,741**	**70,782**	**72,998**	**491,066**	**WP 4-8 Line 2**

Additional Cost Information:
PSPS events forecast assumes three PSPS events with an additional potential/borderline event per year over the course of the GRC rate case period. Number of events is based on a 10-year historical weather analysis.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – PSPS EVENTS

The "historical weather analysis" evaluates actual weather events and models the associated PSPS events that would have occurred, including both transmission and distribution system impacts. This analysis identifies approximately 30 weather events across the past 10 years that would have triggered a PSPS event under the 2020 PSPS decision-making protocols.

Cost per event is using the average cost per event over the 2019 and 2020 periods. Over the past two years, PG&E executed nine PSPS events in 2019 and six PSPS events in 2020.

Benefits

PG&E's most important responsibility is protecting the health, welfare, and safety of our customers and the communities we serve. When severe weather or other circumstances threaten the ability to provide electricity safely, PG&E must take the appropriate steps necessary to protect the public. PG&E's PSPS program proactively de-energizes a portion of the Company's electric system, in the interest of public safety, as the wildfire prevention measure of last resort when there is a potential for a catastrophic wildfire should the lines be left energized. PG&E understands that de-energizing customers causes significant disruption and is actively working to reduce the impact on our customers.

Alternatives Considered

Alternative 1: Incorporate more than three plus one borderline/potential event into the forecasted number of events per year to align with 2019 and 2020 averages or align with the recommended federal court's conditions for PSPS criteria.[1]

Alternative 2: Less PSPS events and increase guidance

[1] Order Resolving Proposed Conditions of Probation RE PSPS Criteria Case 3:14-cr-00175-WHA Document 1386 Filed 04/29/21

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – PSPS Projects

Project Title: PSPS Projects
Major Work Categories: AB
Planning Order Numbers: 5051516, 5049383, 5049315, 5047213
Project Start Date: 2018
Project Completion Date: On-going
Operative Date (only applies to Capital): N/A

Project Description

This program builds out and improve tools that are critical to PSPS execution. Examples of such tools include:

1. PSPS Viewer – provides the ability to orchestrate the scoping of a PSPS event from planning until the point of de-energization. It translates geographic areas of meteorological fire risk to the Distribution and Transmission assets potentially compromised by those conditions;
2. PSPS Portal – online platform to share key event and sensitive customer information with Public Safety Partners;
3. PSPS Situational Intelligence Platform – provides the primary interface to support PSPS events, connecting PSPS data together across multiple systems for real-time intelligence and post-event reporting; it is a central repository of event data for decision making during events; and
4. PSPS FORCE Tool – estimates field resources needed to patrol and restore PSPS events.

In addition, the PSPS Operations team, develops process for Transmission PSPS scoping working with meteorology and asset strategy that are funded through the Transmission Owner rate case, improve overall PSPS event scoping process by minimizing manual process steps, ensure accuracy and timeliness of reporting data, and manage PSPS Process Documentation.

PSPS PMO Projects is a Wildfire mitigation (WLDFR-M006).

Justification

Increased number of dead trees, drought, hotter temperatures, and higher winds due to climate change have radically increased the risk of a significant wildfire in the event of an ignition. As a result, PG&E have been and will continue lean on PSPS to mitigate the wildfire risk as a measure of last resort. PG&E were forced execute nine PSPS events in 2019 and six events in 2020. The 2020-2021 rainfall totals have been disappointing, and PG&E will need to be prepared for any potential PSPS events in the near future.

During PSPS events, PG&E relay heavily on these tools execute a successful PSPS event. PG&E is constantly look at ways to improve a process or to reduce the time of de-energization for our customers. These tools are critical in achieving these goals.

Cost

PG&E's expense forecast for the PSPS Program team is $1.5 million in 2021, $1.6 million in 2022, and $1.6 million in 2023. PG&E expects to incur similar expenses on an annual basis going forward. The forecast assumes work on the PSPS portal/viewer and other tools will continue to be needed.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – PSPS Projects

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast				
	2016	2017	2018	2019	2020	2021	2022	2023	Total	Workpaper Reference
EXPENSE										
MWC AB PO 5047213			9	18	151				179	
MWC AB PO 5049315			-	1	-				1	
MWC AB PO 5049383			-	3	337				340	
MWC AB PO 5051516					6,410	1,544	1,591	1,641	11,186	
									-	
Expense Total	**-**	**-**	**9**	**22**	**6,898**	**1,544**	**1,591**	**1,641**	**11,706**	**WP 4-8 Line 18**

Benefits

The benefits of the PSPS projects include improving the execution of a PSPS event utilizing the tools outlined in the project description.

Alternatives Considered

Alternative 1: Reduce number of tools utilized during PSPS event

- Pros:
  - Reduced cost
- Cons:
  - May take longer to execute certain tasks
  - Could lead to inaccuracy of resource needs to patrol and restore PSPS events

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – CRC PREPAREDNESS

Project Title: Community Resource Center (CRC) Preparedness
Major Work Categories: AB and 21
Planning Order Numbers: MWC 21 - 5790335, 5543591; MWC AB - 5051737
Project Start Date: January 2020
Project Completion Date: CRC costs will continue to be incurred as long as there are PSPS events
Operative Date (only applies to Capital): Operative as installed

Project Description

Community Resource Center (CRC) Preparedness encompasses efforts needed in advance to open CRCs during PSPS events. CRCs are designed to help mitigate the hardships that customers may experience due to a PSPS related outage. At the CRCs, PG&E provides customers with PSPS event information, device charging for cell phones, laptops, and small medical devices, water, snacks, restrooms, tables, chairs, blankets, and, WiFi and cellular service access. As a Covid-19 precaution, small portable batteries are provided to customers who do not require medical device charging so they can “grab-and-go.”

This project ensures that CRCs are ready to be activated during PSPS events. It includes a small project management team, construction to make all indoor sites ADA compliant and electrical upgrades where needed for placement of temporary generating units, CRC material procurement, and key third party vendor contracts (including contracts with emergency service providers and external customer staffing for the sites).

All indoor CRC sites are ADA compliant. Any building improvements required to make the facility compliant, such as repairing cracks in the path of travel or restriping ADA parking is included. Indoor CRC sites also undergo the electrical upgrades required for the building to be equipped with an automatic transfer switch so that the PG&E-provided or site-owned generator will automatically activate during an outage.

Third party vendor contracts are included in this project as well. A professional staffing firm is hired to recruit and train 850 to 1,000 customer service staff to work at activated CRCs. This project includes all the work required to onboard, train, and prepare these contract staff. Actual hours worked during CRC activations are not included.

Additional third party vendors, called emergency service providers, are paid a retainer in advance of PSPS season to keep on hand all materials required to set up CRCs during a PSPS event, and to guarantee being able to support a certain number of CRCs throughout the PSPS season. These emergency service providers are the first people on site at a CRC, setting up tables, chairs, WiFi, and all other logistical supplies. so the center can open to the community on time. Actual costs incurred during events are charged to the event itself.

The project also includes support from our logistics and materials teams to procure and store all materials needed for CRC sites in advance of PSPS season. This includes reusable items such as signs that direct visitors where to go, and share what resources are available at CRCs, along with items given to visitors (such as water, snacks, blankets, and small batteries).

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – CRC PREPAREDNESS

Justification

CRC's are required per Decision 29-05-051. Rulemaking 18-12-005. Appendix A. Per this decision, CRCs are intended to meet "a variety of safety needs for access and functional needs and vulnerable populations." These are to be "set up in fixed facility locations that can be quickly opened… in areas known to the public, such as recreational centers, public offices, schools, and libraries. CRC locations shall be ADA (American with Disabilities Act) accessible." "CRCs should, at a minimum, provide device charging stations that are capable of charging medical devices, cellular network services, water, chairs, PSPS information representatives and restrooms."

CRC Preparedness is a mitigation for the wildfire risk.

Cost

Project forecast is based on actual expenses incurred in 2020. It includes costs for electrical work, inspections, and ADA compliance upgrades. It assumes that each year some new sites will be needed (20 in 2021-2023, 15 by 2024, 10 in 2025 and 5 in 2026) and that each site will require $60,000 in electrical work and $15,000 in ADA work (based on 2020 actual data). The forecast also includes the continued support of the third party staffing agency and emergency service providers who staff and set up the CRCs, respectively. It includes the acquisition of physical items used in CRC activations (such as laptops and signs) and items provided to customers (such as blankets, water and portable batteries) along with expenses related to project management.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast							
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	Workpaper Reference
Expense Total	-	-	-	-	15,423	14,774	15,226	15,703	-	-	-	61,126	WP 4-8 Line 19
[redacted]													
CAPITAL													
Capital Total	-	-	-	-	-	-	255	262	269	277	284	1,347	WP 4-19 Line 7
TOTAL PROJECT COST	-	-	-	-	15,423	14,774	15,482	15,965	269	277	284	62,473	

Benefits

Opening CRCs during PSPS events helps mitigate the impact of PSPS on our customers, especially vulnerable customers and those who rely on electricity for medical devices. Customers who visit a CRC benefit from a safe place where they have access to:

- Electricity either through the power strips on site or through the portable battery packs that allow customers to "grab-and-go" to minimize potential Covid exposure

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – CRC PREPAREDNESS

- Basic needs such as water, snacks and ADA-compliant restrooms along with other weather-dictated items such as blankets or ice
- WiFi and cellular networks
- Up-to-date information about the PSPS event

Alternatives Considered

Without the CRC preparedness budget, PG&E will struggle to open CRCs at the scale it has previously. It will not be able to meet county, tribal, and community expectations for support during PSPS events.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – PSPS PROGRAM TEAM

Project Title: PSPS Program Team
Major Work Categories: AB
Planning Order Numbers: 5048809, 5052656, 5049811
Project Start Date: 2019
Project Completion Date: On-going
Operative Date (only applies to Capital): N/A

Project Description

PG&E established a dedicated PSPS Program team in 2019 to focus on continuously improving and refining the overall program with core responsibilities of:

- Building critical operational tools needed to execute PSPS events. These tools are described in the PSPS Project section.
- Building cross-functional process by collaborating with cross-functional LOB (Line of Business) team to build and continuously improve the end-to-end PSPS execution process, including gathering and prioritizing requirements, establishing process handoffs and conducting tabletops.
- Establishing and evolve PSPS decision-making process by working closely with Meteorology and Electric Asset Management to develop and operationalize PSPS thresholds and operationalize OIC decisions to support successful execution
- Leading HFRA effort by determining program scope by identifying areas at risk of catastrophic fire risk during high-wind events
- Driving and track execution against PSPS regulatory requirements
- Managing PSPS event data including design control, system and reporting for key PSPS data
- Developing and lead PSPS training
- Supporting every PSPS event

The PSPS Program Team is a Wildfire mitigation (WLDFR-M006) referred to as the PSPS Project management Organization (PMO).

Justification

Increased number of dead trees, drought, hotter temperatures, and higher winds due to climate change have radically increased the risk of a significant wildfire in the event of an ignition. As a result, PG&E have been and will continue lean on PSPS to mitigate the wildfire risk as a measure of last resort. PG&E were forced execute nine PSPS events in 2019 and six events in 2020. The 2020-2021 rainfall totals have been disappointing, and PG&E will need to be prepared for any potential PSPS events in the near future.

The PSPS Program team consist of only internal resources. It is essential to have a dedicated team to improve the PSPS process and support internal engagement for the overall PSPS program. The PSPS program team is a mitigation for the wildfire risk.

Cost

PG&E's expense forecast for the PSPS Program team is $5.5 million in 2021, $4.5 million in 2022, and $4.6 million in 2023. PG&E expects to incur similar expenses on an annual basis going forward. This initiative began in 2019 and did not incur any expenses prior to 2018.

The cost for PSPS Program team consist of labor cost of the PG&E employees. PG&E expense forecast assumes 28 FTEs dedicated to support the PSPS Program at an estimated cost of $150,000 per FTE.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – PSPS PROGRAM TEAM

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast				
	2016	2017	2018	2019	2020	2021	2022	2023	Total	Workpaper Reference
EXPENSE										
MWC AB PO 5048809				719	2,658	5,533			8,910	
MWC AB PO 5052656							4,502	4,643	9,145	
MWC AB PO 5049811				3	(478)				(475)	
									-	
Expense Total	**-**	**-**	**-**	**722**	**2,180**	**5,533**	**4,502**	**4,643**	**17,579**	**WP 4-8 Line 17**

Benefits

The benefits of the PSPS Program team include:

- **Oversight**: Improved oversight via a centralized entity that oversees strategy and execution
- **Accountability**: Improved accountability through dedicated resources focused solely on program delivery
- **Change Management**: Improved change management and coordination due to cross-functional design of program, intended to intersect many Lines of Businesses across PG&E as well as groups within Electric Operations

Alternatives Considered

Alternative 1: Full-Time Resourcing

- Pros:
  - Dedicated resources that are accountable and have no competing organization priorities
- Cons:
  - Increased costs

Alternative 2: Reduce number full time resourcing

- Pros:
  - Reduced costs
- Cons:
  - May lose accountability on certain deliverables
  - May need to prioritize workload with certain deliverables not being
  - Burnout of team members

Alternative 3: Part time resourcing

- Pros:
  - Reduced cost for execution
  - Flexibility to scale up or down
- Cons:
  - Loss of accountability
  - Competing priorities for resource time
  - Lack of support for new amount of workload being executed

Of these alternative, PG&E is operating with option 1 (Full-Time Resourcing). The workload and cross-functional needs of the program merit dedicated resources to effectively run the program day-to-day. The team has a lot on their plates and reduction in FTEs will cause employees to burn out.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – EXCLUSIVE USE HELICOPTER CONTRACTS

Project Title: Exclusive Use Helicopter Contracts
Major Work Categories: AB
Planning Order Numbers: 5052769
Project Start Date: 2019
Project Completion Date: On-going
Operative Date (only applies to Capital): N/A

Project Description

Exclusive use helicopter contracts ensure availability of up to 65 helicopters during the PSPS season. The 65 helicopters are owned and operated by vendors. The use of helicopter allows PG&E to shorten the patrol time of our circuits following an all-clear, therefore, reduce the duration of a PSPS event.
Exclusive Use Helicopters are a Wildfire mitigation (WLDFR-M006).

Justification

PG&E is required to restore electric service to all impacted customers within 24 hours from de-energization.[1] With the use of helicopters, PG&E is able to cover more ground during patrols in attempt to safely re-energize as quickly as possible. There is terrain in PG&E's service territory that is either not accessible by ground or is difficult to get to by land.
Risk for not securing helicopters could lead to longer duration of a PSPS event and exceeding the requirement to restore 100% of PG&E's customers within 24 hours.

Exclusive Use Helicopter costs are a mitigation for the Wildfire Risk.

Cost

PG&E's expense forecast for Exclusive Use Helicopters is $8.0 million in 2021, $14.9 million in 2022, and $15.4 million in 2023.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast				
	2016	2017	2018	2019	2020	2021	2022	2023	Total	Workpaper Reference
EXPENSE										
MWC AB PO 5052769					28,668	7,976	14,944	15,411	66,999	
									-	
Expense Total	-	-	-	-	**28,668**	**7,976**	**14,944**	**15,411**	**66,999**	**WP 4-8 Line 20**
TOTAL PROJECT COST	-	-	-	-	**28,668**	**7,976**	**14,944**	**15,411**	**66,999**	

[1] Decision 29-05-051. Rulemaking 18-12-005 page 85

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – EXCLUSIVE USE HELICOPTER CONTRACTS

Additional Cost Information:
EU contract forecast is based on 2020 final recorded costs. 2020 recorded costs shown in the GRC ($28.7M) did not include 2020 post-close adjustment due to timing of GRC preparation. There were post-close adjustments that allocated helicopter daily EU fees to various non-PSPS programs/projects that used the helicopters. The final 2020 recorded costs that remain in the PSPS program is $14.3M.

Additional cost is incurred when these helicopters are used. An hourly rate is paid to the operator when the helicopters are flown. These variable flight costs are captured in PSPS event orders.

Benefits

The benefit to utilizing helicopter is the rate of patrolling PG&E assets following de-energization. For larger PSPS events, with the amount of miles that needs to be inspected, meeting our requirement of restoring 100% of our customers within 24 hours becomes a challenge without the support of helicopters. The Exclusive Use contracts allows PG&E to utilize up to 65 helicopters for larger events for a quicker restoration.

Alternatives Considered

PG&E's alternative could eliminate the exclusive use contract entirety; however, helicopters are not guaranteed to be available for PG&E use during a PSPS event. There would be a significant risk to meet our requirement of 100% restoration within 24 hours.

A second alternative would be to reduce the number of helicopters in the contract that is made available for PG&E during a PSPS event. There would be a significant risk to meet our requirement of 100% restoration within 24 hours for larger PSPS events.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – WILDFIRE SAFETY PUBLIC ENGAGEMENT TEAM

Project Title: Wildfire Safety Public Engagement Team
Major Work Categories: AB
Planning Order Numbers: 5053510
Project Start Date: 2020
Project Completion Date: On-going
Operative Date (only applies to Capital): N/A

Project Description

The Wildfire Public Engagement team is focused on increasing the transparency of PG&E's wildfire safety and public safety power shut-off program (PSPS) with external stakeholders — in particular, local and tribal government and public agencies — to increase mutual trust and cooperation. The WSPE mission is to organize and execute planning and outreach work to provide external stakeholders with increased understanding and coordination, with a focus on county and tribal emergency management. This team concentrates on three key workstreams:

1. Outreach to county and tribal government and public agencies to provide detailed local insight into PG&E wildfire and PSPS mitigation work, and to gather continuous feedback on improvement efforts
2. Evolve the Liaison Officer and supporting roles during PSPS events, in particular PG&E's support and coordination with local emergency management during events
3. Identify, prioritize and advocate for local projects based on community feedback as part of wildfire and PSPS mitigation work in Electric Operations (e.g., hardening, sectionalizing, vegetation management)

The Wildfire Public Engagement Team is a Wildfire mitigation (WLDFR-M006).

Justification

Increased number of dead trees, drought, hotter temperatures, and higher winds due to climate change have radically increased the risk of a significant wildfire in the event of an ignition. As a result, PG&E have been and will continue lean on PSPS to mitigate the wildfire risk as a measure of last resort. PG&E were forced execute nine PSPS events in 2019 and six events in 2020. The 2020-2021 rainfall totals have been disappointing, and PG&E will need to be prepared for any potential PSPS events in the near future.

The Wildfire Public Engagement team consist of only internal resources. It is essential to have a dedicated team to work with external stakeholders to incorporate feedback as PG&E works to improve the wildfire safety and PSPS program.

Wildfire Public Engagement Team is a wildfire risk mitigation.

Cost

The forecast for this program is $1.2 million in 2021, $1.0 million in 2022, and $1.0 million in 2023. Cost includes labor for the individuals on the team. PG&E expects to incur similar expenses on an annual basis going forward. This initiative began in 2020 and did not incur any expenses prior.

The cost for the Wildfire Public Engagement team consist of labor cost of the PG&E employees. PG&E expense forecast assumes 5 FTEs dedicated to support the PSPS Program at an estimated cost of $160,000 per FTE.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.2, PSPS OPERATIONS
PROJECT SUMMARY – WILDFIRE SAFETY PUBLIC ENGAGEMENT TEAM

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast				
	2016	2017	2018	2019	2020	2021	2022	2023	Total	Workpaper Reference
EXPENSE										
MWC AB PO 5053510					298	1,158	957	987	3,399	
									-	
Expense Total	**-**	**-**	**-**	**-**	**298**	**1,158**	**957**	**987**	**3,399**	**WP 4-8 Line 19**
TOTAL PROJECT COST	**-**	**-**	**-**	**-**	**298**	**1,158**	**957**	**987**	**3,399**	**WP 4-8 Line 19**

Benefits

- **Oversight**: Improved oversight via a centralized entity that oversees strategy and execution
- **Accountability**: Improved accountability through dedicated resources focused solely on program delivery
- **Change Management**: Improved change management and coordination due to cross-functional design of program, intended to intersect many Lines of Businesses across PG&E as well as groups within Electric Operations
- **External Engagement**: Improved external outreach and coordination with a centralized PMO that will be tasked with engaging hundreds of stakeholders and hundreds of thousands customers

Alternatives Considered

Alternative 1: Full-Time Resourcing

- Pros:
  - Dedicated resources that are accountable and have no competing organization priorities
- Cons:
  - Increased costs

Alternative 2: Reduce number full time resourcing

- Pros:
  - Reduced costs
- Cons:
  - May lose accountability on certain deliverables
  - May need to prioritize workload with certain deliverables not being
  - Burnout of team members

Alternative 3: Part time resourcing

- Pros:
  - Reduced cost for execution
  - Flexibility to scale up or down
- Cons:
  - Loss of accountability
  - Competing priorities for resource time
  - Lack of support for new amount of workload being executed

Of these alternative, PG&E is operating with option 1 (Full-Time Resourcing). The workload and cross-functional needs of the program merit dedicated resources to effectively run the program day-to-day. The team has a lot on their plates and reduction in FTEs will cause employees to burn out.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY - ASSET HEALTH & PERFORMANCE CENTER

Project Title: Asset Health & Performance Center
Major Work Categories: FZ, MAT FZA
Planning Order Numbers: 5058332
Project Start Date: 1/1/2017
Project Completion Date: Ongoing
Operative Date (only applies to Capital): Not applicable

Project Description

The Asset Health and Performance Center (AH&PC) (Formerly known as the APC) performs diagnostics on data from automated field equipment to support the Distribution/Substation/Transmission Control Centers. The implementation of grid technology has significantly increased the volume of asset condition and distribution system data, and the AH&PC aims to leverage this data to develop advanced analytics to assess and monitor the condition of electrical assets to prevent wildfire risk. There are three main types of work performed at the AH&PC:

A. Operation/Monitoring of AH&PC sensors and data systems.
B. Development work to transition advance fire risk mitigation technology R&D/Pilot efforts into operational systems.
C. Data Analytics to support Operational Lines-of-Business (LOBs).

A) Operation/Monitoring of AH&PC Data Systems – Enhancements and Expansions

The core of the AH&PC effort is to operate and maintain systems to assess the health and operational safety and performance of electric field equipment. This is achieved by using computer-based analytical models, machine learning tools, and program scripts that query sensor data and operational databases. The status of assets is displayed on dashboards as well as shown in automatically generated reports. Systems developed by the AH&PC can be transitioned into operational lines of business (LOBs) for use by system operators and engineering or be permanently maintained by the AH&PC. AH&PC also works with the operational LOBs to implement enhancements and system expansions requested by operations. Specific examples of these types of monitoring systems include:

- Field Line Sensor Operational Monitor
- RF sensors – Used to detect incipient fault conditions on circuits.
- ECCVM sensors - Used to characterize fault types on distribution circuits.
- Programmatic and AI-based fault location determination using aggregated data from multiple field sensors.

Using automation tools, the AH&PC personnel continually monitor these systems during working hours to ensure they are operating correctly. If there are operational problems, such as data dropout or script failures, AH&PC personnel, working with IT, troubleshoot and fix these systems. Modifications are tested and reviewed before final implementation.

Using advanced analytical tools, the AH&PC will use data from multiple sensor data sources including circuit-based sensors, SmartMeters™, and other environmental sources to quickly calculate the location of system

disturbances or faults. This data is used to promptly dispatch field personnel to correct the issue based on severity.

Management of any subcontractor that supplies either products or services critical to AH&PC operation is also handled by AH&PC personnel.

AH&PC personnel periodically review work efforts with operational LOBs and department management to ensure they are consistent with department/corporate objectives and coordinated with other related projects.

B) Transition R&D/Pilot Efforts into Operational Systems

AH&PC will continue to bring new monitoring systems on-line as they successfully emerge from R&D and pilot efforts. AH&PC will also investigate new operational technology including new sensor types, new analytical tools, new methods of data integration and process improvement. R&D and pilot efforts typically utilize "sandbox" and/or laboratory environments. These need to be transitioned into standardized development/production environments. Data connections need to transition from laboratory data extracts to automated production sources. Algorithms may require further adjustments to ensure acceptable operational parameters are maintained. Dashboards will need to be formalized into operational hardened systems.

Examples of transitions R&D/pilot efforts to operations include:

- Customer Phase Identification
- Service Transformer Health
- Incipient fault detection using RF sensors, ECCVM Sensors, Line Sensors
- SmartMeter™ Partial Voltage detection
- SIQ enablement
- DOE Sensor Electric Phenomenon Cluster / Fault Signature Library pilot

C) Data Analytics to Support Operations LOB

PG&E is building a targeted analytics team operationalizing existing and new data sets to support monitoring of system health and reduction of wildfire risk. The AH&PC will also support expanding operational needs, strategic evaluations, or regulatory requirements. AH&PC staff, leveraging the latest analytic tools and system platforms from its operational work, will conduct this analysis. This work will include data extraction and conditioning, scenario model development, statistical reporting, operational efficiency tools, deep learning system anomaly detection tools, and data visualization.

Examples of the type of work to be conducted in this area include:

- Analytics on system sensors to support Community Wildfire Safety Program
- GDAT (Grid Data Analysis Tool) for automated distribution fault location.
- SmartMeter™ Analytics to detect early-stage equipment failures including (transformers, conductors)

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY - ASSET HEALTH & PERFORMANCE CENTER

Justification

The implementation of new smart grid technology, such as line sensors, SmartMeters™, intelligent controllers, and advance grid sensors has significantly increased the volume of useful data for system integration and cross functional operations coordination. PG&E's desire to continually improve wildfire risk reduction, safety and system resiliency, combined with its increasingly complex and varied infrastructure, means that coordinated and concentrated analytics and situational awareness monitoring are needed. AH&PC initiatives will support quick and efficient assessment of the electrical system to ensure safety and reliability performance.

Risk Reduction – The AH&PC will support operational assessment of the distribution system, for example energized wire down scenarios, through the automated and semi-automated analytics of Smart Meter™ , SCADA data and new advance sensors. This will help reduce the risk of public and community exposure to wildfire ignitions and other safety hazards.

Compliance – The AH&PC supports efforts and requirements from the Wildfire Mitigation Plan (WMP)

- Line Sensor Deployment and monitoring
- RF Sensor Deployment and monitoring
- ECCVM Sensor Monitoring
- SmartMeter™ Partial Voltage Detection Implementation and Engineering
- Sensor IQ implementation and utilization
- DOE Arc Signature Library

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY - ASSET HEALTH & PERFORMANCE CENTER

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast			
	2016	2017	2018	2019	2020	2021	2022	2023	Total
Various POs	-	705	775	455	1,487	3,256	-	-	6,678
SYSPLAN FRMMA FZA (PO #5058332)	-	-	-	-	-	-	2,576	3,437	6,013
Total	-	705	775	455	1,487	3,256	2,576	3,437	12,691

The forecast for the AH&PC is based on staffing support requirements, equipment operational maintenance and support, licensing costs, and other minor expenses.

In 2019 the reformulation of the APC into the Asset Health and Performance Center refocused the groups' effort into methods of reducing wildfire risk through monitoring and analytics technology. The work included redirecting the expansion of the line sensor project into high fire threat district monitoring of incipient fault conditions, development of line sensor event investigation and issue correction processes, and the development of a line sensor monitoring dashboard. In 2019 the department also launched two pilot projects to investigate new advanced early warning monitoring systems (RF Sensors and ECCVMs) within the EPIC 2 program. These pilots continued into 2020.

In 2020, the AH&PC also benchmarked distribution system monitoring technology and devised a 10-year long-term blueprint on how to use sensors and analytics to reduce system risk and reduce wildfire ignitions. The plan was adopted for the start in 2021 and became the foundation for the expansion of line sensors, RF sensors, and ECCVMs to cover the high fire threat districts circuits.

In 2021 the AH&PC is continuing the expansion of line sensors and began the production deployment of RF sensor and ECCVM system, with a continued planned rollout into 2022 and beyond in accordance with its 10-year plan.

Additionally, AH&PC has been working on EPIC Phase 3 projects, specifically EPIC 3.20 (Data Analytics for Predictive Maintenance) and EPIC 3.43 (Momentary Outage Analytics). AH&PC will work with the Data Analytics teams to develop these tools and to scale these technologies for operational use once the projects are completed.

Benefits

Through its expansion of key sensor data and analytics coupled with its development and operation of new interfaces and analytical methods, the AH&PC will help system safety and reduction of wildfire risk by providing new tools to detect incipient conditions and hidden anomalies along with more situational awareness to operational LOBs. This will help PG&E reduce latent issue that can cause wildfires and other risks along with improving reliability and the restoration of power to customers. Additionally, the AH&PC will help improve power quality and asset planning which will help with integration of renewables on the distribution system.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY - ASSET HEALTH & PERFORMANCE CENTER

Benefits for the AH&PC can be categorized into four general areas:

1. Reduced Wildfire Risk – Provide data and detection tools to eliminate many emergent system asset issues through sensors, data analytics, machine learning methods, dashboards, reports, and automated dispatch correction platforms.
2. Reduced Restoration Time – Validation that field equipment is operational through situational awareness dashboards will help to achieve a reduction in restoration time for operators.
3. Avoided Emergency Maintenance – Use of the predictive failure warning systems will permit maintenance problems to be addressed during normal operating times and avoid emergency call-out overtime.
4. Post-Event Analysis – Assessment of long-term performance issues will be possible through the analytics and data collection within the AH&PC and its components. This information will be used in conjunction with asset engineering departments to tune system performance.

Alternatives Considered

1) Take No Action:

- Maintenance and operations of AH&PC-related line sensor data systems are left in current pilot state.
- Not take advantage of the massive quantities of data already available but not correlated with other data or turned into actionable events.
- Not implementing new sensor technologies to better monitor system health.
- Analytics continued to be done on an ad hoc basis through LOB department staff or third-party contractors.
- Successful EPIC projects are transitioned individually using sponsoring department resources.

2) Assign Maintenance and Analytics to Operations Departments:

- Operations department, within current daily activities, maintains line sensor data systems.
- Use operational focused departments to lead new sensor technology and analytical projects, often in conflict with day-to-day activities. Analytics would be done on an ad hoc basis through the LOB or outsourced to contractors.
- Successful EPIC projects are transitioned individually using sponsor department resources outside of operations.

PG&E recommends implementation of the expanded AH&PC as described in this Project Summary. Choosing the option to expand the AH&PC is the most effective way to leverage valuable sensor data and new analytic approaches to support distribution system operations and wildfire prevention. It also provides an operational landing place for successful EPIC related pilot projects.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – AUTOMATION AND PROTECTION

Program Title: Automation and Protection
Major Work Categories: MWC 49, MAT 49A
Planning Order Numbers: Various
Project Start Date: 2020-2021
Project Completion Date: December 2026
Operative Date (only applies to Capital): Operative as installed

Project Description

The Distribution Line Automation program (MAT 49A) includes forecasts for the replacement of outdated line recloser controllers in both High Fire Threat District (HFTD) areas (in 2021) and non-HFTD areas (in 2022-2026). The MAT 49A work in HFTD areas in 2021 is discussed here because it is a Wildfire mitigation (WLDFR-M10A). The MAT 49A work forecast for non-HFTD areas is discussed in Chapter 13, and in a Chapter 13 Project Summary entitled "3A and 4C Line Recloser Replacement." All of the 49A work is a mitigation for Failure of Distribution Overhead Assets (DOVHD-M10)[1]

High impedance faults are conditions where line to ground faults do not draw a full fault current that a protective device can reliably sense and trip (function of contact resistance to ground), creating a potential ignition source. The replacement of the legacy SCADA recloser controls protecting Tier 2 and 3 HFTD areas with new recloser controllers will enable the use of protective features designed to address high impedance fault conditions as well as integrating with current communication protocols. Under this distribution system automation initiative, the existing oil filled reclosers and controllers will be replaced with a solid dielectric recloser and new micro-processor controller with protection elements like Downed Conductor Detection (DCD), Sensitive Ground Fault (SGF), and platforms that allow for future protection elements that are under development to reliably detect high impedance faults. All of these units will have SCADA capability.

In 2021, PG&E will replace approximately 80 remaining legacy controllers that are located throughout PG&E's service territory in Tier 2 and 3 HFTD areas. Due to a change in recloser standards, PG&E will be replacing the entire recloser assembly, including the controls and recloser tank, for most installations.

Justification

Risk – Modern SCADA-equipped reclosers will mitigate PG&E's Wildfire and Failure of Distribution Overhead Assets risks by providing localized isolation, offering remote isolation via SCADA, detecting load characteristics associated with these events, and rapidly opening switches to isolate wire down locations. These reclosers will also help to mitigate the Company's Emergency Preparedness and Response to Catastrophic Events risk by quickly isolating outages, improving reliability, and preventing customer equipment damage such as from single phasing events.

[1] Prior to 2021 this work was forecasted in MAT 09A – Electric Distribution Line SCADA program, which was located in the Substation/Transmission MWC 09.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – AUTOMATION AND PROTECTION

Compliance – Modern, SCADA-equipped reclosers help support the safe and reliable operation of PG&E's distribution system by providing system reliability and automatic fault isolation capabilities.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
Various POs	-	-	7,668	6,789	1,456	-	-	-	-	-	-	15,913
FRMMA SCADA 49A Plan (PO # 5790140)	-	-	-	-	-	6,990	-	-	-	-	-	6,990
Total	-	-	**7,668**	**6,789**	**1,456**	**6,990**	-	-	-	-	-	**22,903**

Additional Cost Information:
Original scope of work for projects as described in PG&E's 2020 RAMP Report only involved replacing outdated recloser controls. PG&E expanded the scope of the project to include replacement of recloser tanks due to and compatibility issues between new controllers and old tanks.

Benefits

- The primary purpose of this project is to improve safety and reliability:
  - Improved public safety and prevent wildfires by helping to isolate energized downed wires
  - Enable protective features which will address high impedance fault conditions in Tier 2 and Tier 3 Fire Areas
  - Reduction in outage frequency to customers
  - Reduction in outage duration
  - Improved customer satisfaction
  - Provides SCADA functionality with current communication protocols.
  - Platform will allow future protection elements under development to reliably detect high impedance faults.
  - Microprocessor controller with protection elements like Downed Conductor Detection and Sensitive Ground Fault will improve the ability to detect high impedance faults.

Alternatives Considered

1 – Replacing Recloser Controls Only (Not Replacing Recloser Tanks)

- Existing models of recloser tank and control (Cooper) have become unreliable and have periodically failed.
- New platforms (Bechtel control and Viper tank) will allow for Downed Conductor Detection, Sensitive Ground Fault and future protection elements currently under development which will reliably detect high impedance faults.
- Increased number of energized wires down would occur due to the inability to detect low impedance wire down events and sectionalize faults.

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PROJECT SUMMARY – AUTOMATION AND PROTECTION

- Would limit PG&E's progress on electric outage management, restoration, and wildfire risk reduction.
- Customers would experience larger and longer duration outages as a result of fewer protective devices and less automatic sectionalizing of system.

2 – Decrease the Number of Future Installations

- This alternative is not recommended as it would limit PG&E's progress on electric outage management, restoration, and wildfire risk reduction. Customers would experience larger and longer duration outages because of fewer protective devices and less automatic sectionalizing of system. Increased number of energized wires down would occur due to the inability to detect both high and low impedance wire down events and sectionalize faults.

3 – Increase the Number of Future Installations or escalate current five-year schedule.

- This alternative is not recommended as it would require that PG&E dramatically accelerate the number of field installations and mandate that resources be redirected from other key safety programs.

PG&E recommends the replacement program described above instead of these alternatives.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – ELECTRIC DISTRIBUTION SYSTEM HARDENING

Project Title: Electric Distribution System Hardening
Major Work Categories: 08W
Planning Order Numbers: Various
Project Start Date: 2018
Project Completion Date: TBD
Operative Date (only applies to Capital): Operative as installed

This project summary section has been modified to describe program changes related to PG&E's updated System Hardening program and forecast as of February 25, 2022.

Project Description

PG&E's System Hardening Program focuses on mitigating against wildfire risk posed by distribution overhead assets in Tier 2 and 3 High Fire Threat Districts (HFTDs) in PG&E's service territory. This program targets high wildfire risk miles and applies various mitigation activities, including: (1) line removal, (2) conversion from overhead to underground, (3) application of Remote Grid alternatives, (4) mitigation of exposure through relocation of overhead facilities, and (5) in-place overhead system hardening.

System Hardening is a mitigation for the Wildfire risk (WLDFR-M002) and the Failure of Distribution Overhead Assets risk (DOVHD-M002).

PG&E is evaluating technologies, processes, and work methods to improve the reasonableness of UG as a primary option for hardening. These include: implementing more horizontal directional drilling and other trenchless technologies to minimize ground disturbances and surface restoration; evaluating wire sizes and conduit capacities to maximize distances between electric equipment enclosures; and establishing electric equipment criteria to meet unique design challenges in HFTDs.

Justification

Distribution overhead assets represent high ignition risk due to a combination of high exposure area (i.e., the large number of overhead assets traversing HFTD areas) and proximity to risk factors such as dry vegetation. When considering wildfires based on the utility equipment involved, PG&E estimates that distribution-related ignitions per circuit mile are 1.6 times that of transmission-related ignitions per circuit mile. When adding vegetation drivers, the estimated distribution ignitions per mile are up to 6 times greater than for transmission circuits.

The following information is based on information in PG&E's June 30, 2021 filing.

PG&E's System Hardening Program is an important initiative that reduces the risk of wildfire ignitions caused by distribution facilities. The System Hardening Program targets three risk areas in PG&E's service territory: (1) the top 20 percent of highest wildfire risk circuit segments as identified by PG&E's 2021 Wildfire Distribution Risk Model for system hardening; (2) overhead structures previously impacted directly by wildfires, and (3) those areas most impacted by PSPS. PG&E identifies locations for system hardening within those 3 categories by various methods, including:

Top 20% of highest Risk Miles:

- Identifying circuit segments with the highest wildfire risk using the 2021 Wildfire Distribution Risk Model;
- Locations where past events have identified deteriorated overhead conductor;

- Electric Corrective Optimization Program (ECOP), where a number of identified corrective repair tags on a single segment of line indicate that hardening the line may be more prudent than repairing each tag individually;
- Idle facilities or other line removal opportunities.

Fire Rebuild:

- Fire damaged line sections requiring rebuild.

PSPS mitigations:

- Projects to mitigate the need for PSPS in a certain area;
- Projects to mitigate PSPS impact to a specific set of critical infrastructure for the community.

PG&E prioritizes projects at the circuit-segment level, as opposed to the regional or full-circuit level. Subsections (a) through (c) describe three mitigation options PG&E considers for each circuit segment when developing a System Hardening Program project – Line Removal and Remote Grid; Relocation of Overhead to Underground; and Overhead Hardening. Subsection (d) explains PG&E's process for considering system hardening alternatives. Finally, subsection (e) describes PG&E's process to address Urgent Fire Rebuild Targeted for System Hardening.

(a) Line Removal and Remote Grid

The complete removal of an existing overhead distribution line eliminates the fire risk associated with that line and is therefore explored for every identified system hardening project. A line removal mitigation can be applied in various ways. The simple application of this mitigation alternative is for known or suspected idle facilities that are not currently, actively serving customer load. Although idle, the lines can be become energized through various means, including magnetic induction and/or electric induction. PG&E follows the procedures and requirements in Utility Procedure: TD-2459P-01 "Idle Facility Program" to investigate potential idle facilities and determine if they can be permanently removed. Another line removal alternative is the rearrangement or re-alignment of the existing circuit path. PG&E reviews the targeted circuit segment for redundant distribution ties through high fire risk areas. Removal of certain circuit segments may have little impact on operational flexibility and provide the most cost-effective measure to reduce wildfire risk. Finally, the application of the Remote Grid alternative mitigation, which is discussed in its own Project Summary, may allow for removal of additional line in the future.

(b) Relocation of Overhead to Underground

A second system hardening approach is to relocate existing high-risk overhead distribution lines to underground. Undergrounding eliminates the wildfire risk associated with overhead distribution facilities. An additional consideration in favor of undergrounding in some cases is that underground construction presents the most reliable method for mitigating the need for initiating a PSPS event.

When considering undergrounding as an alternative, it is essential that all execution (construction) risks are considered. The cost risks to installing underground assets include, but are not limited to: accessibility, rights-of-way, public utility easements, private property crossings, the

number of services, space for necessary subsurface and pad-mounted equipment, environmental restrictions such as naturally occurring asbestos or endangered species, Archeology and Historic Preservation, soil remediation, and soil conditions.

Another impediment to undergrounding are schedule risks. A typical overhead hardening project can advance from concept to execution, documentation, and close out in 13-16 months. In contrast, a typical underground project can often take 18-45 months depending on the various risks presented. In many cases, the most significant driver of schedule risk involves land rights. For most electric lines in the high-risk areas, PG&E only has overhead rights, thus requiring the acquisition of new underground easements to complete an undergrounding relocation. As PG&E is often unable to

construct underground in the exact same path as the overhead, these easements are often required with customers and/or agencies without current agreements. The land rights acquisition process can take 6-18 months and requires the project to be at a fairly mature design stage prior to contacting property owners about the needed rights.

PG&E has found in the past that there are many impediments to underground construction that limit its technical feasibility and commercial reasonableness as a mitigation alternative when compared directly to overhead system hardening. Nonetheless, PG&E believes that undergrounding is a viable hardening option in some circumstances and may be especially suitable in areas with high tree density and strike potential of trees and/or where overhead lines could block critical ingress/egress routes if they fell during a fire.

There will be occasions that undergrounding is chosen even when it does not present the best Risk Spend Efficiency (RSE) of the hardening options because it is the most reasonable alternative to mitigate all risks considered.

(c) Overhead Hardening

The most frequently used method for system hardening is overhead hardening in place. Overhead system hardening can be done more quickly than undergrounding through the use of existing rights and easements. After analyzing projected performance of overhead hardened facilities on more than 4,600 outage types, PG&E projects that overhead system hardening will reduce 62 percent of the distribution overhead asset ignition risk caused by equipment failures or external contact/strikes with energized lines, such as tree strikes. This alternative generally has a higher RSE when compared to the undergrounding alternative in many scenarios. Overhead system hardening achieves risk reduction through these foundational activities:

i. Replacement of Primary and Secondary Bare Conductor with Covered Conductor

Replacement of bare overhead primary (high voltage) conductor and associated framing with conductor insulated with abrasion-resistant polyethylene coatings (sometimes referred to as covered conductor or tree wire) can provide effective mitigation against wildfire ignitions caused by distribution lines. Installing covered conductor can help reduce the likelihood of faults due to line-to-line contacts, tree-branch contacts, and faults caused by animals. Installing covered conductor on secondary lines has similar benefits to installing it on primary lines.

ii. Pole Replacements

All existing poles in areas being considered for overhead hardening are evaluated to see if they are strong enough to bear the weight of the new heavier covered conductor and associated equipment. Often the majority or all poles on a circuit segment will need to be replaced. When poles need to be replaced, PG&E has tested and confirmed that composite poles and intumescent wrapped poles have increased fire damage resiliency to reduce the risk of a pole failure during a wildfire.

iii. Replacement of Non-Exempt Equipment

Replacement of existing primary line equipment such as fuses/cutouts, and switches with equipment that has been certified by CAL FIRE as low fire risk is another component of overhead system hardening. This replacement work eliminates overhead line equipment and devices that may generate exposed electrical arcs, sparks, or hot material during their operation.

iv. Replacement of Overhead Distribution Line Transformers

Consistent with PG&E's current equipment standards, transformers installed on hardened overhead lines will be filled with fire resistant FR3 insulating fluid, a natural ester derived from renewable vegetable oils— providing improved fire safety, transformer life, increased load capability, and environmental benefits. In addition, new transformers are manufactured to achieve higher Department of Energy (DOE) electrical efficiency standards.

v. Framing and Animal Protection Upgrades

On hardened circuits, PG&E will replace crossarms with composite arms, wrapping jumpers, and installing animal protection upgrades to reduce contacts and pole-related ignition risks.

vi. Vegetation Clearing

Vegetation clearing is a critical component of the System Hardening Program. Significant removal of dense vegetation on the ground directly beneath the lines being removed or hardened may be required in order to execute a project. In addition, changes to a line's profile, such as taller poles or wider cross-arms, may require additional vegetation clearing both to execute and to comply with regulatory requirements, which mandate 4 feet of clearance all year long.

(d) <u>System Hardening Process – Alternatives Consideration and Final Design</u>

Once a circuit segment is identified for system hardening, a project is launched for a segment that is no longer than 10-miles. PG&E's Distribution Planning Engineers develop alternatives for construction consistent with approved decision trees that can consist of the various alternatives discussed in sections a-c above or more commonly, a hybrid alternative utilizing a combination of the hardening alternatives thought to be the best fit for each section in the project.

The system hardening project design options are brought to a scoping desktop review team made up of various experts to discuss and analyze additional issues such as tree strike potential, ingress

and egress risks, localized fuel types and past fire history, land constraints, environmental risks, PSPS impacts, and general constructability concerns.

The tree strike potential factor is analyzed by PG&E's Applied Technical Services team. LiDAR data processing extracts pole, span, and fall-in tree geospatial information. This data is processed into an Excel spreadsheet to determine tree-span-pole associations. The tree strike threat is calculated as the number of "fall-in" trees in each span that can touch the line. A "fall-in tree" is simply a tree that is tall enough to potentially strike the span regardless of wind direction.

Ingress, egress, fuel types and past fire history is also determined and provided by PG&E's Public Safety Specialist (PSS) to the field scoping desktop meeting. The PSS team is comprised of PG&E's field wildfire risk experts who help inform PG&E's decision-making process for system hardening. Several team members hold significant first responder experience, often decades, and with that experience, they analyze system hardening issues with a fire fighters' mindset to better understand the fuel types in the area, the historical fires, and the main egress and ingress routes. These experts are invaluable in providing analysis based upon first-hand experience, often working with local fire officials to understand the risks and available mitigations. At the conclusion of the field scoping desktop meeting, the project scoping team often recommends protecting main egress routes through undergrounding, relocation, or fire resilient poles. Recent updates to the decision trees would require underground in future work in support of identified ingress/egress mitigation. This was done mainly because structures near roadways pose other risks outside of fire resiliency such as vehicle contacts that PG&E believes underground to be the most appropriate mitigation. Relocation is often chosen for areas where an ignition may be hard to spot to ensure response times for local first responders are minimized.

The execution of system hardening projects is very challenging due to various environmental and other conditions found in high fire risk areas. Land and environmental specialists analyze the alternatives provided prior to the desktop meeting and Google Earth images are provided to aid in the analysis. Where significant environmental risks, water features, endangered species and habitats, known cultural areas, and local agencies required for the new rights are identified, appropriate scope, schedule, and cost impacts are discussed to aid in the decision making.

Projected PSPS impacts are also analyzed by PG&E's meteorology team and provided to the project scoping team to aid in the understanding of past potential frequency and customer impact. In areas where greater than one PSPS event per year on average has been modeled, or greater than 5,000 customer meters are projected to be impacted, the design alternative for undergrounding is strongly recommended to reduce or eliminate the customer impacts caused by potential PSPS events. The measure for PSPS benefit changes annually with our understanding of system performance. For 2023 incremental work planned to support additional available underground projects, PG&E began looking at a weighted PSPS impact as well as a PSPS risk density when compared to the number of HFTD OH miles. This calculation was used to target new PSPS mitigation work as well as looking into identified impacted Hospitals and other Critical facilities. This benefit can still be difficult to capture and may not be immediately obtained in all cases due to the radial (i.e. "one-way") nature of most of PG&E's distribution system. That is, if lines that are targeted for hardening are undergrounded, but the source of electricity is still coming from overhead lines that are likely to be de-energized, the PSPS savings may not be realized until significantly more work is done. Because of

this, when PG&E targets PSPS mitigation work, we do not focus on circuit segments alone, but the whole circuit to ensure savings are realized.

Utilizing all of this information, the field scoping team will review the design alternatives provided, make changes as necessary, and provide a final field scope document to the estimating team. An estimator then performs a field check where necessary to analyze the assumptions made during the field scoping desktop meeting to confirm the constructability and execution risks associated with the mitigation measures chosen.

Once the design alternatives have been vetted to this level, a final economic analysis is performed creating net present values for the lifetime costs of each design approach, including long-term maintenance needs and costs including annual vegetation management, inspections, etc. A final recommendation and associated documentation is then submitted to PG&E's Wildfire Risk Governance Steering Committee (WRGSC) to review the project scope, risk spend efficiency and related analysis. The WRGSC approves and provides guidance on System Hardening Program projects. Once approved, these projects are scheduled for final design, permitting, and execution.

(e) Urgent Fire Rebuild Targeted for System Hardening

During PG&E's emergency response to a wildfire that has damaged overhead or underground assets, several alternatives may be considered when restoring services to customers. The following guidance has been provided to the Grid Design Engineers, estimators, and assessment leads when choosing the best rebuild alternative tailored to the needs of the area. These alternatives are provided in the order of consideration for each segment and circuit for evaluation:

- Removal – Radial tap lines that are identified as Idle Facilities or circuit back-ties that are not required by our design standards for operational flexibility should not be rebuilt and should be removed;
- Remote Grid Standalone Power System (SPS) – Isolated customer(s) in Tier 2/3 HFTD areas fed by longer segments of distribution line that, if removed or not rebuilt, could be served remotely through temporary generation solutions until a permanent SPS is installed;
- Underground – Distribution primary conductor in an accessible area with adequate space and rights to facilitate underground infrastructure. Temporary generation may be required to support immediate customer restoration while the underground planning and construction project progresses;
- Overhead Harden in a Different Location – Distribution primary conductor through rural, heavily wooded, or inaccessible terrain should be evaluated for relocation to a road or more accessible location. Temporary generation would be required to support immediate customer restoration while the planning and construction project progresses;
- Overhead Harden in Place – This solution is appropriate for primary distribution overhead conductor in Tier 2/3 HFTD areas where >4 spans require full reconstruction or large sections of intermittent damage (generally greater than 50 percent of the segment) requires rebuild. These lines often represent mainline or major customer lines that cannot be effectively generated or switched to alternate sources of power and serve large sections of customers/critical facilities;
- Restore in Place – This solution is appropriate when intermittent damage is found without significant rebuild required; and

- All of the Above – Some combination of all of the above depending on the circumstances for a given circuit.

Once an entire segment has been assessed, a grid design engineer works closely with an estimating team to document the damage notifications into a Google Earth image to clearly identify the damage found on the distribution assets. Then routes are determined, and initial recommendations are made for protection, switches, and wire size. These designs are sent to estimating professionals to discuss with the incident commander at base camp, to distribution planning engineers for fuse sizes and protection settings, and to land and environmental specialists to begin the process of easement acquisitions and dependency clearing. In some cases, alternatives with longer timeframes for implementing must be rejected in favor of alternatives with shorter timeframes. For example, after a wildfire event, it generally will make sense for PG&E to install system-hardened overhead lines in certain areas as opposed to undergrounding so that service can be restored more quickly to customers.

(f) System Hardening Work to Date

In 2019, based on prioritization derived from the 2019 Wildfire Risk Model, the System Hardening Program began with a target of completing 150 miles of hardened facilities. Much of this targeted system hardening work was overhead hardened facilities, although there was also undergrounding and removal work included in this target. In total, 171 miles were hardened by the end of 2019. This included targeted hardening work, idle facility removals, fire rebuild miles and hardened facilities associated with New Business and Capacity projects. As the first year of the program, 2019 also featured the development of many key processes such as establishing a clearly defined field scoping document and process; developing ECOP for evaluating sections with a number of identified corrective tags; implementing the beginning stages of the finite element analysis for tree-strikes, and building execution capacity to support annually increasing the target.

In 2020, the System Hardening Program established a 220-mile target to harden overhead facilities within the highest fire risk miles based on 2019 Wildfire Risk Model. PG&E completed approximately 342 total miles, which includes approximately 194 miles hardened in HFTD areas during fire rebuild efforts and another 21 miles undergrounded through the Butte rebuild effort. The unprecedent wildfires in 2020 and the damage to the electric system in impacted areas led to the development of a more standardized fire rebuild process, which allowed PG&E to complete nearly 200 miles of hardened fire rebuild in the last four months of 2020.

In addition to the system hardening work completed in 2020, PG&E further built on prior program improvements by developing a standard tree strike analysis utilizing LiDAR data for facilities and tree locations. PG&E standardized the use of wood poles with an intumescent wrap to increase fire resiliency of hardened lines and supplement the supply limitations and design challenges associated with composite poles. Project strategies were refined to better coordinate permitting, easement acquisitions, vegetation clearing, and other dependencies in advance of construction.

For 2021, PG&E switched over from REAX to Technosylva as our Wildfire Consequence Modelling tool. The Tecnosylva Wildfire Consequence Model was incorporated into PG&E's 2021 Wildfire Distribution Risk Model. This change and other associated improvements in PG&E's modeling, data, and understanding of fire risk, has led to a shift in thinking about where to target

system hardening resources. PG&E's 2021 Wildfire Distribution Risk Model resulted in a significant change in where PG&E is targeting work in order to harden the highest wildfire risk miles first.

PG&E targeted 180 miles in 2021. While 2021 mileage target is less than the 2020 mileage target, this is as a result of the previously referenced improvement in modeling and significant pivot in targeting. PG&E needed to revise its plans by stopping previously selected projects and starting different projects aligned with our updated risk model. More importantly, the 180 miles targeted in 2021 represent a greater risk reduction value than if we had maintained the old work plan and executed approximately 300 miles in 2021. PG&E added additional conditions to ensure quality of the targeted miles that 80 percent of system hardening miles be highest risk miles (as defined above) and that 10 percent must be performed through undergrounding or asset removal over the 3-year period from 2021-2023. PG&E met its 2021 goal and completed 210 miles and is on track to meet both conditions described above.

(g) System Hardening 2022 and Beyond

Although we hardened fewer miles in 2021 than previously targeted, PG&E used 2021 to rebuild the pipeline of hardening projects in alignment with the new risk model. These efforts include identifying, vetting, designing, and permitting projects for future construction. The result of this activity is that the pace of system hardening will increase substantially in 2022 and is forecasted to be between 450 to 500 miles per year between 2023 and 2026. Even with the shift in the risk model, PG&E anticipates aligning with previously outlined system hardening goals; PG&E's most recent WMP plan forecasts completing 1021 miles in the 2020-2022 timeframe.

In addition to the base System Hardening effort, PG&E is starting to expand its undergrounding capability since we have seen improvements in unit costs and benefits from what we had previously forecasted. Some examples of these recent improvements include utilizing new materials and equipment, improved relationships with our material suppliers and contractors, partnering with our internal gas teams to share costs where possible, and bundling work into larger blocks to take advantage of economies of scale. PG&E is looking at additional potential cost reduction opportunities. These opportunities include leveraging lessons learned from the Butte and North Complex Rebuilds, updating of design and construction standards, process improvements in the sourcing of materials and services, new technologies to expedite construction, leverage process improvements such as programmatic permitting and standardizing design requirements, and adopt lessons learned from other utilities with underground experience.

In the PG&E's February 25, 2022 update, PG&E updated its System Hardening program and forecast to increase focus on undergrounding. PG&E's updated 2022-2026 forecast includes the work planned as part of its 10,000-mile undergrounding program. As a result, the System Hardening program overhead work was reduced and undergrounding scope has increased.

Cost

Costs provided are based on efficiency assumptions gained through process improvements and analysis of the past years' spending. The change in the mix of targeted work following the update of PG&E's risk model is expected to lower the overall vegetation clearing costs associated with this work by 75-85 percent. Additional miles that are typically lower unit costs such as removal, remote grid, and fire rebuild will also help drive the unit cost down from normal planned levels.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – ELECTRIC DISTRIBUTION SYSTEM HARDENING

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
Various POs (MAT 08W)	-	70	23,670	297,884	484,915	415,654	1,030,125	1,512,026	2,541,346	3,018,650	3,423,762	12,748,102
Total	**-**	**70**	**23,670**	**297,884**	**484,915**	**415,654**	**1,030,125**	**1,512,026**	**2,541,346**	**3,018,650**	**3,423,762**	**12,748,102**

Benefits

- The primary purpose of this project is to improve safety and reliability, including:
  - Prevent and/or mitigate wildfires
  - Reduction in outage frequency to customers
  - Reduction in outage duration
  - Improved customer satisfaction
  - Harden the overhead electric infrastructure to make it less vulnerable to extreme weather events.
  - Targeted Undergrounding to minimize tree strike, ingress/egress and PSPS risk

Alternatives Considered

Electric Distribution System Hardening is a complete solution addressing most available initiatives as part of a single project. Alternatives considered would be:

1 – Do not perform System Hardening and Rebuild

- Discontinuing hardening installations of Overhead System Hardening and Rebuilding will limit PG&E's progress on improving public safety, preventing and mitigating wildfires, and addressing the system impacts brought on by the 'new normal'.

- Customers will not be able to take full advantage of the safety and reliability benefits associated with this work.

2 – Perform lower levels of System Hardening and Rebuild

- This would eliminate all cost effectiveness benefits of bundling like work within a given risk area and drive overall cost upwards.
- This would cause redundancy and re-work in the areas where multiple risk factors lie, impacting overall resource demands.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – SINGLE PHASE RECLOSER INSTALLATIONS

Program Title: Single Phase Recloser Installations, Distribution
Major Work Categories: MWC 49, MAT 49T
Planning Order Numbers: 5541859 and 5544491
Project Start Date: January 2021
Project Completion Date: December 2026
Operative Date (only applies to Capital): Operative as installed.

Project Description

A single phase recloser is a cost-effective, intelligent device mounted on cross-arms that can replace fuses with the capability to trip all phases (i.e., open all phases), eliminating the risk associated with wire down events where a downed wire remains energized by a back-feed condition. This is a condition that traditional overcurrent protection devices like fuses are not able to sense and trip. PG&E will install single phase reclosers on distribution laterals that have a history of energized wire down conditions. The single phase recloser will open all phases for the initial line to ground fault and eliminate the risk of ignition from a back-feed condition.

In 2017, PG&E began using the TripSaver single phase reclosers to improve reliability to address transient (momentary) faults on fused laterals. However, the TripSaver device (like the fuse) only trips the faulted phase and can't sense a back-feed condition on a wire-down event. PG&E piloted a single phase recloser device called the FuseSaver in 2019 which has improved functionality. This includes gang tripping (open all three phases) and SCADA capability. This new functionality allows the FuseSavers to be utilized as a PSPS sectionalizing device and can be used to support wildfire risk reduction.

For 2021 and future years, PG&E plans to deploy FuseSavers for purposes of both reliability and wildfire mitigation. The reliability component of PG&E's single phase recloser program is described in Chapter 13.

For purposes of wildfire mitigation, PG&E currently forecasts ramping from 66 FuseSaver installations in Tier 2 and 3 HFTD areas in 2021 to approximately 80 per year starting in 2023. The scaling of this initiative is small in comparison to the total number fused laterals within Tier 2 and 3 HFTDs because the current technology is limited by a 1-amp continuous load requirement. Once a newer single phase recloser model is available that is voltage powered and does not have minimum load requirements, the program will be expanded to target more laterals within HFTD areas. PG&E currently cannot forecast when an improved model will be available.

PG&E identified locations for 2021 single phase recloser installations based on the following criteria: (1) Tier 2 or Tier 3 HFTD areas; (2) two or more wire down outages in the last 10 years; (3) fused cutout experienced FIA fire potential days (R4, R5, or R6, which are elevated fire risk classifications); (4) load on all phases greater than 1 ampere (amp); and (5) fault duty below 5,000 amps symmetric. Site selection for FuseSavers installations in 2022 through 2026 will also utilize similar risk modeling and will evolve as refinements are made to the model and lessons continue to be learned from the execution program.

Justification

The FuseSaver technology PG&E is installing has proven to be cost effective in that it works in conjunction with distribution circuit breakers, line reclosers, and overhead line fuses already in service and provides public safety, reliability, and reduces costs.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – SINGLE PHASE RECLOSER INSTALLATIONS

Risk - FuseSaver technology mitigates the Wildfire and Failure of Distribution Overhead Assets risks by providing localized isolation, offering remote isolation via SCADA, detecting load characteristics associated with these events, and rapidly opening switches to isolate wire down locations. This program is a Wildfire mitigation referred to as "Additional System Automation and Protection – FuseSaver" (WLDFR-M10B).

Compliance - This technology supports the safe and reliable operation of PG&E's distribution system by providing system reliability and automatic fault isolation capabilities.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
2021 ODP 49T Fuse Savers WMBA (PO #5541859)	-	-	-	-	-	2,305	-	-	-	-	-	2,305
SYSPLAN FRMMA 49T WLDFR-M10B (PO #5544491)	-	-	-	-	-	-	2,764	2,940	3,087	3,241	3,403	15,435
Total	**-**	**-**	**-**	**-**	**-**	**2,305**	**2,764**	**2,940**	**3,087**	**3,241**	**3,403**	**17,740**

Additional Cost Information:

The forecasted cost of each FuseSaver installation is approximately $30,000 per location (for three devices, one on each phase).

Benefits

- The primary purpose of this project is to improve safety and reliability, including:
  - Improved public safety and prevent wildfires by helping to isolate energized downed wires
  - Provides high-speed fault isolation with half-cycle interruption, significantly reducing the arc energy available to start a fire when an earth fault occurs.
  - Reduction in outage frequency to customers
  - Reduction in outage duration
  - Improved customer satisfaction
  - Reduces the cost of replacing blown line fuses; material and emergency response costs.
  - Provides cost-effective three-phase isolation vs. traditional line recloser.
  - May be fitted with remote control unit to provide SCADA functionality.

Alternatives Considered

1 – Discontinue FuseSaver Installations

- Would limit PG&E's progress on electric outage management, restoration, and wildfire risk reduction.
- Customers would experience larger and longer duration outages as a result of fewer protective devices and less automatic sectionalizing of system.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – SINGLE PHASE RECLOSER INSTALLATIONS

- Increased number of energized wires down would occur due to the inability to detect low impedance wire down events and sectionalize faults.
- Continued risk of backfeed condition on a wire down event for areas with a history of wire down events.

2 – Decrease the Number of Future Installations

- Install a total of 40 sets of FuseSavers annually in 2021-2026, 50 percent fewer than currently forecast. This would result in lowered capital costs of approximately $1.5 million each year for 2021-2026.
- This alternative is not recommended as it would limit PG&E's progress on electric outage management, restoration, and wildfire risk reduction. Customers would experience larger and longer duration outages as a result of fewer protective devices and less automatic sectionalizing of system. Increased number of energized wires down would occur due to the inability to detect low impedance wire down events and sectionalize faults.

3 – Increase the Number of Future Installations

- Install a total of 160 FuseSaver installations in 2021-2026, 100 percent higher than currently forecasted. This would result in additional capital costs of approximately $3.0 million each year for 2021-2026.
- This alternative is not recommended as it would require that PG&E dramatically accelerate the number of field installations and mandate that resources be redirected from other key safety programs.

PG&E's current forecast will enable Electric Operations to install an average of 80 sets of FuseSaver installations annually in 2021-2026, which PG&E believes is a reasonable estimate of its system needs for that period in order to continue bolstering its circuit infrastructure and reliability performance while minimizing rate impacts.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4, WILDFIRE RISK MITIGATIONS
PROJECT SUMMARY – DISTRIBUTION LINE SECTIONALIZING & MOTORIZED SWITCH OPERATOR (MSO) SWITCH REPLACEMENT

Project Title: Distribution Line Sectionalizing & Motorized Switch Operator (MSO) Switch Replacement
Major Work Categories: MWC 49, MAT 49H
Planning Order Numbers: Various
Project Start Date: Various
Project Completion Date: Various
Operative Date (only applies to Capital): Operative as installed

Project Description

Distribution Line Sectionalizing for PSPS

This project, tracked in MAT 49H, proposes to deploy automated granular sectionalizing systems to improve electric reliability and improve public safety through support for wildfire risk mitigations.[1] This work supports the remote implementation of PG&E's Public Safety Power Shutoff (PSPS) program by providing distribution operators with remote control of automated (SCADA) distribution line sectionalizing devices.

During fire season and other periods of high fire risk, PG&E has been controlling SCADA-operable circuit breaker and line recloser protective relays to limit device reclosing, and in some cases remotely open these devices to de-energize lines as part of PG&E's PSPS program. Existing distribution line reclosers now being operated for fire safety are installed in locations that were originally selected to optimize electric reliability and limit the number of customers exposed to outages, rather than in the best locations for isolating fire threat zones during PSPS events. In an effort to continue further sectionalizing distribution circuits to reduce both the number of customers impacted by fire program operations such as PSPS, and the duration of impacts to those customers, PG&E is proposing to continue installing additional automated distribution sectionalizing devices in Tier 2 and Tier 3 High Fire Threat District (HFTD) areas.

The distribution line sectionalizing work is a Wildfire risk mitigation (WLDFR-M006) referred to as PSPS Reduction Initiatives – Sectionalizer Device Install/Replace.

Motorized Switch Operator (MSO) Switch Replacement

Motorized Switch Operators (MSO) switches were installed on PG&E's distribution system in 2019 as automated sectionalizing devices to help reduce the scope of PSPS events. Despite these switches being understood to meet CAL FIRE's exempt criteria for not posing an ignition risk during normal operation, some MSO switches were reported to exhibit an arc flash during the opening (de-energizing) operation. Based on this feedback and subsequent testing PG&E is undertaking this sub-initiative to remove and replace MSO switches to address this potential risk. This project will be tracked within MAT 49H.

Justification

Distribution Line Sectionalizing for PSPS

The automated sectionalizing and protection technology that PG&E has been installing has proven to be operationally effective; SCADA-operable line reclosers and switches provide the ability to remotely operate and de-energize portions of the overhead electric distribution system. During 2019 and 2020, PG&E successfully

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1 MAT 49H was repurposed in 2018 to capture granular sectionalizing work. Prior to 2018, MAT 49H was used for costs related to Underground Fault Indicators.

installed over 800 SCADA-operable distribution sectionalizing devices on line segments where circuits transition from non-HFTD areas (Tier 1) into Tier 2 and Tier 3 HFTD areas. The combination of these newly installed devices, plus the existing distribution line reclosers that had previously been installed for reliability purposes, provides PG&E the ability to remotely shutoff any of the Tier 2 and Tier 3 HFTD areas.

Depending on forecast weather conditions and modeling, PG&E may only need to implement PSPS in select HFTD areas rather than the entire Tier 2 and Tier 3 HFTD footprint. Therefore, additional circuit segmentation within HFTD areas would benefit PG&E and its customers by allowing PG&E to implement PSPS in a more surgical fashion to further reduce impact. Beginning in 2021 PG&E will install additional SCADA-operable distribution sectionalizing devices within the HFTD areas, rather than at the non-HFTD transition boundary described above. The current forecast will enable PG&E to install at least 250 additional granular sectionalizing installations in 2021, and then 100 per year in 2022-2026 as further segmentation possibilities become more limited.

Risk – Automated granular sectionalizing and protection technology helps mitigate PG&E's Emergency Preparedness and Response to Catastrophic Events Risk, and supports mitigations that reduce Wildfire risk, by quickly isolating outages and allowing remote control of distribution line devices to support PSPS. This work also supports Distribution Overhead Conductor Primary risk mitigations by providing remotely controlled switches that are used to detect load characteristics associated with wire down events and allow distribution operators to open switches to isolate wire down locations.

Compliance - This technology supports the safe and reliable operation of PG&E' s distribution system.

<u>Motorized Switch Operator (MSO) Switch Replacement</u>

Risk – PG&E installed over 100 SCADA automated MSO switches during 2019 to be utilized as PSPS sectionalizing devices to deenergize lines traversing Tier 2 and Tier 3 HFTD areas. After some concerns regarding MSO switches were identified in the field in late 2019, PG&E undertook an evaluation of this equipment. During testing of an MSO switch in PG&E's lab environment to replicate the reported field conditions, the MSO switch exhibited an arc flash during its opening operation. PG&E immediately halted further installations of MSO switches. After further testing, PG&E determined that the current version of MSO switches should not be installed and took the following remedial steps:

- PG&E issued guidance document TD-076253-B004 "Limited Use of Inertia SCADA MSO" which sets controls in place to mitigate wildfire risk until all installed MSOs can be replaced. This control requirement mandates that any MSOs in the field are to be only operated with a Qualified Electrical Worker present during OPEN and CLOSE operations to handle any onsite issues that might arise.

- During 2021, PG&E began assessing various alternatives to address the identified risk with MSOs, which included potentially retrofitting the MSO with new vacuum-break technology, or complete replacement with either new automated line reclosers or new automated SCADAMATE-SD switches. After initial testing of the vacuum-break technology had unsatisfactory results, PG&E decided to proceed with complete replacement of the MSO's with proven line reclosers and SCADAMATE-SD switches to ensure the wildfire risk is eliminated.

- PG&E plans to replace about 40% of the installed PSPS MSO switches in 2021 and complete the remaining replacements in 2022.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4, WILDFIRE RISK MITIGATIONS
PROJECT SUMMARY – DISTRIBUTION LINE SECTIONALIZING & MOTORIZED SWITCH OPERATOR (MSO) SWITCH REPLACEMENT

Compliance – Replacing these MSO switches supports the safe and reliable operation of PG&E' s distribution system.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
Various POs	-	-	452	51,094	69,441	42,890	20,919	11,933	12,255	12,586	12,926	234,496
Total	**-**	**-**	**452**	**51,094**	**69,441**	**42,890**	**20,919**	**11,933**	**12,255**	**12,586**	**12,926**	**234,496**

Additional Cost Information:
PG&E utilized an average of $107,000 per sectionalizing device site installation to determine the forecast costs. See Exhibit (PG&E-4), Ch. 4.3 Workpapers for additional cost information.

Benefits

Distribution Line Sectionalizing for PSPS

- The primary purpose of this project is to improve safety and reliability, including:
  - Improve public safety through wildfire prevention
  - Limit the number of customers impacted by PSPS outage events.
  - Reduce unplanned outage frequency and duration to customers
  - Improve customer satisfaction

Motorized Switch Operator (MSO) Switch Replacement

- The primary purpose of this project is to improve safety and reliability, including:
  - Improve public safety through wildfire prevention
  - Eliminate the arc flash risk identified with the MSO switch
  - Limit the number of customers impacted by PSPS outage events
  - Reduce unplanned outage frequency and duration to customers
  - Improve customer satisfaction

Alternatives Considered

Distribution Line Sectionalizing for PSPS

1 – Cancel Planned Future Installations

- Canceling planned future installations of automated granular sectionalizing and protection systems will perpetuate the negative impact on customers when a PSPS is initiated.
- PG&E will make less progress on electric outage management and restoration.
- Customers will not be able to take full advantage of an enhanced automated sectionalizing infrastructure which helps to identify power outages and restore power in a faster and safer manner.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4, WILDFIRE RISK MITIGATIONS
PROJECT SUMMARY – DISTRIBUTION LINE SECTIONALIZING & MOTORIZED SWITCH OPERATOR (MSO) SWITCH REPLACEMENT

2 – Decrease the Number of Future Installations

- Install 50 granular sectionalizing reclosers per year in 2022-2026, 50 percent fewer than currently forecasted
  Based on a high-level estimate, this will result in lowered capital costs by $5.3 million each year for 2022-2026.

3 – Increase the Number of Future Installations

- Doubling the proposed level of installations to 200 installations per year in 2022-2026, 100 percent higher than currently forecasted
- Based on a high-level estimate, this will result in additional capital costs of $10.6 million each year for 2019-2022.

  PG&E recommends its forecasted cadence of at least 250 additional granular sectionalizing installations in year 2021, and then 100 per year in 2022-2026 as further segmentation possibilities become more limited. Within 10 years, PG&E expects that all HFTD/High Fire Risk Area (HFRA) locations will be fully sectionalized with remote-capability where beneficial. This level of investment will allow PG&E to continue bolstering its wildfire prevention efforts and reliability performance while minimizing rate impacts.

<u>Motorized Switch Operator (MSO) Switch Replacement</u>

1 – Cancel Planned Replacements

- Canceling planned replacements of MSO switches used for PSPS does not resolve the identified wildfire risk issues with this device and would have negative impact when PSPS is initiated by having to operate these devices manually rather than remotely.
- PG&E will make less progress on electric outage management and restoration.
- Customers will not be able to take full advantage of an enhanced automated sectionalizing infrastructure which helps to restore power in a faster and safer manner.

2 – Retrofit MSOs -vs- Replace MSOs

- Following initial testing of retrofitting the MSO with new vacuum-break technology which had unsatisfactory results, PG&E decided to abandon this alternative due to the wildfire safety risk.
- Line reclosers, a proven technology, can be used to replace many of the MSO locations, but they cannot be installed at riser pole locations which is where primary underground cable transitions to overhead conductor.
- PG&E stopped installing SCADAMATE switches in late 2017 due to environmental reasons since they contained SF6 gas for extinguishing the arc when operated. Beginning in 2021 the upgraded SCADAMATE-SD switch was reinstated for PG&E use since the SF6 gas has now been replaced with Solid Dielectric for extinguishing the arc when operated. SCADAMATE-SD switches can also be installed at riser pole locations.

The current forecast will enable PG&E to replace about 40% of the MSO switches in 2021, and the remaining 60% in 2022. PG&E expects this project to be completed by year-end 2022.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – REMOTE GRID

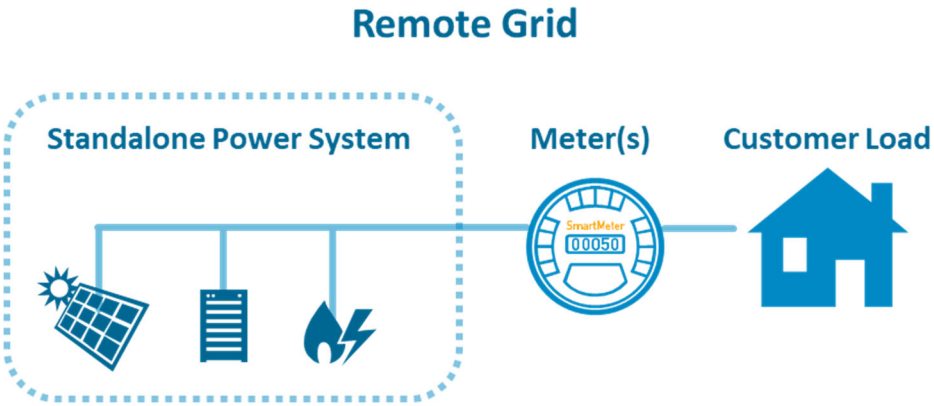
Project Title: Remote Grid
Major Work Categories: MAT 08W[1], MAT KAT, MAT AB#
Planning Order Numbers: 5052592, 5059010
Project Start Date: April 1, 2019
Project Completion Date: 2026
Operative Date (only applies to Capital): Operative as installed

Project Description

Throughout PG&E's service territory, there are pockets of isolated small customer loads that are currently served via long electric distribution feeders. In certain circumstances, these feeders are overhead line construction that traverse HFTD areas and require significant annual maintenance and vegetation management. If these long feeders were removed and the customers served from a local and decentralized energy source (i.e., a "Remote Grid"), the resulting reduction in overhead lines could reduce fire ignition risk as an alternative to or in conjunction with system hardening and other risk mitigations.

"Remote Grid" refers to relatively small, permanently islanded distribution facilities serving customers who are generally located on remote portions of PG&E's distribution system. The Remote Grid facilities include a Standalone Power System (SPS) made up of local sources of electricity supply, such as solar PV generation, battery energy storage, and other distributed generation, as well as distribution and service facilities to connect customers to the SPS. Figure 1 below provides an example of the components of a Remote Grid.

FIGURE PG&E-1: DIAGRAM OF EXAMPLE COMPONENTS OF A REMOTE GRID



The Remote Grid program leverages clean, emergent technologies such as solar-paired battery storage in a way that is intended to be cost-effective and/or more resilient relative to current distribution service

[1] No specific capital planning orders are assigned to the Remote Grid program. To the extent a remote grid project is conducted the capital funding will come from MAT 08W.

delivery options. The objective of the Remote Grid program is to develop and validate the concept as an alternative to other service arrangements and/or wildfire risk mitigation activities such as system hardening.

Initial Remote Grid project locations were selected to validate a variety of Remote Grid configurations while simultaneously providing immediate risk mitigation value at a reduced cost when compared to alternative risk mitigations. In 2019 and 2020, PG&E undertook an extensive review of all distribution feeders in Tier 2 and Tier 3 HFTD areas and developed a preliminary screening protocol, to identify potential Remote Grid projects where this alternative distribution method could deliver superior risk-spend efficiency and overall distribution cost reduction (including reduced capital costs). PG&E prioritized sites for detailed evaluation based on a combination of factors including:

- Located at the end of a radial distribution line;
- Consist of a small number and size of customer loads;
- Historically served by a long section of line;
- Preliminary feasibility assessment based on initial customer outreach and desktop screening for technical viability and constructability of a SPS';
- Potential cost savings: Remote Grid vs preferred alternative risk mitigation strategy (e.g., hardened overhead distribution or underground conversation); and
- Risk ranking of line segment(s) to be eliminated or hardened according to the ignition risk modeling framework as used for all System Hardening work.

From this list of preliminary screening results, PG&E has applied criteria including customer responses to initial outreach, site solar access (shading), civil constructability, and site accessibility to identify initial Remote Grid projects that are likely feasible for this early stage of Remote Grid deployment. PG&E believes the initial planned sites will prove successful, both in terms of demonstrating operational feasibility and delivering wildfire ignition risk reduction in a cost-effective manner. Through the initial projects, PG&E aims to validate the actual data needed to confirm cost-effectiveness, performance, and customer acceptance of the Supplemental Provisions agreement for terms of service, approved by Resolution E-5132. Further validation is needed to increase the certainty of and to identify the "total addressable market" for Remote Grid.

PG&E has six (6) Remote Grid projects in the advanced stages of development, which when completed will eliminate a total of 11.6 miles of overhead line. PG&E plans to begin operations of the first Remote Grid project to serve customer load by the end of 2021. The Remote Grid Program has five (5) additional sites slated to come online in 2022 that will mitigate the need to harden an additional 10.2 miles of line in Tier 2/3 HFTD areas.

In addition to the current projects, PG&E has identified and started developing a portfolio of potential additional Remote Grid deployments designed to validate the viability of this new class of distribution asset. PG&E is completing a detailed scoping and feasibility assessment to verify customer interest, environmental requirements, solar access, civil constructability, and site accessibility. After confirming the feasibility of these additional projects, PG&E will move to the design, permitting and build phase, which may take 9-12 months or more depending on specific site conditions. Several site-specific conditions can reduce the feasibility of an individual project or delay implementation. Examples include customer acceptance, physical space constraints, shading and other constructability related considerations such as grading requirements and geological conditions, permitting challenges such as presence of threatened species, cultural heritage, or adjacency to scenic highway among others.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – REMOTE GRID

In 2021, PG&E will continue to mature the Remote Grid concept toward an eventual standard configuration. Experience gained through the deployment and initial operation of the initial Remote Grid projects will contribute to refinements in the deployment processes, design and performance standards, customer agreements, and operational protocols for future Remote Grid solution. PG&E expects to further validate the availability of viable commercial sourcing agreements via another round of competitive solicitations for SPS' and supporting services. In addition, PG&E received CPUC approval of a Supplemental Provisions Agreement[2] via Resolution E-5132 to extend and clarify how the existing rules and tariffs apply to a customers served by Remote Grid, and to make clear the roles, restrictions, and responsibilities of both PG&E and the customer.

The capital forecast for Remote Grid projects is included in the overall system hardening forecast (08W). PG&E plans to scale its Remote Grid program in the GRC forecast time frame from approximately 20 projects and 26 line miles in 2023 to 69 projects and 90-line miles per year by 2026.

Remote Grid is an alternative Wildfire mitigation (WLDFR-M017).

Justification

Remote Grids that allow for the removal of lines in high wildfire risk areas could provide benefits to both the customers served by Remote Grids and to all distribution customers who will benefit from the cost-effective elimination of wildfire risks associated with distribution lines that run for significant distances through HFTD areas to serve a small number of remotely located customers. The elimination of these type of lines will serve three key objectives: (1) reducing the likelihood of fire ignition due to damage or failure of such lines; and (2) eliminating or reducing asset maintenance costs, including asset inspections and maintenance repairs, as well as vegetation management or (3) reducing the cost to harden these lines to mitigate the fire-related risks. In addition to acting as an alternative to conventional system hardening approaches for the hardest to serve customers at the end of distribution lines, Remote Grid could reduce wildfire risk and provide a cost-effective alternative for the rebuilding of fire-damaged or destroyed infrastructure in remote areas.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast			
	2016	2017	2018	2019	2020	2021	2022	2023	Total
CWSP - Remote Grid (PO# 5050089)				31	755				786
CWSP – Remote Grid PLAN DOVHD-M011 (PO #5052592)	-	-	-	-	-	1,382	1,423	1,464	4,269
SYSPLAN ED KAT Remote Grid (PO #5059010)	-	-	-	-	-	-	617	953	1,570
Total	-	-	-	-	-	1,382	2,040	2,417	6,625

The forecast for Remote Grid projects is included in the overall system hardening forecast. PG&E plans to scale its Remote Grid program in the GRC forecast time frame from approximately 20 projects and 26 line miles in 2023 to an estimated 69 projects and 90 line miles by 2026. See Exhibit (PG&E-4), Ch. 4.3 Workpapers for additional cost information. The cost of these projects will be recorded in MAT 08W. For risk-

[2] Advice 6017-E9 filed on December 15, 2020

spend analysis purposes, we assumed the following spending: $8.5M in 2023, $18.2M in 2024, $25.4M in 2025, $28.8M in 2026.

Benefits

- Remote Grids can reduce the likelihood of fire ignition due to damage or failure of such lines by removing all or a portion of overhead wires required to serve a customer.
- Remote Grids can offset future potential costs to harden overhead lines in high-fire risk areas and reduce the need to conduct enhanced VM to mitigate the fire-related risks. These cost savings would be capital savings.
- Remote Grids can reduce existing costs to underground lines where installation of hardened overhead lines would not sufficiently mitigate system risk. These cost savings would be capital savings.
- Remote Grids can offset potential future costs to replace distribution lines to remote service points once the lines have reached the end of life. These cost savings would be capital savings.
- Remote Grids can reduce the existing risk and cost of weather-related outages by eliminating lines that would otherwise be subject to PSPS or inclement weather. These cost savings would be expense savings.
- Remote Grid is considered an alternative mitigation for Wildfire (WLDFR-M017)

Alternatives Considered

Hardened Overhead Conductor instead of Remote Grid. One alternative to Remote Grids is to serve customers with overhead hardened primary conductor. Overhead hardened conductor can partially reduce the risk of electric failure and wildfire ignition relative to bare overhead conductor. However, the presence of overhead lines means that this configuration retains some risk, relative to undergrounding or eliminating the line completely. This alternative has substantially higher upfront capital costs than the initial capital cost for remote grid, but a lower annual expense cost. This alternative does not reduce as much risk as the line removal associated with Remote Grid projects. This alternative is a viable option where many customers or larger customers require service and the Risk-Spend Efficiency is superior to the use of Remote Grid or underground conductor.

Underground Conductor instead of Remote Grid. The other alternative to Remote Grids is the use of underground primary conductor. Underground conductor can nearly completely reduce the risk of electric failure and wildfire ignition, relative to bare overhead conductor. However, the cost of undergrounding primary conductor is substantial relative to the use of hardened overhead conductor or Remote Grids for small customers. This alternative has substantially higher upfront capital costs than the initial capital cost for remote grid, but a lower annual expense cost. This alternative reduces a similar amount of risk as the line removal associated with Remote Grid projects. This alternative is a viable option where many customers or larger customers require service and the tree-strike or ignition risk of hardened overhead conductor remains significant.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – TEMPORARY DISTRIBUTION MICROGRIDS

Project Title: Temporary Distribution Microgrids (referred to as Resilience Zones in 2020 GRC)
Major Work Categories: MWC 49, MAT 49M
Planning Order Numbers: Various
Project Start Date: May 1, 2018
Project Completion Date: August 2022
Operative Date (only applies to Capital): Operative as installed

Project Description

PG&E's temporary distribution microgrids are designed to reduce the number of customers impacted by PSPS events and support community resilience by powering a cluster of shared resources (e.g., commercial corridors and critical facilities within the energized zones) so that those resources can continue serving surrounding residents during PSPS events. Though each distribution microgrid varies in scale and scope, the following design features are likely for each:

- Devices used to disconnect the distribution microgrid from the larger electrical grid;
- A pre-determined space for backup generation and equipment to allow for rapid connections (e.g., pre-installed interconnection hub (PIH)); and
- The use of temporary generators allowing PG&E to shorten the design and construction time typically required to ready a permanent microgrid for operation.

To determine the appropriate locations for distribution microgrids, PG&E identifies distribution circuits most likely to be impacted by PSPS events in the future, based on foundational data analysis of 10 years of historical weather events. This "historical lookback" takes historical weather events and builds the associated PSPS events that would have occurred, including both transmission and distribution impacts. PG&E reviews these circuits to identify communities with clusters of shared services (i.e., those involving food, fuel, healthcare, and shelter) and critical facilities served by electrical infrastructure that would likely be safe to energize during PSPS events. To determine whether distribution microgrids present viable, effective near-term mitigation measures for a particular location, PG&E also reviews them for implementation feasibility (i.e., land availability and construction complexity) and the potential to be served by alternative grid solutions.

All activities, resources, and costs related to the procurement and deployment of temporary generation or the operation of completed temporary distribution microgrids falls into the 'Generation Enablement and Deployment' initiative.

In 2020, PG&E operated four distribution microgrids (three enabled by permanently installed PIHs, one enabled by a temporary configuration without a PIH). These microgrids energized over 2,000 unique service points (customers) for as many as four PSPS events per service point (approximately 5,600 customer-events). In addition, in October-December 2020, PG&E prepared three additional distribution microgrids in Lake County and Placer County using a temporary configuration without a PIH. The distribution microgrids in North and South Clearlake were on standby to support customers if needed during the October 25, 2020 PSPS event and subsequent PSPS events. The distribution microgrid in Colfax was on standby to support customers if needed during the January 2021 PSPS event.

For 2021, PG&E is planning to develop at least five additional distribution microgrid PIHs by the end of the calendar year. PG&E will continue to follow the methodology described above to locate these sites, which considers likelihood of PSPS impacts, presence of shared services in corridors that can likely be safely

energized during PSPS events, and implementation feasibility. As in prior years, PG&E will collaborate with county and local government to ensure local priorities help shape site selection and design where technically feasible.

For 2022, PG&E is planning to apply all remaining 2020 GRC MAT 49M (CWSP – Resilience Zones) funds to develop additional temporary distribution microgrids following the targeting methodology described above.

PG&E currently is not forecasting any costs for the construction of new temporary distribution microgrids for 2023-2026, shifting its focus during this time on improving the operation of completed microgrids during PSPS events (see Generation Enablement & Deployment). As PG&E continues to evolve its understanding of the PSPS risk and matures its PSPS mitigation program, we will continue to evaluate the need for additional temporary distribution microgrids as well as permanent generation.

Temporary distribution microgrids are a Wildfire mitigation (WLDFR-M006) referred to as PSPS Reduction Initiatives – Temporary Distribution Microgrids.

Justification

The focus of Temporary Distribution Microgrids is to, where feasible, help mitigate the potential impact of service interruptions to shared community services during PSPS operations in well-hardened, downtown corridors.

Temporary Distribution Microgrids utilize proven utility equipment in a unique configuration intended to enhance community resilience during PSPS operations. The equipment described in the previous section has been deployed elsewhere in PG&E's service area in different configurations for a different use case. Prior similar work has deployed pad-mounted transformers with quick-connection capability at the end of radial feeders to address local reliability issues. In the Temporary Distribution Microgrids, similar equipment is deployed on mid-feeder segments with additional isolation equipment to support PSPS operations. Pre-installing distribution equipment to enable rapid connection of generation minimizes costly investments in permanent generation equipment, which might be rarely used. This is a prudent approach given that variable weather events drive PSPS execution decisions. Additionally, as generation and DER options mature, this approach preserves the option for PG&E to deploy the commercially available resources that are best suited to meet Temporary Distribution Microgrids needs based on safety, technical effectiveness, emissions, and cost considerations.

Risk – Temporary Distribution Microgrids mitigate risk associated with PSPS events by providing temporary power to community services, including shelters and other services supporting public safety, during PSPS operations.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
Various POs	-	-	692	3,283	13,718	16,448	13,559	-	-	-	-	47,700
Total	-	-	**692**	**3,283**	**13,718**	**16,448**	**13,559**	-	-	-	-	**47,700**

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – TEMPORARY DISTRIBUTION MICROGRIDS

Additional Cost Information:
See Exhibit (PG&E-4) Ch. 4.3 Workpapers for additional cost information.

Benefits

- The primary purpose of this project is to improve safety and reliability, including:
    - Improve public safety through wildfire prevention
    - Limit the number of customers impacted by PSPS outage events.
    - Reduce the unplanned outage frequency and duration to customers
    - Improved customer satisfaction

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3 – SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – DISTRIBUTION GRID SENSORS

Project Title: Distribution Grid Sensors
Major Work Categories: MWC 49, MAT 49I
Planning Order Numbers: 5535121 and 5539545 (Line Sensors); 5540619 (RF Sensors); 5540620 (ECCVM Sensors)
Project Start Date: 5/2019
Project Completion Date: 12/2030
Operative Date (only applies to Capital): Operative as installed

Project Description

The three types of distribution grid sensors described below detect non-equipment failure types that cannot be detected by existing detection methods and patrol techniques. In some cases, non-equipment failure-type outages (no problem found) are indicators of latent conditions that could cause more significant issues or fire risks if left unresolved. These technologies also detect other power flow anomalies/disruptions that may be indicative of incipient faults. By proactively detecting failing conditions before they continue to degrade, these sensors enable PG&E to address latent or incipient issues in their early stages before they cause an ignition that leads to a wildfire.

Several types of sensors, which monitor different signals, act in conjunction as a system to detect a wide variety of conditions that could not be effectively detected and locate with just a single technology.

- Line sensors and communicating faulted circuit indicators (cFCIs) are able to detect larger overcurrent conditions (faults) at various points along the circuit and can moderately categorize and localize the location of the condition. Line Sensors are commercially available and can be immediately deployed. cFCIs will be available in 2021.
- Event Classification through Current and Voltage Monitoring (ECCVM) sensors (also sometimes called Distribution Fault Anticipation sensors) are also measure current and high resolution, but add voltage reads for a comprehensive and synchronized power measurement of each phase from the substation outlet. This high-resolution data matched with a 20-year distribution event waveform library can accurately categorize the type of event, but due to its single measurement location cannot determine location on the circuit.
- Radio frequency (RF) sensors[1] (while still an emergent technology) are able to detect incipient conditions as subtle as a broken strand or vegetation proximity, and larger fault conditions based on the RF energy created by partial discharge, with sub-span locational accuracy.

Each of these three sensors alone have limited impact on detection of equipment issues. However, combined they are a powerful tool that can provide the location (Line Sensors/cFCIs and RF sensors) and the cause of the event (ECCVM) for quick action and remedy. This platform requires using an analytical platform to intersect the data. Initially, Line Sensors/cFCIs and EECVM would be used to cover most HFTD circuits, with RF sensors gradually replacing most of the Line Sensor/cFCI functionality, but not completely.

PG&E provides specific forecasts and deployment plans for each of these sensor categories below, but our plans could change pending continued evaluation of each technology's capabilities as well as integration with other grid modernization and wildfire mitigation efforts described in this chapter and elsewhere in the GRC. In

[1] RF sensors are sometimes also referred to as Early Fault Detection, or EFD, sensors, which is a brand name for a type of RF sensor.

coordination with deployments of other technologies, future sensor deployments will utilize PG&E's risk model tools in combination with feasibility screens to help prioritize highest-risk locations for installations. Deployment costs factor in IT costs for data integration and analytics.

1) Line Sensors and cFCIs

Line sensors and cFCIs are single phase, conductor mounted devices that continuously monitor an electric line to capture various disturbances such as overcurrent events. Line sensors harvest power from the conductor and continuously measure current in real time and report events as they occur, while cFCIs operate on batteries and are placed on low current sections of circuit and usually communicate regular data once a day and fault event alerts (excluding waveforms) as they occur.

When fault events are detected, line sensors and cFCIs generate alerts through to OSISoft PI™ and display them in PG&E's Distribution Management System (DMS). Line Sensors provide waveforms of the fault event. RMS (root mean square) current values can be used in fault locator models like CYME to estimate the location of the disturbance. Deployment costs should also factor in IT costs for data integration and analytics.

Building from its Smart Grid Pilot Program, PG&E deployed 801 line sensing devices on 60 circuits in 2019 and 2020 at Tier 2 and Tier 3 High Fire Threat District (HFTD) areas in Humboldt, North Bay, North Valley, Sierra, Sonoma, and Yosemite. Efforts were focused on reducing wildfire risk and improving public safety by monitoring the grid continuously; performing analytics on captured line disturbance data; identifying potential hazards and, when necessary; and dispatching field operations to proactively patrol/maintain/repair failing field conditions or assets.

In 2019, line sensor work was suspended from reliability improvement work and moved to the Community Wildfire Safety Program (CWSP). For 2019-2022, PG&E is suspending the routine work in this program to focus on the new Overhead System Hardening Program and other Wildfire risk mitigations. PG&E plans to expand coverage of the technology first to the highest fire-risk areas, with full coverage to 600+ HFTD circuits over the next 10 years or so. PG&E currently forecasts installing line sensors / sFCIs on approximately 50 circuits each year.

PG&E's forecasts annual expenditures in MAT 49I of $12.4 million in 2021, $8.0 million in 2022, $8.3 million in 2023, $6.5 million in 2024, $6.0 million in 2025 and $6.1 million in 2026 for its line sensor/cFCI program.

Line Sensors are a Wildfire risk mitigation (WLDFR-M07A). The mitigation is referred to as Situational Awareness and Forecasting Initiatives – Line Sensors.

2) RF Sensors

RF sensors are sophisticated technology that listens for the radio frequency signal that is generated by partial discharge arcing on AC circuits and uses precision time measurement of events to locate the source along the conductors. These sensors are mounted near a conductor set approximately every three (3) miles for the entire length of the conductor to be monitored. The sensors work in coordination from set-to-set and samples on a duty cycle basis. The sensors can locate anomalies to within thirty feet.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3 – SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – DISTRIBUTION GRID SENSORS

PG&E conducted a pilot in 2019-2020 of 20 RF Sensors on two circuits in an HFTD Tier 2/Tier 3 area.[2] In PG&E's pilot of RF sensors, line risks that were detected included a broken conductor strand, a bullet lodged in conductor, deteriorated cross arm conductor insulator attachment, vegetation contact, failing fuses, failing transformers, candling fuse, and loose clamps. Because these issues were detected, PG&E was able to repair them with normal maintenance tags before complete failure occurred. The recommendation from the pilot was to continue deployment of this emerging technology.

RF Sensors show the greatest promise in identifying and locating line risks, but still require additional product development and a lower total installed cost before they are ready for full-scale deployment. PG&E's efforts to date have also relied on a single vendor and PG&E plans to explore additional vendors going forward.

PG&E deployed RF Sensors on one additional circuit in 2020 and currently plans to expand RF Sensors to cover an additional 11 circuits between 2021-2022 with an additional 66 circuits in 2023-2026.

PG&E forecasts annual expenditures in MAT 49I $4.7 million in 2022, $5.4 million in 2023, $6.2 million in 2024, $7.5 million in 2025 and $8.8 million in 2026 for its RF Sensor program.

RF Sensors are a Wildfire risk mitigation (WLDFR-M012). The mitigation is referred to as Situational Awareness and Forecasting Initiatives – EFD.

3) ECCVM Sensors

ECCVM sensors are substation Current Transformer (CT) / Potential Transformer (PT)-based devices that measure volts, amps and arcing conditions. These sensors monitor magnitude, phase, harmonics, real and reactive power and cycle-to-cycle deltas in these values. They also cluster and categorize events and generate waveforms; these alerts are usable in fault locator models like CYME to estimate disturbance location. The lead vendor in the segment uses 20+ years of utility data of event signatures to categorize events. The categorization of events assists with focusing investigations on specific equipment or construction types.

Examples of line risks identified by ECCVM Sensors in a pilot conducted by PG&E include: candled fuses, arcing switches, line slap, failing underground elbow, and failing transformer/secondary issues.

PG&E conducted a pilot of ECCVMs from 2019 to 2020 as part of the second wave of the CPUC's Electric Program Investment Charge (EPIC 2) on six circuits[3]. The pilot was in one of PG&E's HFTD Tier 2 and 3 areas and was deemed successful. The recommendation from the pilot was to continue deployment of this emerging technology.

PG&E is planning on expanding ECCVMs to cover an additional 160 circuits between 2021-2022 with an additional 464 circuits in 2023-2026.

PG&E forecasts annual expenditures in MAT 49I of $10.4 million in 2022, $9.0 million in 2023, $9.0 million in 2024, $9.2 million in 2025 and $9.5 million in 2026 for its ECCVM Sensor program.

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[2] The recorded costs for the RF and ECCVM sensors are funded through the EPIC program, but we have shown them in this GRC chapter together with their future cost forecasts to show the evolution of these sensor programs.

[3] The recorded costs for the RF and ECCVM sensors are funded through the EPIC program, but we have shown them in this GRC chapter together with their future cost forecasts to show the evolution of these sensor programs.

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EXHIBIT (PG&E-4) CHAPTER 4.3 – SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – DISTRIBUTION GRID SENSORS

ECVVM Sensors are a Wildfire risk mitigation (WLDFR-M011). The mitigation is referred to as Situational Awareness and Forecasting Initiatives – DFA.

Justification

Addressing latent or incipient issues in their early stages may remove many of the conditions that cause wildfires. With the ability to proactively detect failing conditions as they evolve and eliminate them quickly, PG&E can better reduce the risk of wildfire. The sensors described above may also be able to more quickly detect and locate aggressively failing components during high-risk conditions and allow field crews and fire protection personnel to more immediately respond and minimize wildfire risks.

Existing detection methods and patrol techniques miss non-equipment failure types since they lack visibility and sensitivity. Non-equipment failure-type outages (no problem found) are indicators, in some cases, of latent conditions that could result in more significant issues or fire risks if left unresolved. There are also other power flow anomalies/disruptions that may be indicative of incipient faults. Advanced monitoring methods that measure different electrical parameters over the distribution circuits can harness these advanced sensors with analytical methods to find conditions early in their degradation mode.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
Line Sensors & cFCIs (PO #5535121 & #5539545)				2,764	2,272	12,369	8,037	8,254	6,474	5,964	6,125	**52,259**
RF Sensors (PO #5540619)							4,647	5,434	6,234	7,486	8,786	**32,587**
ECCVM Sensors (PO #5540620)							10,351	8,965	9,002	9,245	9,495	**47,058**
Total				**2,764**	**2,272**	**12,369**	**23,036**	**22,653**	**21,711**	**22,696**	**24,405**	**131,904**

Additional Cost Information:

In 2020 PG&E deployed only line sensors under this project on a limited number of feeders. RF and ECCVM sensors were still part of the EPIC program. 2021 includes a ramp up of an additional 900 line sensors, 50 ECCVM circuits and 3 RF circuits. There is some initial spending on analytical IT infrastructure to support the large volume of data being ingested and analyzed.

2022 plan increases the number of sensors in all categories and funds additional IT spend to integrate all of the sensor technologies.

A majority of the IT spend on analytics and data occurs in 2021-2023. Each system has its own development and integration schedule and results in varying annual totals. In 2024 the costs return to just the hardware components and commissioning. Though there is a gradual increase in the number of RF feeders installed per year (increasing 2.5 per year).

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PROJECT SUMMARY – DISTRIBUTION GRID SENSORS

RF sensors deployment has a 2.5 feeders per year increase starting 2022. RF sensors are the most expensive of the technologies.

Benefits

- Each sensor has the ability to detect certain types of incipient faults on a circuit.
- Line sensors can detect the location and phasing of larger faults.
- ECCVM sensor can categorize and determine the type of condition that caused a fault.
- RF sensor can detect very minute arcing conditions and pinpoint to sub span accuracy.
- By detecting incipient conditions prior to failure or during non-high fire risk conditions, many fire ignitions can be avoided.
- The aggregate of all sensors working inside the analytics platform has the ability to pinpoint conditions more effectively.
- Ultimately, the sensors working in a collaborative and automated manner will be more proactive and respond in real time to both detect and curtail potential ignitions.

Alternatives Considered

1 – Continue using the existing method.

- Use data from reclosers and manual analyses date with a large number of engineers and limited sensor sources resulting large patrol areas and no detail of event type.
- Analysis and detection would be delayed, and only large events would be found.
- Many incipient conditions would be left undiscovered and could result in more fire ignitions
- This alternative is not recommended because customers would experience more frequent and repeated outages as a result of fewer issues resolved.

2 – Complete rebuild of infrastructure and clear all vegetation

- Rebuild all high fire thread circuits with new equipment minimizing risk for wildfire ignition sources and clear all hazardous vegetation.
- Although this method is being extensively deployed, it is extremely expensive, time and resource intensive and is not sustainable. All systems exposed to the environment and nature eventually start to decay or grow and would need some effective monitoring (sensors). This alternative alone is not recommended for the above stated reasons.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – SENSOR IQ

Project Title: Sensor IQ
Major Work Categories: MWC 21, MAT 21A (Capital) and MWC AB (Expense)
Planning Order Numbers: 5052593 and 5544495
Project Start Date: January 2019
Project Completion Date: Ongoing
Operative Date (only applies to Capital): 12/2023

Project Description

The Sensor IQ (SIQ) software works with existing SmartMeters™ to capture and store high resolution, real time, and granular load, voltage, and outage data to enable predictive maintenance data analytics.

Although SIQ does not currently have a direct impact for wildfire reduction, this technology can decrease overall wildfire ignition risk by detecting early-stage equipment failure, enabling PG&E to conduct repairs before infrastructure fails. PG&E anticipates the additional data source may provide an analytical methodology to detect early-stage equipment failure resulting in voltage and other meter-detectable conditions including, loose conductor splices, failing or overloaded transformers, and momentary, secondary, and primary vegetation contact.

In addition to providing early awareness of degrading conditions on equipment, the data collected and analyzed by SIQ also supports other wildfire related objectives. For example, the data collected through SIQ can be used to determine phase assignment of meters through machine learning methods and is critical for Rapid Earth Fault Current Limiter, which requires feeder phasing to determine the line-earth capacitive imbalance. Another example of a wildfire-related use case for this data is improving PG&E's wires down algorithms to find faults.

The SIQ pilot began in 2020 and includes 500,000 SmartMeters™ in High Fire Threat District (HFTD) Tier 2 and 3 areas. PG&E expects to have Sensor IQ capability deployed on all planned meters by October 2021[1] and to complete a full evaluation of potential uses in 2022. For example, PG&E will use an advanced data analytics and machine learning platform to evaluate whether SIQ improves its ability to find loose conductor splices, failing/overloaded transformers, or a momentary secondary and primary vegetation contact.

The total cost for the pilot from 2020-2021 is $2.0 million. If the technology proves to be effective in the early detection of wildfire risks, the deployment of the SIQ technology may be extended to additional meters, including possibly all 5.5 million electric SmartMeters™ across PG&E's service territory, which will improve safety and reliability system-wide.

PG&E's 2023 capital expenditure forecast for the SIQ Program in MAT 21A is $10.5 million. PG&E's 2023 expense forecast is $3.8 million.

Sensor IQ is a Wildfire mitigation (WLDFR-M07F) referred to as Situational Awareness and Forecasting Initiatives – Sensor IQ.

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[1] This date differs from the original anticipated completion date of 12/31/2020. The SIQ pilot was delayed due to several issues identified to date and the uncertainty related to further challenges with this new technology. These issues and challenges are described in more detail in PG&E's 2021 WMP filing in Section 7.3.2.2.4 and in PG&E's September 11, 2020 Change Order Report.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – SENSOR IQ

Justification

PG&E believes useful and valuable wildfire related data can be obtained from SmartMeters™. The current SmartMeters™ are only able to capture limited lower frequency and less comprehensive real time data. PG&E has worked to harness as much intelligence from the meters as possible in the current configuration. The SIQ software is expected to provide higher resolution data and additional data fields that can be set to report in real time, allowing for a more insightful view of undesirable changes that could negatively impact PG&E equipment. Early awareness of degrading conditions can allow for a prompt response and help reduce the risk of potential wildfire ignition sources.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded			Forecast						
	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
EXPENSE										
MWC AB PO 5050409	-	24	1,871	145	-	-	-	-	-	2,040
MWC AB PO 5052593	-	-	-	-	-	3,783	-	-	-	3,783
Expense Total	-	24	1,871	145	-	3,783	-	-	-	5,823
CAPITAL										
MWC 21 PO 5534621		29	(30)	-	-	-	-	-	-	-
MWC 21 PO 5544495	-	-	-	-	-	10,507	-	-	-	10,507
Capital Total	-	-	-	-	-	10,507	-	-	-	10,507
TOTAL PROGRAM COST	**-**	**53**	**1,841**	**145**	**-**	**14,290**	**3,886**	**3,991**	**4,100**	**16,330**

Additional Cost Information:

The capital forecast is comprised of software licensing ($7.5 million), IT integration costs ($1 million), system hardware deployment costs ($1 million), and implementation costs ($1 million). The software licensing forecast is based on vendor quote and remaining forecast was derived from an internal preliminary high-level concept estimate.

The expense forecast is comprised of software license maintenance fees, cellular communication costs, and operational staff to maintain the system. The software licensing forecast is based on vendor quote, cellular communication forecast is based on cellular data rates, and remaining forecast was derived from an internal preliminary high-level concept estimate.

Benefits

- High resolution data will support multiple machine learning and AI programs to enable more comprehensive condition-based monitoring and management.
  - Transformer monitoring
  - System loading
  - Phase balancing and loading

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – SENSOR IQ

- Platform will provide custom instant alarms and notifications based on defined critical thresholds that are potential safety issues.
    - Sudden load or voltage changes on circuit
    - Sudden temperature changes at service locations

Alternatives Considered

1 – Use existing low-resolution interval data

- Many of the use cases have explored using the lower quality data but have run into issues with low fidelity and missing data fields (current, PF). In order to get higher resolution data PG&E considered increasing the read interval for the standard meter billing profile (which the currently collected data is included with) from 60 minutes to 5 minutes but that also required an increase in billing data. That increase in data requirements would have a significantly negative impact on the current meter to cash platform. The currently available data also does not allow for custom alarms.

2 – Install next generation of Smart Meters™ as bellwether or full deployment

- The next generation of Smart Meters™ has capabilities similar to SIQ but gaining that functionality would be significantly through the meter would be expensive and would require the deployment of new hardware. Since SIQ is software based, the cost is much less and can be implemented more quickly.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – CWSP - Rapid Earth Fault Current Limiter (REFCL) Distribution Pilot Project (EPIC 3.15)

Project Title: CWSP - Rapid Earth Fault Current Limiter (REFCL) Distribution Pilot Project (EPIC 3.15)
Major Work Categories: MWC 49, MAT 49R
Planning Order Numbers: 5541620, 5544490
Project Start Date: 8/1/2019
Project Completion Date: 9/30/21
Operative Date (only applies to Capital): Operative as installed

Project Description

REFCL technology mitigates ignitions from line-to-ground faults such as wire down or tree contacts. The technology uses a component called a Ground Fault Neutralizer (GFN) that detects these faults and limits the fault current below ignition thresholds. A high-impedance fault like a wire down or tree contact could remain undetected and become an ignition source. In addition, high-impedance, line-to-ground faults on distribution circuits are difficult to detect with traditional overcurrent protection. REFCLs are intended to address these risks. REFCL is installed on a substation transformer and provides line-to-ground protection for all circuits served from the substation transformer.

Using the REFCL technology for this purpose is relatively new. Although the core technology has been around for decades and used in Europe, the application for mitigating wildfire risk (which has much tighter performance standards than what is being implemented in Europe) has only been implemented in the past few years.

In 2018, PG&E initiated a pilot project under EPIC 3.15 for REFCL technology at PG&E's Calistoga Substation based on wildfire risk in that area and historical line-ground outage events. The Calistoga Substation and associated circuits (Calistoga electric distribution feeders 1101 and 1102) met the design criteria for the REFCL system that include 3-wire 12 kV with transformers connected line to line and charging current less than 100-amps. PG&E completed installing the Calistoga REFCL pilot project in 2020. The field installation involved replacing 15 line reclosers with advanced controllers, replacing 14 sets of line fuses with Fuse Saver devices that trip all three phases, updating all the distribution line voltage regulating devices, and installing 12 capacitive balancing units to balance the circuit capacitance necessary to tune the REFCL system and maintain sensitivity. The substation work included installing the GFN and Arc Suppression Coil with associated controls along with upgrading the feeder relays and voltage regulators.

PG&E is currently testing the REFCL technology for wildfire mitigation and expects to have results from this pilot project by September 2021. The system testing will involve stress testing the new and existing distribution equipment by energizing the GFN and adjusting the voltage to simulate a line-to-ground fault condition. The stress test will be followed by a series of fault tests where a specialized test trailer will connect to an energized conductor, creating an actual line-to-ground fault condition. During the live test, the actual line-to-ground current will be measured to ensure currents are below 0.5-amps (below ignition levels) and the GFN activates within the specified times for the conditions.

Since this technology has been successful in Australia and based on our initial testing, PG&E has developed a short-term strategy to install REFCLs in HFTD areas. PG&E forecasts deploying REFCLs at an additional 2 substations each year, but these plans could change pending pilot results and integration with other grid modernization and wildfire mitigation efforts described in this chapter. In coordination with

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – CWSP - Rapid Earth Fault Current Limiter (REFCL) Distribution Pilot Project (EPIC 3.15)

deployments of other technologies, future REFCL deployments will utilize PG&E's risk model tools in combination with feasibility screens to help prioritize highest-risk locations for installations.

The REFCL pilot project was sponsored under EPIC 3.15. Since the EPIC expense order does not work with the distribution work management system, capital orders were created under MAT 49R to install the equipment required for the REFCL pilot project. The capital distribution work was categorized as either EPIC – direct support or CAPEX – indirect support. The total planned EPIC work was $3.5 million and the CAPEX $2.2 million. The CAPEX work was comprised of equipment that needed to be replaced because of age and type (asset management) that not directly needed to demonstrate the REFCL technology; these costs will remain in MAT 49R.

The work described in this program is a Wildfire risk mitigation (WLDFR-M10C) referred to as Additional Automation and System Protection – REFCL.

Justification

The REFCL pilot project is part of PG&E's CWSP. This program is in response to a climate change driven 'new normal' which includes the October 2017 wildfires, multiple years of drought, more severe winter storms, and extended summer heat waves. The work forecast for this program is needed an as additional precautionary measure to further reduce the risk of, and impact from, future wildfire ignitions.

Risk – The REFCL pilot project is primarily a fire safety project. It is considered a mitigation for PG&E's Wildfire risk (WLDFR-M10C). This project has the potential of reducing the risk of electrical ignition events and could improve reliability over the operating practice of proactively de-energizing circuits during high fire risk events.

The REFCL system can protect hundreds of miles and be deployed at a faster rate than system hardening. It doesn't eliminate the need for system hardening but instead greatly reduces ignition risk for the most common risk of a line-to-ground contact.

This project is the first deployment of a resonant grounded system in the United States.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
PO #5541620	-	-	-	57	4,798	8,224	-	-	-	-	-	13,079
PO #5544490	-	-	-	-	-	-	16,876	17,331	17,800	18,280	18,774	89,061
Total	**-**	**-**	**-**	**57**	**4,798**	**8,224**	**16,876**	**17,331**	**17,800**	**18,280**	**18,774**	**102,140**

Benefits

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS

PROJECT SUMMARY – CWSP - Rapid Earth Fault Current Limiter (REFCL) Distribution Pilot Project (EPIC 3.15)

The primary purpose of this project is to improve safety and reliability, including:

- Pilot REFCL technology and determine its effectiveness in mitigating fire ignitions from wire down condition
- Prevent and/or mitigate wildfires
- Reduction in outage frequency to customers
- Reduction in outage duration
- Improved customer satisfaction

Other Alternatives Considered

1 – Do not perform REFCL Technology Projects
- Discontinuing REFCL Technology Projects will limit PG&E's progress on improving public safety, preventing, and mitigating wildfires, and addressing the system impacts brought on by the 'new normal'.
- Customers will not be able to take full advantage of the safety and reliability benefits associated with this work.

2 – Perform lower levels of REFCL Technology Projects
- Delaying additional REFCL Technology Projects will delay the programs' benefits in terms of improving public safety, preventing and mitigating wildfires, and addressing the system impacts brought on by the 'new normal'.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – EXPULSION FUSE REPLACEMENT

Project Title: Expulsion Fuse Replacement
Major Work Categories: MWC 2A, MAT 2AP
Planning Order Numbers: Various
Program Start Date: January 1, 2021
Program Completion Date: December 31, 2026
Operative Date (only applies to Capital): Operative as installed

Project Description

Non-exempt[1] equipment is equipment, such as expulsion fuses, that may generate electrical arcs, sparks, or hot material during its normal operation. If a non-exempt fuse experiences excessive fault current, it has the potential to spread hot molten metal material that could cause an ignition. By contrast exempt fuses are designed to internalize any molten material resulting from a fuse failure. By using exempt fuses, PG&E can reduce the potential for vegetation ignitions due to molten material spread.

High Fire Threat District (HFTD) Tier 2 and 3 areas are the focal point for the non-exempt fuse replacement program. The non-exempt fuse replacement program was initiated in 2019, and as the program has matured the prioritization of non-exempt fuses has evolved. In 2019, non-exempt fuse locations were spread across the territory. In 2020, PG&E targeted non-exempt fuse replacement exclusively in the Sierra Division, which had the highest count of non-exempt fuses and therefore the largest amount of risk reduction of any Division. PG&E is pivoting its Expulsion Fuse Replacement program in 2021 to use the 2021 Wildfire Distribution Risk Model, which became available for circuit prioritization in January 2021. Going forward, the Expulsion Fuse Replacement program will target the circuits the model ranks as having the highest risk. PG&E will attempt replacement of all non-exempt fuses on a circuit; previously, mostly end-of-line fuses were selected for replacement. PG&E's prioritization strategy will continue to evolve as refinements are made to the model and lessons continue to be learned from the execution program. This program is a complementary wildfire risk reduction program, which will be coordinated with other programs that include expulsion fuse replacement, such as system hardening, which is targeting the highest wildfire risk distribution miles, and pole replacement, to avoid duplicating work. In areas where this work will be conducted, projects with identified WIP (work in progress) polygons will be evaluated to avoid replacing fuses at these locations. Fuses at locations such as fire resiliency and pole replacement projects will be reconstructed per electric standard TD-9001 which specifies installation of non-exempt equipment at all rebuild sites.

13,305 non-exempt fuses have been identified at known operating number fuse locations in HFTD areas. System hardening and other programs are forecast to replace between 3,000 and 4,000 units as part of the scope of their rebuild efforts. The remaining approximately 10,000 fuses will be addressed as part of the MAT 2AP expulsion fuse replacement program. PG&E committed to replace 625 non-exempt fuses each year in this program. Approximately 700 and approximately 640 fuses were replaced in 2019 and 2020 respectively.

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1 "Exempt" and "Non-Exempt" refer the fact that California Public Resources Code Section 4292 requires utilities to maintain a 10-foot radial clearance around poles that have asset types that pose a fire risk [non-exempt equipment] but also provides that CAL FIRE can issue exemptions for particular models of those asset types that have been shown to have a low fire risk [exempt equipment].

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – EXPULSION FUSE REPLACEMENT

PG&E forecasts replacing 1,200 fuses per year at $15 million per year (with escalation) starting in 2021 until all the

non-exempt fuses in HFTD areas are replaced in 2027. As efficiency gains are realized or if more funds become available, the program is scalable to ramp to expedite the program.

In addition to non-exempt fuses identified with known operating numbers, PG&E also has population of 25,000-32,000 non-exempt fuses connected to transformers in HFTD area. Most of these are transformer bushing mounted cut-outs. Replacement of bushing mounted cut-outs may require the addition of a cross-arm or even replacement of the pole. PG&E initiated a pilot in 2021 to investigate the use of retrofit kits that could avoid the need for cross-arm installation at these locations. Based on the results of this pilot and finalization on the count of non-exempt transformer fuses, a formal program for replacement of non-exempt transformer fuses is planned for 2022.

Expulsion Fuse Replacement is a Wildfire mitigation (WLDFR-M004). This program also mitigates the Failure of Distribution Overhead Assets risks (DOVHD-M004).

Justification

To address increasing wildfire risks, PG&E created the Expulsion Fuse Replacement program to replace non-exempt fuses and cutouts. Non-exempt equipment is equipment that may generate electrical arcs, sparks, or hot material during its normal operation. The replacement of non-exempt equipment with exempt equipment will further reduce fire risk since the exempt equipment is considered “non-expulsion” and does not generate arcs/sparks during normal operation. By using exempt fuses, we can reduce the potential for vegetation ignitions due to molten material spread.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
Various POs	-	-	0.3	9,130	7,847	15,125	15,388	15,752	16,257	16,777	17,314	113,590
Total	**-**	**-**	**0.3**	**9,130**	**7,847**	**15,125**	**15,388**	**15,752**	**16,257**	**16,777**	**17,314**	**113,590**

Additional Cost Information:
Refer to Exhibit (PG&E-4), Ch. 4.3 Workpapers for additional cost details.

Benefits

On average, a single fuse installation costs approximately $12,500 per unit, which includes approximately $4,000 in equipment costs and $8,500 in all other costs, such as labor, permitting, and traffic control. Once installed, the fuse-holding device (i.e., cut-out) will not need to be replaced for up to 40 years. On the other hand, the annual base cost for vegetation replacement is approximately $900 per tag, but can range as high as

$5,000 per tag, depending on complications that arise from “refusals” from disputing property owners who aim to prevent VM work.

As a result, in the most conservative estimate for a low-cost VM scenario of $900 per tag, the fuse installation would break even in less than 14 years. However, the costs of a fuse replacement can break even as quickly as under three years should there be high-cost refusals, a reasonably likely scenario within PG&E territory. There are ancillary benefits in terms of customer satisfaction when vegetation is not removed and instead a fuse is replaced.

Fuse replacements occur periodically as those that are end-of-life need to be substituted for new ones, while VM is an annually recurring cost that includes high outliers in specific instances.

This cost/benefit analysis does not take include the benefits associated with wildfire ignition risk reduction associated with a wildfire that could potentially be ignited by a non-exempt fuse.

Alternatives Considered

Multiple alternatives were considered, but replacement of non-exempt fuses is the most feasible option at this time.

Ongoing vegetation removal at the base of non-exempt poles is an alternative to non-exempt fuse replacement, but it is not a permanent solution and requires ongoing annual clearing and expenses.

Alternate system hardening methods including undergrounding, remote grid, or asset elimination can eliminate the need for overhead equipment like fuses entirely. These have limited applications because they typically require significant additional infrastructure installations to make them possible.

A longer-term alternative is to replace non-exempt fuse with automatic vacuum fuse technology such as Fuses avers that can also provide remote operation and SCADA visibility. At a unit cost over 10 times that of a standard non-exempt replacement makes these currently only feasible at select strategic locations.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – GENERATION ENABLEMENT & DEPLOYMENT

Project Title: Generation Enablement & Deployment
Major Work Categories: MWC AB, IG
Planning Order Numbers: Various
Project Start Date: 2020
Project Completion Date: On-Going
Operative Date (only applies to Capital): N/A

Project Description

PG&E established a new Generation Enablement and Development organization, whose goal is to procure and deploy temporary generation (TG) system-wide across the four generation initiatives supporting PG&E's Public Safety Power Shutoff (PSPS) initiative. The organization will include an Operations team, the Temporary Generation Project Management Office (TG PMO), two Program Managers and an Analyst (further described in the Cost section below). The organization will utilize the latest meteorological data to identify and prioritize opportunities to pre-stage TG resources and seek to drive improvement and efficiencies by capturing, implementing, and documenting the actions taken to support reduction of customer impacts during PSPS events. The organization will also be better prepared to develop and execute longer duration new-technology pilot projects and implement successful pilots as warranted.

The Generation Enablement and Deployment PMO is a Wildfire mitigation (WLDFR-M006).

Justification

A cycle of drought, extreme heat, and widespread tree mortality has created a "new normal" in California that requires PG&E to change its approach to how it designs and operates the electric system. Extreme weather events driven by climate change are causing unprecedented wildfires. As a result, PG&E is launching the Generation Enablement and Development organization to further assist in mitigating customer impacts during PSPS events.

The TG PMO will reside within the Generation Enablement and Development organization with the purpose to coordinate, organize and establish a single source of reporting to senior leadership the operational readiness of procured TG in relation to the workstreams supported by the TG PMO: Substation; Microgrids; Temporary Distribution Microgrids; Back-up Power Support; and Community Resource Centers (CRC).

The new organization will be responsible to ensure staffing, coordination, and training of the TG Branch within the Operations section of the Emergency Operations Center (EOC). For 2021 the TG Branch consist of eight teams of five positions each. These five positions include: Director; Deputy; Primary Lead; Secondary Lead; and Documentation Lead.

The Generation Enablement and Deployment organization will also work closely with stakeholders, vendors, and regulators to ensure a transition to a cleaner TG fleet in 2021. The goal for this team is to establish at least one Clean Substation Project candidate site for testing and demonstration in 2021, and work to deploy the project if bids meet CPUC established cost-effectiveness criteria.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 4.3, SYSTEM HARDENING, ENHANCED AUTOMATION, AND PSPS IMPACT MITIGATIONS
PROJECT SUMMARY – GENERATION ENABLEMENT & DEPLOYMENT

Finally, a key function the TG PMO will be to better integrate planning for temporary generation with other system planning activities to provide suggestions to help improve electrical infrastructure that might reduce the need of TG for PSPS events.

Cost

The Generation Enablement and Development organization is comprised of 14 Full-Time Equivalents (FTE), 9 of which support PSPS readiness and scalability of processes for PSPS: one Senior Manager to oversee the organization; one manager and four supervisors to ensure the safety of internal and contractor crews during deployments, operational readiness and PSPS activations; one Operations Lead to coordinate with the Control Center processes and enhancements; one Substation Strategy manager to study effective and efficient utilization of TG at substations; one Process and Project Management to ensure that processes are developed, financial oversight and any operational readiness activities are appropriately project managed. Finally, a Testing, Standards and New Technology manager will primarily support the Clean Substation pilot projects contemplated by the Microgrid OIR and more generally the transition to a cleaner fleet of TG as contemplated in that Rulemaking.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast			
	2016	2017	2018	2019	2020	2021	2022	2023	Total
EXPENSE									
Various POs	-	-	-	22	3,494	3,031			6,547
SYSPLAN FRMMA TempGen PMO WLDFR-M006 (PO #5058335)	-	-	-	-	-	-	2,063	1,957	4,020
Total	-	-	-	22	3,494	3,031	2,063	1,957	10,567

Benefits

The benefits of the Generation Enablement and Development organization include:

- **Oversight**: Improved oversight via a centralized entity that oversees strategy and execution
- **Accountability**: Improved accountability through dedicated resources focused solely on program delivery
- **Change Management**: Improved change management and coordination due to cross-functional design of program, intended to intersect many Lines of Businesses across PG&E as well as groups within Electric Operations
- **External Engagement**: Partnership and collaboration with internal stakeholders to enable improved external outreach and coordination with a centralized TG PMO reporting on TG priority deployments across the four workstreams and operational readiness.

Alternatives Considered

Several approaches were considered for the program management and execution of the Generation Enablement and Development organization:

1. Part-Time, Interim Resourcing
    - Pros:
        - Reduced costs for execution
        - Flexibility to scale up or down

- Cons:
  - Loss of accountability
  - Competing priorities for resource time
  - Lack of support for new amount of workload being executed

2. Full-Time Resourcing
   - Pros:
     - Dedicated resources that are accountable and have no competing organization priorities
     - Ability to initiate controls, process and year-over-year planning to ensure stability
     - Opportunity to focus on future state of generation with Testing, Standards and New Technology position
     - Improved ability to partner with other EO line-of-businesses to utilize TG for other uses i.e. planned outages, capacity, emergency deployments and potential cost offsets to MWC AB.
     - Consistency within the TG Branch of the EOC development, training and staffing.
     - Improve consistency around Safety best practices for Contractors and internal employees.
   - Cons:
     - Increased costs for execution
     - Lack of flexibility to scale up or down

Of these alternative, PG&E selected option 2 (Full-Time Resourcing). The workload and cross-functional needs of the program merit dedicated resources to effectively develop and implement the organizations objectives, evolve new technologies, properly track, monitor, initiate and ensure safety of the organization and run the program day-to-day.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.4, COMMUNITY WILDFIRE SAFETY PROGRAM PMO
PROJECT SUMMARY – CWSP PROGRAM MANAGEMENT OFFICE (PMO)

Project Title: CWSP Program Management Office (PMO)
Major Work Categories: MWC AB
Planning Order (PO) Numbers: 5045652, 5057602, 5056974, 5053869 (MWC AB)
Project Start Date: 2018
Project Completion Date: On-Going
Operative Date (only applies to Capital): N/A

Project Description

In 2018, PG&E launched the Community Wildfire Safety Program (CWSP) to bolster wildfire prevention and emergency response efforts, put in place new and enhanced safety measures, and harden its electric system to further reduce wildfire risks and keep customers safe. The CWSP has been and will continue to be a significant effort as PG&E works in partnership with its customers, regulatory entities, communities and other partners to further reduce wildfire threats.

A dedicated Program Management Office (PMO) will continue to be needed to effectively manage the CWSP an it's multiple workstreams, with the common goal of mitigating, detecting, and responding to wildfires. The PMO is responsible for leading the overall CWSP, monitoring progress, handling resourcing needs including providing additional resources when needed, directing workstreams as issues arise, and facilitating the development of PG&E's annual WMP filings and associated regulatory reports.

Justification

A cycle of drought, extreme heat, and widespread tree mortality has created a "new normal" in California that requires PG&E to change its approach to how it designs and operates the electric system. Extreme weather events driven by climate change are causing unprecedented wildfires. As a result, in 2018, PG&E launched the CWSP to further reduce wildfire threats.

The PMO consists of a combination of internal and contract resources. PG&E employees oversee the overall PMO delivery. Contracted resources include engineering, risk analysis, management, and wildfire experts that may be needed throughout the different lifecycles of each workstream and/or initiative.

The PMO supports internal and external engagement, including public affairs and government relations, local customer outreach, and marketing and communications for the CWSP program overall. This PMO support is key to both employee engagement and effective customer, community and stakeholder outreach. Lastly, the PMO facilitates the development of PG&E's annual WMP filings, associated reports and other wildfire-related regulatory engagements.
The CWSP PMO is a risk mitigation (WLDFR-M009).

Cost
The costs for the CWSP PMO consists of the following:

1. Labor costs for third party consultants (PO 5045652)
    - **a.** Activities associated with PO 5045652: Third party consulting support for:

i. Internal and external engagement activities, including public affairs and government relations, local customer outreach, community education and partnership, and communications for the CWSP program overall
ii. Supplemental support for coordinating the development of the annual Wildfire Mitigation Plan filings and annual and quarterly WMP related compliance reporting requirements.

b. Estimating Methodology: Forecasted costs in 2021 through 2026 for third party consultants for the CWSP PMO are based on 2020 recorded costs for the three primary consultants that have supported the program in 2019 and 2020:: Keadjian Associates, PWC and KPMG.

2. Recorded labor costs for internal PG&E Management and Support (PO 5056974 and 5057602)
   a. Activities associated with PO 5056974: Costs related to the Electric Compliance and Quality Assurance department which supports compliance-related activities for various regulatory filings. An analysis was performed to allocate costs, in alignment with the work that was being supported, to the appropriate cost recovery mechanism (e.g., Base Expense, FRMMA WMPMA, CEMA, Distribution,Transmission). The appropriate Compliance and Quality Assurance costs for supporting incremental wildfire workstreams were allocated to this wildfire related PO in the FRMMA.
   b. Activities associated with PO 5057602: Costs related to Operational Management and Operational Support (MWC OM / OS) of wildfire risk activities as described in Chapter 4.4. An analysis was performed to determine what portion of those costs were related to wildfire support and transferred to wildfire related PO. (See Chapter 22 for estimating methodology details.)
   c. Estimating Methodology: In 2021, forecasted internal headcount costs associated incremental FRMMA work not forecasted in the 2020 GRC are forecasted in Chapter 4. In 2022 and beyond, these costs to support wildfire work are forecasted in the OM / OS MWCs in Exhibit (PG&E-4), Chapter 22.
3. Fees associated with industry consortiums for wildfire maturity benchmarking (PO 5053869)

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast			
	2016	2017	2018	2019	2020	2021	2022	2023	Total
MWC AB PO 5045652	N/A	N/A	4,530	30,635	17,724	15,438	14,994	13,460	96,781
MWC AB PO 5057602			-	-	14,896	8,715	-	-	23,611
MWC AB PO 5056974			-	-	1,388	3,648	-	-	5,036
MWC AB PO 5053869			-	-	135	-	-	-	135
MWC IG PO 5053390					119				119
Expense Total	**-**	**-**	**4,530**	**30,635**	**34,262**	**27,801**	**14,994**	**13,460**	**125,682**
CAPITAL									
MWC 21, PO 5530528			(1)	10					9
Capital Total			**(1)**	**10**	**-**	**-**	**-**	**-**	**9**
COST	**-**	**-**	**4,529**	**30,645**	**34,262**	**27,801**	**14,994**	**13,460**	**125,691**

Benefits

The benefits of the CWSP PMO include:

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 4.4, COMMUNITY WILDFIRE SAFETY PROGRAM PMO
PROJECT SUMMARY – CWSP PROGRAM MANAGEMENT OFFICE (PMO)

- **Oversight**: Improved oversight via a centralized entity that oversees strategy and execution
- **Accountability**: Improved accountability through dedicated resources focused solely on program delivery
- **Change Management**: Improved change management and coordination due to cross-functional design of program, intended to intersect many Lines of Businesses across PG&E as well as groups within Electric Operations
- **External Engagement**: Improved external outreach and coordination with a centralized PMO that will be tasked with engaging hundreds of stakeholders and hundreds of thousands customers

Alternatives Considered

Several approaches were considered for the program management and execution of the CWSP:

1. Part-Time Resourcing
    - Pros:
        - Reduced costs for execution
        - Flexibility to scale up or down
    - Cons:
        - Loss of accountability
        - Competing priorities for resource time
        - Limited ability to support increases inworkload
        - Risk of inability to maintain instituational history and knowledge of this work
2. Full-Time Resourcing
    - Pros:
        - Dedicated resources that are accountable and have no competing organizational priorities
    - Cons:
        - Increased costs for execution
        - Lack of flexibility to scale up or down
3. Hybrid of Full-time and Part-time Resourcing
    - Pros:
        - Balanced costs for execution
        - Flexibility to scale up or down
        - Assigned accountability to dedicated resources
        - Core of full-time resources can capture lessons learned and instituational history and knowledge
    - Cons:
        - Requires increased coordination across resources
4. No dedicated Program Management Office (PMO)
    - Pros:
        - No incremental cost
    - Cons:
        - No centralized management of the wildfire workstreams or related processes including regulatory filings, program governance, etc.
        - Limited coordination and cross-functional support across wildfire workstreams
        - No coordination of external engagement and education

Of these alternative, PG&E selected option 3 (Hybrid). The workload and cross-functional needs of the program merit dedicated resources to effectively implement the program's objectives and run the program day-to-day, while also using some part-time and rotational resources to scale up when needed and allow for flexibility to adapt to new information, requirements, or program objectives.

Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4.5, Information Technology for Wildfire Mitigations
Program Summary: Asset Management & Risk Analysis

Program Title: Asset Management & Risk Analysis
Major Work Categories: 2F, IG,
Planning Order Numbers: 5780791, 5780951, 5781843, 5784103, 5794706, 5261114, 5261239, 5262082, 5264594, 5272486
Program Start Date: Ongoing
Program Completion Date: Ongoing
Operative Date (only applies to Capital): Various

Program Description

The Asset Management and Risk Analysis value stream is a fundamental and key enabler of asset management and supports specific areas of PG&E's WMP. This value stream is focused on investments in cross-functional technology solutions that capture, manage, and provide access to Electric Operations asset-related data in support of understanding asset condition and related risks. It is important to note that these investments specifically address IT developed data-related capabilities that are geared to support business requirements identified in the WMP.

The overall vision and objective of this value stream is to optimize the use of all asset related data, including SAP, Geographic Information System (GIS), operational data, three-dimensional data and imagery, for integration into a comprehensive engineering infrastructure model ("digital twin"). The digital twin is a representation of asset structures, framing, attached conductors, and equipment. Three-dimensional data from light detection and ranging (LiDAR) and imagery will also provide information on proximity and risk of vegetation and non-PG&E structures. The estimating, design, and construction departments will use the infrastructure model—the evolving digital twin—as the initial basis for asset knowledge and grid design. This model will also be used to optimize asset maintenance and vegetation management using predictive models. Data from the digital twin will also be integrated for real-time operational use cases. This foundational data and the analytical tools will provide capabilities, with a primary focus on wildfire, to mitigate risk and manage safety factors. Building the digital twin requires ongoing technology and resource investments to develop and keep the models up to date for completeness, reliability, data accessibility and ease of use.

Justification

The Asset Management and Risk Analysis value stream provides the foundation for Electric Operations Asset Management and related RAMP risk mitigation, including Wildfire and Failure of Distribution Overhead Assets. Programs enabled are in direct support of the WMP and are at the core of supporting the transition to a data driven, risk informed model for asset management, including prioritization of inspections, vegetation management and predictive maintenance – identifying and correcting potential asset issues before they fail.

Risk Assessment and Mapping involves the use of tools and processes to develop and update risk maps and simulations and to estimate risk reduction potential of initiatives for a given portion of the grid (e.g., circuit, span, or asset). To support this initiative, PG&E intends to develop and use risk modeling and mapping to estimate the risk reduction potential of initiatives. This will focus on refining data inputs, creating more integrated models, and improving granularity in model outputs.

Situational Awareness and Forecasting involves the collection, recording and analysis of data from weather stations and other sources. To support this initiative, PG&E intends to continue investment in integrating

additional data sources, including data from Electric Operations assets, and developing and optimizing associated models in support of overall asset risk modeling.

Asset Management and Inspections consists of the inspections and asset management work and processes, including preventive and predictive maintenance. To support this initiative, PG&E intends to continue investment in asset management systems and model development and optimization that will prioritize inspections and maintenance work based on risk.

The development of an enterprise-wide remote sensing data platform will allow for the ingestion, storage, tracking, and access of all imagery (raster, LiDAR, infrared, multispectral, 360-degree spherical, and videos) currently being stored and utilized by various LOBs throughout the Company. By storing and making remote sensing data centrally available, the organization will utilize remote sensing images and derived data to achieve various improvements covered in PG&E's WMP, including:

- Utilizing data for improved data analytics, vegetation insights, and asset and vegetation inspection;
- Development of asset failure and wildfire ignition risk models, including fire spread models;
- Determining asset conditions through change detection and sharing data with other internal and external systems; and
- Providing search and visualization capabilities and ensure organizational alignment with regards to data acquisition, standards, quality assurance, and data access.

Cost

Major Program Spending Estimates
(Thousands of Nominal Dollars)

	Recorded			Forecast						
	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
EXPENSE										
MWC IG	172	349	14	6,300	5,500	4,000				16,335
Expense Total	172	349	14	6,300	5,500	4,000				16,335
CAPITAL										
MWC 2F	2,824	2,968	199	5,000	8,500	8,500	8,500	8,000	8,000	52,495
Capital Total	2,824	2,968	199	5,000	8,500	8,500	8,500	8,000	8,000	52,495
TOTAL PROGRAM COST	**2,996**	**3,317**	**213**	**11,300**	**14,000**	**12,500**	**8,500**	**8,000**	**8,000**	**68,830**

Additional Cost Information:

PG&E used the IT Project/Program Estimating Tool (PET) to document estimate assumptions and generate labor and non-labor cost forecasts for this program. To calculate labor costs, the PET captures labor hours by activity and resource type, multiplies that by standard labor rates, and adds in standard overhead factors. To calculate non-labor costs, the PET captures contract costs by type (such as software licenses or third-party services), material costs by unit quantity and unit price, and standard overheads such as materials burden and AFUDC. Other factors, such as escalation and capital/expense ratios, are calculated based on standard rates and accounting guidance. See Exhibit (PG&E-7), Chapter 8 for additional information regarding the PET. PG&E can provide the specific PET outputs produced for this program upon request.

Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4.5, Information Technology for Wildfire Mitigations
Program Summary: Asset Management & Risk Analysis

Benefits

Non-Financial Benefits:

- The various initiatives discussed in this program are intended to reduce risk of wildfire and improve safety, through advanced predictive modeling capabilities, by identifying conditions that warrant repair or replacement of assets prior to failing. This will support PG&E's objectives in eliminating asset related ignitions and reducing the customer impacts of both planned (e.g. PSPS) and unplanned outages, thereby improving System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) metrics.
- Fewer asset related ignition events will reduce incurred the potential cost of penalties and system repair.
- Fewer unplanned outages will reduce repair and replacement costs as assets will be maintained on a proactive basis, reducing the potential extra costs associated with emergency repairs.
- Reduce manual data entry and hand-offs between systems, providing data for analysis that is more complete, accurate and timely. This will reduce the manual efforts required for data entry and data corrections between systems.

Alternatives Considered

1. **Maintain status quo**
   This is not a viable option given the WMP and RAMP commitments.

2. **Defer implementation to future years**
   This is not a viable option, although this is a multi-year strategy that will build out capabilities over time.

For these reasons and benefits described in this project summary, PG&E did not choose either of these alternatives.

Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4.5, Information Technology for Wildfire Mitigations
Program Summary: Customer Service

Program Title: Customer Service
Major Work Categories: 2F, IG
Planning Order Numbers: 5781839, 5782139, 5538700, 5794700, 5262078, 5262335, 5262421, 5268212, 5272478
Program Start Date: Ongoing
Program Completion Date: Ongoing
Operative Date (only applies to Capital): Various

Program Description

The Customer Service value stream part of the Information Technology for Wildfire Mitigations focuses on investments that provide customer management and self-service tools in support of wildfire response and mitigation efforts. It is important that PG&E continue to enhance its website, self-service and notification functionality to meet customer needs to improve the customer experience as it relates to wildfire and PSPS.

Planned technology investments in this value stream will build and enhance technology capabilities used by PG&E to communicate with customers during wildfire and Public Safety Power Shut-off (PSPS) events. This value stream includes web, customer notifications and as well as other technology capabilities and enhancements.

The PG&E Safety and Alert Center website, also known as Emergency Web is a multi-year program that is used for PSPS events.

During the PSPS event of October 8, 2019, PGE.com experienced significant performance issues which caused some customers to experience longer wait times or see a “site not found” error message. Shortly thereafter, PG&E partnered with a third-party vendor to implement a stop-gap mitigation in the form of a content distribution network (CDN) to support PSPS events for the remainder of 2019. To prevent the capacity issue from reoccurring and to improve customer experience in preparation for the 2020 PSPS season, PG&E created a new cloud-based Emergency Website.

Emergency Web was created with multiple redundancies to support high availability. The website is hosted in a multi-region Amazon Web Services (AWS) environment. The Environmental Systems Research Institute (ESRI) map was also created with a high availability configuration. Emergency Web was successfully tested to support 240 million hits per hour. A backup application was also enhanced to support the same capacity in case the primary site failed. The following are some of the functionalities implemented in Emergency Web in 2020:

- Content publishing for the website
- Content pages for wildfire and PSPS emergencies, including a PSPS Event page, and various pages to support safety partners and provide additional PSPS detail on certain topics
- Customer Resource Center information with search by county
- Single address lookup
- Multiple address lookup
- Maps for current and planned outages with improved display using parcels vs. polygons
- Integration of the Customer Resource Centers (CRCs) in the maps
- Ability to click on shapes for outage details on Forecast Map
- Microgrid details on Forecast Map and in address search
- Priority and Partner Early Access Map & File Downloads
- Help text added throughout website and authorable on the fly by PG&E publishers without a developer
- Website available in 16 languages including languages that are displayed right to left

Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4.5, Information Technology for Wildfire Mitigations
Program Summary: Customer Service

- Website is compliant with American with Disabilities (ADA) regulations (Web Content Accessibility Guidelines - WCAG 2.0) as tested by Level Access

Emergency Web was first used during the PSPS event of September 7, 2020 and subsequently supported the other PSPS events in 2020. The website did not have any capacity or availability issues during these events. As part of its continuous improvement efforts, PG&E analyzed the website load during the 2020 PSPS events. Starting in 2021, PG&E intends to scale the system configuration and testing approach based on prior wildfire seasons. Additionally, PG&E will continue to address customer feedback to enhance functionality in 2021 and beyond.

Other technology capabilities and enhancements will focus on improving the speed of execution from an operations perspective and, supporting program requirements as they evolve.

Justification

This program is a continuation of work from 2020.

Emergency Web accomplishments include the enablement of several key business capabilities, including:

- The development of a new standalone site in the cloud that can scale to handle high traffic,
- Improved functionality such as rebuilt maps and address search tools
- The delivery of tools and information to customers speaking languages other than English
- Accessibility for those with vision impairments and other needs so that those customers could get essential safety information

Ongoing work in this program is imperative to provide continuous improvement based on changing program dynamics. For example, microgrids are unique in how they function. Some microgrid customers have one shutoff when the microgrid is being removed, while others have two shutoffs: one at when the microgrid is being installed and one when it is being removed. To most clearly communicate the outage experience given the variety of circumstances, unique page layouts should be created for each experience.

In addition, customer feedback is collected each year. For example, in 2020 PG&E received feedback that it was confusing to have PSPS maps by zone on the pge.com/weather map when the PSPS outage map showed information at the parcel level. In 2021, PG&E will be merging the two sites so there is one source of data. It's important that PG&E gather feedback on an ongoing basis so that it can continuously enhance or implement the key changes its customers expect.

Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4.5, Information Technology for Wildfire Mitigations
Program Summary: Customer Service

Cost

Major Program Spending Estimates
(Thousands of Nominal Dollars)

	Recorded			Forecast						
	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
EXPENSE										
MWC IG	680	690	7,136	400	200	200				9,306
Expense Total	680	690	7,136	400	200	200				9,306
CAPITAL										
MWC 2F	299	1,118	6,584	2,600	2,000	2,000	3,000	3,000	3,300	23,901
Capital Total	299	1,118	6,584	2,600	2,000	2,000	3,000	3,000	3,300	23,901
TOTAL PROGRAM COST	**979**	**1,808**	**13,720**	**3,000**	**2,200**	**2,200**	**3,000**	**3,000**	**3,300**	**33,207**

Additional Cost Information:

PG&E used the IT Project/Program Estimating Tool (PET) to document estimate assumptions and generate labor and non-labor cost forecasts for this program. To calculate labor costs, the PET captures labor hours by activity and resource type, multiplies that by standard labor rates, and adds in standard overhead factors. To calculate non-labor costs, the PET captures contract costs by type (such as software licenses or third-party services), material costs by unit quantity and unit price, and standard overheads such as materials burden and AFUDC. Other factors, such as escalation and capital/expense ratios, are calculated based on standard rates and accounting guidance. See Exhibit (PG&E-7), Chapter 8 for additional information regarding the PET. PG&E can provide the specific PET outputs produced for this program upon request.

Benefits

Non-Financial Benefits:

- By offering a site in 16 languages, information can more easily be communicated to the diverse customer base in PG&E's service territory.
- Customers with disabilities can get the information they need as well.
- The web is also an effective mass communication tool.
- More customers can self-serve at the same time than could be handled through in-person channels.
- The site also provides dynamic outage tools that are updated frequently, allowing customers to get information as they want it.
- Perhaps most importantly, continuous investment in the platform means the site can continue to evolve to meet changing customer and program needs.

Alternatives Considered

1. **Status Quo**
   Maintaining the status quo is not seen as a viable option. The web is a core customer communications channel that provides information at scale. Information must be presented in an easy to consume format to avoid customer confusion and ensure customers are aware of the support available to them.

In addition, this would not allow PG&E to meet compliance commitments created by the PSPS OIR or made in the WMP.

2. **Defer implementation to future years**
   It's important that PG&E continue to enhance or develop tools to provide customers with critical information, so deferring implementation of key programs or enhancements is not seen as a viable option. In addition, this would not allow PG&E to meet compliance commitments created by the PSPS OIR or made in the WMP.

For these reasons and benefits described in this project summary, PG&E did not choose either of these alternatives.

Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4.5, Information Technology for Wildfire Mitigations
Program Summary: Data Enablement

Program Title: Data Enablement
Major Work Categories: 2F, IG
Planning Order Numbers: 5783883, 5794708, 5264379, 5268895, 5272488
Program Start Date: Ongoing
Program Completion Date: Ongoing
Operative Date (only applies to Capital): Various

Program Description

The Data Enablement value stream focuses on investments in foundational technology solutions in support of Wildfire mitigation efforts by focusing on foundational data management activities that will help drive risk reduction and directly supports the 2021 WMP (Area 7.3.7 Data Governance and subsection 7.3.7.1 Centralized Repository for Data).

PG&E is in the process of implementing and operationalizing a data analytics platform that integrates asset-related information from disparate data sources, enabling data-driven approaches to wildfire risk mitigation. To enable and sustain value from this environment, PG&E is also implementing enterprise data management practices. To do this effectively, PG&E will adopt a practical data integration approach that utilizes data pipelines from source data systems into an integrated data platform. This approach, combined with an effective data management practice, enables access to timely, trusted, and consistent information that can be used for advanced data analytics, thus enabling the company to make more effective, data-driven decisions faster and with greater confidence.

Wildfire mitigation activities, such PSPS, have required the use of data in new ways beyond the original purpose and level of quality required, thus driving the need for trusted, high-quality data which will enable the company to make well-informed business decisions related to wildfire mitigation. To do this effectively, the Data Enablement value stream must include Data Quality as part of its strategy. PG&E's Data Quality strategy focuses on improving data quality at its core. PG&E intends to do this through various workstreams enabling Electric Operations to identify data elements critical to wildfire mitigation, assign data stewards accountable for these critical data elements, and measure data quality on these critical data elements. This work would take the form of source-system data cleansing activities to improve data quality across several dimensions, including accuracy, completeness, conformity, consistency, uniqueness, synchronization, and timeliness.

Additional data streams from new technologies, such as remote sensing and Light Detection and Ranging (LiDAR), introduce emerging data needs for high capacity storage and processing, while advanced analytics such as Artificial Intelligence and Machine Learning, offer the potential to leverage data to better manage risk and predict potential ignition events before they happen.

Justification

As part of the Data Enablement value stream, Electric Operations (EO) is working with Enterprise Data Management to develop a long-term plan that will guide PG&E's efforts to continue building its central data platform, data products and data management capabilities to improve asset and risk management capabilities through efficient and effective data-driven decision making. It's important to note that the Data Enablement value stream is tightly linked with the Asset Data Management and Risk Analysis value stream as it provides foundational technology and governance capabilities. This is in direct support of 2021 WMP section 7.3.7.1

Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4.5, Information Technology for Wildfire Mitigations
Program Summary: Data Enablement

Centralized Repository for Data. PG&E is developing and implementing strategies for more effective data management, integration, and access. Below are data enablement initiatives PG&E is evaluating for 2021 and beyond.

Data Schema: In 2021, PG&E will evaluate and decide whether to develop and implement a central data schema for Electric Operations to be built on the Common Information Model (developed by the International Electrotechnical Commission), in alignment with the Wildfire Safety Division (WSD) GIS data schema. Conceptually, this model would align asset, operational, maintenance and other data to PG&E's assets and operations, creating a "digital twin" of the utility. Upon completion of the evaluation, PG&E anticipates the implementation of this work would be a multi-year effort.

Data Management: PG&E has embarked on an initiative to mature its data management capabilities, which will ultimately enhance the Company's abilities to make effective data-driven decisions around wildfire mitigation and asset management. PG&E will continue to advance its data management maturity using a phased approach, with the focus for the next 2-3 years on the development and implementation of new standards, processes, and tools to support the maturation of data management practices.

Data Quality: PG&E expects to continue investing in improving the quality of its data, particularly in support of wildfire mitigation. This starts with identifying the data elements critical to wildfire mitigation and improving the quality of those data elements across several dimensions. Having high quality data from which to make informed decisions continues to take on greater significance, examples of which include the following:

- During PSPS, it's important that PG&E have a valid telephone number and/or email address on file so that the company can contact its customers. This is even more important for customers who rely on medical equipment and critical facilities or urgent care. The ability to correctly map customer address to county is important for sharing this information with public safety partners.
- In the area of asset inspection, there are instances when asset location is not precise, HFTD tier is blank or SAP Equipment ID is missing. The ability to proactively flag asset records missing these or other critical data elements is important in supporting the field inspection process to help ensure assets are inspected based on priority and in accordance with schedule.

Cost

Major Program Spending Estimates
(Thousands of Nominal Dollars)

	Recorded			Forecast						
	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
EXPENSE										
MWC IG	-	28	1,802	3,700	4,000	4,500				14,030
Expense Total	0	28	1,802	3,700	4,000	4,500				14,030
CAPITAL										
MWC 2F	-	(4)	12	2,500	3,300	3,800	5,300	6,300	6,500	27,708
Capital Total	0	(4)	12	2,500	3,300	3,800	5,300	6,300	6,500	27,708
TOTAL PROGRAM COST	**0**	**24**	**1,814**	**6,200**	**7,300**	**8,300**	**5,300**	**6,300**	**6,500**	**41,738**

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Exhibit (PG&E-4), Chapter 4.5, Information Technology for Wildfire Mitigations
Program Summary: Data Enablement

Additional Cost Information:

PG&E used the IT Project/Program Estimating Tool (PET) to document estimate assumptions and generate labor and non-labor cost forecasts for this program. To calculate labor costs, the PET captures labor hours by activity and resource type, multiplies that by standard labor rates, and adds in standard overhead factors. To calculate non-labor costs, the PET captures contract costs by type (such as software licenses or third-party services), material costs by unit quantity and unit price, and standard overheads such as materials burden and AFUDC. Other factors, such as escalation and capital/expense ratios, are calculated based on standard rates and accounting guidance. See Exhibit (PG&E-7), Chapter 8 for additional information regarding the PET. PG&E can provide the specific PET outputs produced for this program upon request.

Benefits

The primary goal of PG&E's Data Enablement value stream is to ensure the health and usefulness of PG&E's data assets, enabling data-driven decision making in support of PG&E's mission. The Data Enablement value stream will enable PG&E to accelerate its transformation to a data-driven company. The business benefits include:

Non-Financial Benefits:

- **Improved safety and minimized risk**
  - Deeper understanding of hazards by improving accuracy and completeness of data on assets and the environment
  - Minimizing customer risk by improving delivery of notifications through enhanced customer data
  - Preventing damages through more accurate data to support risk informed asset maintenance and grid operations
  - Improving prioritization of asset inspection/repair/replacement with increased analytic capabilities

- **Enhanced stakeholder engagement**
  - Meeting our commitments to improve (CPUC, ISOC, State of California, wildfire victims, probation court, investors, etc.)
  - Improving internal clients and external customer satisfaction with accurate and accessible data for historical and operational events
  - Improving the timeliness and accuracy of public reporting
  - Increased transparency through external data sharing portals
  - Respond to repeated employee requests to address the root cause of data quality issues, and shift
  - focus to work that adds true business value

- **Improved efficiency**
  - Reduce the manual effort required for data governance by providing tools and automation technology for data management

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Exhibit (PG&E-4), Chapter 4.5, Information Technology for Wildfire Mitigations
Program Summary: Data Enablement

- Establish a central EO ontology that catalogs all EO data sources and provides access through a single platform, ensuring that all users have access to consistent data, providing potential efficiency gains for both data users as well as for IT support of integration and analytics tools
- Support WSD GIS Data Reporting requirements with increased accuracy/completeness and less manual effort

Alternatives Considered

1. **Status Quo**
   This is not a viable option given the commitments made under WMP subsection 7.3.7.1 Centralized Repository for Data and the dependencies of the related Asset Data Management and Risk Analysis value stream.

2. **Defer implementation to future years**
   This is not a viable option given the commitments to the WSD to mature our capabilities in this category to a 2.5 level by 2023.

For these reasons and benefits described in this project summary, PG&E did not choose either of these alternatives.

Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4.5, Information Technology for Wildfire Mitigations
Program Summary: Event Management

Program Title: Event Management
Major Work Categories: 2F, IG
Planning Order Numbers: 5781883, 5781884, 5781885, 5782093, 5783221, 5784418, 5788192, 5788193, 5789658, 5790678, 5791030, 5794336, 5794698, 5262154, 5262155, 5262156, 5262419, 5262424, 5263484, 5264832, 5265992, 5267546, 5267547, 5268893, 5269235, 5269314, 5269774, 5271196, 5271973, 5272476
Program Start Date: Ongoing
Program Completion Date: Ongoing
Operative Date (only applies to Capital): Various

Program Description

The Event Management value stream part of Information Technology (IT) for Wildfire Mitigations focuses on investment in cross-functional technology solutions in support of wildfire response and mitigation efforts. This includes enabling PSPS business processes, and consists of risk identification, event scoping, data sharing with external agencies, field patrol and restoration, and real-time intelligence and reporting. It also covers areas of direct wildfire mitigation and response, including enablement of the Wildfire Safety Operations Center (WSOC) with solutions to monitor PG&E's service territory for wildfire risk and mobilize the organization appropriately in the event of a wildfire through the sharing of intelligence.

The forecast of work is driven by regulatory requirements and commitments defined in separate proceedings—such as the PSPS Order Instituting Rulemaking and WMP—identified post-event improvement opportunities, and feedback from Public Safety Partners. PSPS is evolving continuously through feedback from customers, its partners, regulators, and stakeholders within PG&E and these learnings result in new and emerging technology requirements for execution.

Planned investments in this value stream will build and enhance technology capabilities that encompass key initiatives. These include:

- PSPS Viewer
- PSPS External Portal
- PSPS Situational Intelligence Platform (PSIP)
- PSPS Field Patrol
- Wildfire Incident Viewer (WIV)
- Other Technology Capabilities and Enhancements

Justification

PSPS Viewer: PG&E began development on its PSPS Viewer product in 2018 as part of the Wildfire Situational Awareness initiative. Since then, the company has continued to enhance the product to assess the impact of PSPS event scope on Electric Distribution assets as well as the resulting customer impact. The output of this scoping is then used to notify customers, create maps to drive the Emergency Web, produce maps and customer lists to share with Public Safety Partners via the PSPS External Portal, and provide situational awareness intelligence via reports and the PSIP.

In 2020, the following major changes and capabilities were incorporated into the solution:

- Migrate the solution from on-premise infrastructure to public cloud infrastructure to improve the scalability and stability of the solution
- Enable the solution to ingest meteorologically defined risk areas to create initial PSPS scope, reducing process execution time by approximately 3 hours

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- Enable the ability to model temporary generation to allow for more granular targeting of customer messaging and maps and improve customer experience
- Create maps with parcel-based granularity, as opposed to circuit-based buffers, that allow for more accurate depiction of the area to be de-energized and improve customer experience

Ongoing work in this program is needed to continue to improve, including:

- Enabling PSPS event scoping to include unmitigated Priority 1 and/or Priority 2 trees and select distribution electric compliance tags and to provide intelligence to prioritize immediate mitigation to minimize scope
- Enabling PSPS event scoping to incorporate PSPS mitigations, such as system hardening, so that areas can be removed from scope if conditions determine it to be safe to do so
- Increase PSPS event scoping speed, through direct integration between systems, including PSIP, PSPS External Portal and meteorology systems

<u>The PSPS External Portal</u> effort was a new product built in 2020, with development continuing into 2021 and future years. The PSPS External Portal was the successor to the External Data Sharing on Enterprise Secure File Transfer (ESFT) product, which was part of the Wildfire Situational Awareness initiative and used during the 2019 PSPS season. The PSPS External Portal enabled PG&E to increase capabilities to its public safety partners, as required in Phase 2 of the PSPS OIR and committed to in PG&E's Wildfire Mitigation Plan. The platform provides public safety partners secure access to PSPS planning and event resources, including:

- PSPS Planning Resources
  - Maps of areas more likely to be affected by PSPS events
  - Summary lists of aggregate customer impacts in areas more likely to be affected by PSPS events
  - List of critical facilities within a particular jurisdiction
  - List of medical baseline customers more likely to be affected by PSPS events within a particular jurisdiction
  - List of critical infrastructure provider facilities in areas more likely to be affected by PSPS events
- PSPS Event Resources
  - Situation reports
  - Lists of customers projected to be impacted during the event including medical baseline customers, critical facilities, and all impacted customers
  - Lists of critical infrastructure provider facilities projected to be impacted during the event
  - Maps of planned and actual de-energization areas

Ongoing work in this program is needed to continue to improve, including:

- Expand the scope and improve usability of the PSPS Situation Report and the PSPS External Portal to support public safety partners
- Expand PSPS maps for Public Safety Partners with the addition of PDF maps for Tribal entities
- Increase PSPS event scoping speed, through direct integration between systems, including PSPS Viewer and PSPS Situational Intelligence Platform

<u>PSIP</u> was a new product built in 2020, with development expected to continue in 2021 and into future years. PSIP is built on PG&E's implementation of the Palantir Foundry system, which is currently to 50+ source systems that contain billions of records relevant to asset health analytics such as GIS and SAP. The number of connected systems, records, and enabled analytics models will continue to grow as additional data products are developed. The data platform does not replace the underlying source data systems of record, but rather provides a central platform to enable data integration/virtualization and access, support for data management and advanced analytics. PSIP is the central platform to inform PSPS decision-making, reporting, and communications. The

features include PG&E's Situational Intelligence Reporting, Customer Notification Management, Event Scoping, Re-Energization Management, Regulatory Reporting and more. The platform is also used to generate information shared with external parties such as CAL FIRE, CAL OES, and local emergency management agencies.

In 2020, PG&E used this platform to develop and manage situational intelligence for all its PSPS events, which provided timely information to internal and external stakeholders. This product resulted in significant operational efficiencies and improved accuracy of PSPS customer notification (accuracy of customer contacts for PSPS events was increased to over 99 percent, a significant improvement over 2019).

Ongoing work in this program is needed to continue to improve, including:

- Enabling PSPS event scoping to include unmitigated Priority 1 and/or Priority 2 trees and select distribution electric compliance tags and to provide intelligence to prioritize immediate mitigation to minimize scope
- Enable PSPS event scoping to incorporate PSPS mitigations—such as system hardening—so that areas can be removed from scope if conditions are safe to do so
- Continue automation and incorporation of additional data sources to improve post-PSPS event reporting required by the California Public Utilities Commission and which supports improvement actions
- Increase PSPS event scoping speed, through direct integration between systems, including PSPS Viewer, PSPS External Portal and meteorology systems

<u>PSPS Field Inspection (PSPS Inspect)</u>: PG&E started the PSPS Field Inspection Application initiative with the goal of providing an inspection and patrol tool for field operators to use during PSPS patrols. Once developed, PSPS Inspect will combine map/navigation features, PG&E asset information, field intelligence, workflow, and work forms to provide a digital tool field operations personnel can use to execute PSPS patrols, document damage or hazards associated with PG&E assets, and initiate work to restore power to customers. PSPS Inspect has two components: (1) the Inspect Application, which is a software application that runs on iOS mobile devices such as iPhones and iPads; and (2) the Engage Web Application, which is a work order assignment, management, and reporting tool used by Task Force or Segment Leads that runs on a web browser. In 2019, the PSPS Inspect product team focused on providing users the ability to document damage, hazard, and near-miss events identified during PSPS patrol and to submit a digital Electric Corrective (EC) notification form to start the restoration process.

In 2020, the PSPS Patrol solution, formerly known as PSPS Field Inspection application, continued development that started in 2019 and will continue into 2021 and future years. The focus of the PSPS Patrol solution is to enable the field patrol resources to capture damage, hazard and near-hit incidents during the patrol and re-energization phase of PSPS. To enable this capability, the team focused on enhancement of the PSPS Damage/Hazard Form to include additional fields required for reporting and to enable download and export capabilities of captured data to facilitate a more efficient validation and reporting process. In future years, the intention will be to further enhance the toolset to include the electronic assignment, completion and work closeout of PSPS patrol scope and implement identity management technology to allow for PSPS Patrol solution to be used by temporary emergency workers (e.g. mutual aid and contractors) that do not already have an identity within PG&E systems.

Ongoing work in this program is needed to continue to improve, including:

- Partnering with cybersecurity to enable mutual aid and contractors to utilize PSPS patrol technology solutions, currently limited to employees
- Enable the electronic assignment of PSPS patrol scope and capture of PSPS patrol results completion to improve execution efficiency and record accuracy

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The WIV/Safety and Infrastructure Protection Team (SIPT) Viewer, which was developed based on structural elements of the PSPS Viewer, integrates into the PSPS process. Following the initial development and deployment of both the PSPS and WIV/SIPT viewers, version 2.0 has been split into separate efforts for further development of the PSPS and WIV/SIPT Viewers that will run independently from the primary model, but are still a part of the complete toolset. The WIV enables tracking of active wildfire incidents and their impact on PG&E infrastructure and supports PSPS field observations. In tracking active wildfire events, the WSOC utilizes the WIV to log and track wildfires and perform spatial analysis to understand risk to assets and the workforce. This analysis is shared across PG&E to take appropriate action and mitigate risk. PSPS field observations inform decisions to both shut-off and restore service during a PSPS event. PG&E is working to complete version 2.0 in 2021 and is already planning for a version 3.0 that will further extend the functionality of the toolset.

Ongoing work in this program is needed to continue to improve, including:

- Improving the stability and scalability of the WIV to support an expanding user base and increasing data streams;
- Expand the Wildfire Active Incidents Dashboard to additional users to increase wildfire situational awareness across PG&E;
- Incorporate new data sources into the WIV, SIPT Viewer, and Active Incident Dashboard to improve situational awareness and response;
- Mature intelligence and situational awareness for large active wildfire response with real-time common operating picture and internal and external Situation Reports; and
- Enable integration of wildfire situational awareness data sources into other operations tools—such as the DMS and Maps+—to increase response capability.

Other technology capabilities and enhancements will focus on integration of capabilities with other operations/situational awareness and emergency response systems. Ongoing work in this program is needed to continue to improve, including:

- Integration of spatial situational awareness layers within the different business unit situational awareness viewers, for example the Distribution Management System, Maps+ or the Gas Control Tactical Analysis Mapping Integration (TAMI) solution; and
- Integration of the PSPS tools and processes with the new Advanced Distribution Management System platform, allowing for the utilization of capabilities such as automated switching plan generation that can save operator time in comparison to the manual switching log process in place today.

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Cost

Major Program Spending Estimates
(Thousands of Nominal Dollars)

	Recorded			Forecast						
	2018	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**Total**
EXPENSE										
MWC IG	245	1,231	6,097	4,500	3,400	3,000				18,473
Expense Forecast Total	245	1,231	6,097	4,500	3,400	3,000				18,473
CAPITAL										
MWC 2F	3,002	8,306	9,669	10,200	8,000	8,000	6,000	6,000	6,000	65,177
Capital Forecast Total	3,002	8,306	9,669	10,200	8,000	8,000	6,000	6,000	6,000	65,177
TOTAL PROGRAM COST	**3,247**	**9,537**	**15,766**	**14,700**	**11,400**	**11,000**	**6,000**	**6,000**	**6,000**	**83,650**

Additional Cost Information:

PG&E used the IT Project/Program Estimating Tool (PET) to document estimate assumptions and generate labor and non-labor cost forecasts for this program. To calculate labor costs, the PET captures labor hours by activity and resource type, multiplies that by standard labor rates, and adds in standard overhead factors. To calculate non-labor costs, the PET captures contract costs by type (such as software licenses or third-party services), material costs by unit quantity and unit price, and standard overheads such as materials burden and AFUDC. Other factors, such as escalation and capital/expense ratios, are calculated based on standard rates and accounting guidance. See Exhibit (PG&E-7), Chapter 8 for additional information regarding the PET. PG&E can provide the specific PET outputs produced for this program upon request.

Benefits

Non-Financial Benefits:

- **Safety**: The primary purpose of the PSPS and Wildfire Event Management is to increase safety during an actual event. The solutions will enable this by:
  - Reducing PSPS outage size
  - Reducing PSPS outage duration
  - Prevention and mitigation of wildfire
- **Customer Satisfaction**: Improve customer satisfaction with reduction in PSPS outage size and duration and improving public safety
- **External Communication & Partnership**: Increased customer and Public Safety Partner satisfaction with products that evolve based on user feedback
- **Change Management**: Reduced complexity in process through more integrated and intuitive toolsets for PSPS and Wildfire Event Management

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Alternatives Considered

1. **Status Quo**
   This does not address the needs to enable wildfire response and mitigation efforts to increase safety, improve customer satisfaction and stakeholder engagement, and deliver more effective change management. Instead, PG&E would continue to leverage what it has been doing with existing processes. In addition, this would not allow PG&E to meet compliance commitments created by the PSPS OIR or made in the WMP.

2. **Defer implementation to future years**
   This alternative would shift important work to later years. While this doesn't address all the needs, there is the possibility of parsing off specific functionality to reduce pain points. However, this approach could result in less than ideal business processes for too long. In addition, this would not allow PG&E to meet compliance commitments created by the PSPS OIR or made in the WMP.

For these reasons and benefits described in this project summary, PG&E did not choose either of these alternatives.

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Program Summary: Field Work Management

Program Title: Field Work Management
Major Work Categories: 2F, IG
Planning Order Numbers: 5534222, 5535422, 5535679, 5784150, 5784377, 5785099, 5785803, 5787973, 5789659, 5790274, 5794710, 5048169, 5049110, 5264624, 5265446, 5265447, 5265533, 5265876, 5265877, 5265878, 5268894, 5269437, 5272490
Program Start Date: Ongoing
Program Completion Date: Ongoing
Operative Date (only applies to Capital): Various

Program Description

The Field Work Management value stream part of Information Technology (IT) for Wildfire Mitigations focuses on investments in cross-functional software products that are necessary to increase the efficiency and quality of field activities (such as asset inspections) and enable alignment of work management processes and tools in support of wildfire response and mitigation efforts.

Planned technology investments in this value stream will build and enhance work management technology capabilities for field and back-office personnel to better perform wildfire operational activities. This value stream includes Sherlock, Inspect as well as other technology capabilities and enhancements.

Sherlock is a multi-year program that enables aerial remote inspections via a suite of integrated web applications, and additionally applies cutting-edge artificial intelligence (AI) techniques to millions of images of PG&E's field equipment in high fire-risk areas. The goal is to automate the steps in the asset inspection process and provide the company with in-depth knowledge of the state of its equipment. The Sherlock solution continues to:

- Enable and enhance the aerial inspection process (drone and helicopter) for greater visibility into asset health
- Use AI and machine learning to generate risk scores based on information gathered by preventative maintenance personnel, by running computer vision models at scale against imagery. These models will drive future maintenance plans/schedules
- Create computer vision models that will enable operations personnel to detect components, leading indicators for potential asset failure, and asset failures in images to may not easily been seen without aid

Electric Distribution Compliance is a multi-year program that is designed to do the following:

- Created single mobile application used by Electric Distribution and Transmission Inspectors to document detailed inspections and create corrective tags found during inspections
- Implemented a standard SAP Enterprise Asset Management (EAM) Checklist to provide a consistent method to capture inspection data
- Create a solution for the capture of electric substation infrared inspections to find unseen issues within electric substations
- Modernize the current technology platform to allow legacy systems to be replaced and/or enhanced to meet growing demands for technology that will improve efficiencies of field personnel and reduce risk of asset failure
- Migrate the current IT infrastructure to the Cloud to provide improved scaling to support additional business capabilities and data streams that are enabled
- Implement necessary security controls to ensure compliance with cybersecurity requirements
- Support regulatory reporting requirements, as well as those from external agencies

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Program Summary: Field Work Management

- Support in system logging and monitoring to ensure a secure, healthy, and efficient IT work process by providing automated and manual system checkpoints for service quality assurance
- Provide data clean-up and archival to allow for more data points to be analyzed consistently to form high-fidelity risk models with improved accuracy

Other technology capabilities and enhancements will focus on more effectively enabling field and back-office personal to support wildfire response and mitigation activities. These include:

- Improving technology for Safety and Infrastructure Protection Teams (SIPT) by enhancing work management systems to assign, execute, and approve work through technology
- Creating an electronic process to facilitate "door-knock" communication with customers during PSPS events to improve customer relations
- Providing features in which field crews can electronically report fire damage to assets to increase visibility and analysis of assets after fires

Justification

The Sherlock program is a continuation of work from 2019. Sherlock program accomplishments include the enablement of several key business capabilities, including:

- Enhanced, efficient asset inspections and related workflows with safety built-in
- Easy search and access of asset imagery and associated data
- End-to-end traceability (who inspected what, when, etc.), and near real-time reporting
- Enablement of A/B testing, which is a simple research methodology that compares two versions of a single variable to determine user preference, and additional metrics to measure the effect of each model on inspector behavior and performance
- Enablement of profiles for different roles across the aerial inspection team to support the aerial inspection review process
- Deployment of several computer vision models into the Inspector profile for different image classifications and object detection

Ongoing work in this program is imperative to ensure the increased performance, quality, and auditability of the aerial inspection program.

The Electric Distribution Compliance technology program accomplishments include the following:

- Enhanced the Inspect application to incorporate the revised Electric Overhead detailed inspection process used for the 2020 System Inspection workplan
- Eliminated the use of ProntoForms, third-party software that was not integrated to our SAP system of record
- Incorporated electric GIS mapping as part of the mobile workflow allowing inspectors to validate the asset prior to inspection documentation
- Integrate the mobile inspection documentation with SAP/BW reporting and attainment reports to validate completion of maintenance plans
- Provide inspection data and photos to core analytics platforms to allow for visibility of asset health

Ongoing work in this program will be imperative to continue to fully digitize the full end to end inspection workflows and provide the System Inspections program with a common set of integrated technology tools. This

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will improve the ability to improve asset data quality, drive field inspection efficiencies and increase visibility of inspection completion and associated corrective work identified during field inspections.

Cost

Major Program Spending Estimates
(Thousands of Nominal Dollars)

	Recorded			Forecast						
	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
EXPENSE										
MWC IG	6	3,658	464	2,000	1,500	1,000				8,628
Expense Total	6	3,658	464	2,000	1,500	1,000				8,628
CAPITAL										
MWC 2F	0	5,961	4,627	5,000	3,500	3,000	2,500	2,000	1,500	28,088
Capital Total	0	5,961	4,627	5,000	3,500	3,000	2,500	2,000	1,500	28,088
TOTAL PROGRAM COST	6	9,619	5,091	7,000	5,000	4,000	3,000	2,400	1,700	36,716

Additional Cost Information:

PG&E used the IT Project/Program Estimating Tool (PET) to document estimate assumptions and generate labor and non-labor cost forecasts for this program. To calculate labor costs, the PET captures labor hours by activity and resource type, multiplies that by standard labor rates, and adds in standard overhead factors. To calculate non-labor costs, the PET captures contract costs by type (such as software licenses or third-party services), material costs by unit quantity and unit price, and standard overheads such as materials burden and AFUDC. Other factors, such as escalation and capital/expense ratios, are calculated based on standard rates and accounting guidance. See Exhibit (PG&E-7), Chapter 8 for additional information regarding the PET. PG&E can provide the specific PET outputs produced for this program upon request.

Benefits

Non-Financial Benefits:

- Increased issue find rate.
- Improved inspection quality.
- Reduced time to inspection.
- Reduced time to finding.

- Improved auditability.
- Near real-time inspection information.
- Improved employee safety by enhancing asset validation and location awareness.
- Enhance safety and efficiency of system hardening efforts to protect assets against changing conditions.

Alternatives Considered

1. **Status Quo**
   Without the requested technology capabilities, aerial inspections would need to rely on a variety of separate tools (e.g., Excel, GIS, SAP) to complete remote inspections. This would lead to an increase in inspection times, an increase in the time from capture to finding, reduced traceability and auditability, and an increase in manual processes. Additionally, models being built and deployed today set up the groundwork to support future increases in scope, without compromising cost or quality. PG&E has also evaluated a number of vendor solutions, but none tie to source systems, have the necessary safeguards and processes in place, nor have the flexibility to meet the current need.

2. **Defer implementation to future years**
   Similar to the above, this would mean that the aerial inspections program would be able to complete less scope within a given year and would delay potential benefits such as cost efficiencies and increased quality. Additionally, models being built and deployed today ensure their increased performance with feedback from the inspection process. By deferring implementation to future years, the performance of these models would be lower, thus compromising quality and potential cost efficiencies as the scope for aerial inspections increases.

For these reasons and benefits described in this project summary, PG&E did not choose either of these alternatives.

Workpaper Table 4-32
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Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Chapter 4.6: Expenses by Major Work Category
(Thousands of Nominal Dollars)

Line No.	MWC	Description	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Recorded	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference
1	BA	E Dist Operate System	$ -	$ -	$ -	$ -	$ -	$ 2,998	$ 2,152	$ 2,219	$ 2,287	$ 2,356	$ 2,425	WP 4-153
2	FZ	E Dist Planning & Ops Engineer	-	-	-	-	-	2,046	7,169	2,063	2,126	2,189	2,254	WP 4-154
3	GC	E Dist Subst O&M	-	-	-	-	-	-	808	833	859	884	911	WP 4-155
4	BH	E Dist Routine Emergency	-	-	-	-	-	12,658	109,095	112,510	106,502	99,834	91,510	WP 4-156
5	IG	Manage Var Bal Acct Processes	-	-	-	-	-	502	29,697	33,504	34,529	35,561	36,611	WP 4-157
6		**Total Expenses**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 18,203**	**$ 148,921**	**$ 151,129**	**$ 146,302**	**$ 140,825**	**$ 133,710**	

Workpaper Table 4-33
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Chapter 4.6: MWC BA - Control Center Work
(Thousands of Nominal Dollars)

Line No.	Workstreams	Description of work	MWC	MAT	2021 Recorded	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions
2	Control Center Work	Provide device setting changes that increase sensitivity, enable EPSS mode, and monitor the distribution system for EPSS outages. Coordinate with field personnel on the safe patrol and restoration of circuits that experience EPSS outages.	BA	BAF	$ 2,998	$ 1,696	1,749	1,803	1,857	1,911	1, 2, 3
3			BA	BAH	-	456	470	485	499	514	1, 2
4				**Total**	**$ 2,998**	**$ 2,152**	**$ 2,219**	**$ 2,287**	**$ 2,356**	**$ 2,425**	

Forecast Assumptions and Details:

1) 2022 Forecast is based on 2021 recorded cost associated with control center operators and engineers, and the growth of the number of circuits planned for programming and potential enablement (currently estimated to increase from 170 circuits in 2021 to 988 circuits in 2022).

2) Forecast for 2023 to 2026 is based on 2022 forecast plus escalation.

3) PG&E is reviewing 2021 recorded costs in MAT BAF to determine if there are recorded costs not related to EPSS control center work and will provide corrected numbers as needed in the next errata or other opportunity.

Workpaper Table 4-34
Pacific Gas and Electric Company
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Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Chapter 4.6: MWC FZ - Reprogram Devices and Engineering
(Thousands of Nominal Dollars)

Line No.	Workstreams	Description of work	MWC	MAT	2021 Recorded	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions
1											
2	Reprogram Devices and Engineering	Ongoing support by Distribution Operations Engineers includes device programming and testing, and running fault location analysis when fault occurs on an EPSS enabled circuit to identify the likely fault location to facilitate restoration.	FZ	FZA	$ 1,396	$ 6,189	$ 2,063	$ 2,126	$ 2,189	$ 2,254	1, 2
3			FZ	FZE	651	980	-	-	-	-	1, 3
4				**Total**	**$ 2,046**	**$ 7,169**	**$ 2,063**	**$ 2,126**	**$ 2,189**	**$ 2,254**	

Forecast Assumptions and Details:

1) Incremental Reprogram Devices and Engineering costs for 2022 forecast is based on 2021 costs and an expected increase in work volume associated with the increase in devices that require support from approximately 1,000 in 2021 to more than 4,000 in 2022. The forecast also includes funding for testing, which was not performed in 2021, based on subject matter expert judgment.

2) PG&E anticipates the bulk of initial device programming and testing will be complete by 2022 and most of the remaining work will be running fault location analysis to facilitate restoration when fault occurs on an EPSS enabled circuit.

3) PG&E anticipates that the EPSS program will require some field circuit setting work (MAT FZE) for 2023 and beyond but has not yet determined to what extent this work will require. Therefore, PG&E is not including an expense forecast for MAT FZE for 2023 and beyond. To the extent PG&E's expense for EPSS related field circuit setting work exceed its forecast for those activities, PG&E proposes to seek recovery of incremental costs through the Wildfire Mitigation Balancing Account (WMBA).

Workpaper Table 4-35
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Chapter 4.6: MWC GC - Substation Support
(Thousands of Nominal Dollars)

Line No.	Workstreams	Description of work	MWC	MAT	2021 Recorded	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions
1											
2	Substation Support	Substation support includes programming and testing of the newly installed devices so they can be EPSS enabled.	GC	GC2	$ -	$ 808	$ 833	$ 859	$ 884	$ 911	1, 2. 3
3				**Total**	**$ -**	**$ 808**	**$ 833**	**$ 859**	**$ 884**	**$ 911**	

Forecast Assumptions and Details:

1) Incremental substation costs for 2022 forecast is based on 2021 preliminary recorded cost for programming and testing of newly installed devices so they can be EPSS enabled, and the increased amount of work associated with the growth of the number of circuits planned for programming and potential enablement (currently estimated to increase from 170 circuits in 2021 to 988 circuits in 2022).

2) Forecast for 2023 to 2026 is based on 2022 forecast plus escalation.

3) PG&E is reviewing 2021 recorded costs to determine if EPSS substation support work was recorded in a different MWC and will provide corrected numbers as needed in the next errata or other opportunity.

Workpaper Table 4-36
Pacific Gas and Electric Company
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Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Chapter 4.6: MWC BH - Additional Patrols
(Thousands of Nominal Dollars)

Line No.	Workstreams	Description of work	MWC	MAT	2021 Recorded	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions	Reference
1												
2	Additional Patrols	Incremental post-outage patrols on EPSS enabled circuits before power can be restored to customers.	BH	BHE	$ 12,658	$ 109,095	112,510	106,502	99,834	91,510	1, 2, 3	WP 4-158
3				**Total**	**$ 12,658**	**$ 109,095**	**$ 112,510**	**$ 106,502**	**$ 99,834**	**$ 91,510**		

Forecast Assumptions and Details:

1) 2022 forecast is based on 2021 preliminary recorded cost and the increased amount of work associated with the growth of the number of circuits planned for programming and potential enablement (currently estimated to increase from 170 circuits in 2021 to 988 circuits in 2022).

2) 2023 forecast is based on 2022 forecast plus escalation.

3) PG&E's forecast for 2024 to 2026 includes a progressive downward adjustment from its 2023 forecast, based on the assumption that further optimization of EPSS settings and learnings from patrols in 2022 and 2023, and undergrounding circuits will result in cost reductions as the program matures;

Workpaper Table 4-37
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Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Chapter 4.6: MWC IG - Customer Support Activities and Other Program Support
(Thousands of Nominal Dollars)

Line No.	Workstreams	Description of work	MWC	MAT	2021 Recorded	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions
1											
2	**Customer Outreach and Education**	Includes customer notifications, website updates, CBO partnerships, and resiliency and support programs outreach	IG	IG#	$ 492	$ 5,110	5,270	5,431	5,594	5,759	1
3	**Customer Communications and Marketing**	Includes mass marketing campaigns, social and other media outreach	IG	IG#	-	7,100	6,188	6,377	6,568	6,762	2
4	**Customer Resiliency and Support Programs**	Generator and Battery Rebate Program	IG	IG#	-	1,200	1,238	1,275	1,314	1,352	3
5		Temporary Generation	IG	IG#	7	6,009	6,197	6,387	6,578	6,772	4
6		Fixed Power Solutions Pilot Program	IG	IG#	-	7,778	12,033	12,401	12,772	13,149	5
7	**Other Program Support**	PMO and other program support	IG	IG#	3	2,500	2,578	2,657	2,737	2,817	6
8				**Total**	**$ 502**	**$ 29,697**	**$ 33,504**	**$ 34,529**	**$ 35,561**	**$ 36,611**	

Forecast Assumptions and Details:

1) 2022 forecast for Customer Outreach and Education includes the following:
- Partnering with our Community Based Organizations (CBOs) on customer outreach and education efforts focused on emergency preparedness
- Continuing our partnership with 211, a free, confidential calling and texting service available to support PG&E customers 24/7. 211 is available to connec individuals with local social services specific to their community.
- Additional inbound call volumes related to EPSS related outages to be handled by Call Center agents
- Improving the notifications that we provide to customers during outages, with more accurate information about when they can expect power to be restored.
- Refining our EPSS-dedicated web page with additional information and resources. (pge.com/epss)
- Encouraging high fire-risk area customers reliant on power for medical or independent living needs to contact their local Disaster Access and Resource Center or disabilitydisasteraccess.org for assistance with emergency planning and resources.

Customer Outreach and Education forecast for 2023 to 2026 is based on 2022 forecast plus escalation.

2) 2022 forecast for Customer Communications and Marketing includes the following:
- Education campaigns using paid advertising on local radio and social feeds.
- Alert ad campaign to improve PG&E's communications, both before and during outages to all potentially impacted customers
- Social media and local media outreach efforts to grow awareness, including posts on social media sites such as Nextdoor and Facebook.
- Creative asset production, including videos and other media content.

2023 forecast for Customer Communications and Marketing assumes approximately 15% decrease (before escalation) due to customer awareness. Forecast for 2024 to 2026 is based on 2023 forecast plus escalation.

3) 2020 Forecast for Generator Battery Rebate Program includes providing rebates to Medical Baseline (MBL), well pump, and essential small business customers located in Tiers 2 or 3 HFTD areas to purchase generators and/or battery storage for use in the event of an outage. Forecast for 2023 to 2026 is based on 2022 forecast plus escalation.

4) 2020 Forecast for Temporary Generation includes providing temporary generation solutions to help mitigate the impacts of outages on K-12 schools in areas impacted by EPSS outages outages. Costs include interconnection (Automatic Transfer Switches) and either Tier 4 Diesel Generation or Battery Energy Storage Systems and related operating costs for approximately 20 schools that are forecasted to be most heavily impacted by EPSS related outages. Forecast for 2023 to 2026 is based on 2022 forecast plus escalation.

5) 2020 Forecast for the Fixed Power Solutions (FPS) Pilot Program includes PG&E's plan to introduce a new permanent backup power offering for its most vulnerable customers, critical facilities, and schools. Forecast includes financial incentives to residential customers that help buy permanent solar and storage installations. PG&E plans to focus the residential FPS offering on MBL, low-income, rental, and other customers located in HFTD areas who face financial barriers to installing expensive permanent backup power solutions. Forecast also includes non-residential portion of the FPS pilot, which will offer technical assistance and financial incentives on the cost of equipment installations, which will help reduce the number of critical facilities and schools that are negatively impacted by EPSS. PG&E estimates approximately 1,000 customers to benefit from the FPS Pilot Program between 2022 and 2033, and expects customer adoption to the FPS Pilot Program to increase and stabilize by 2023. Forecast for 2024 to 2026 is based on 2023 forecast plus escalation.

6) 2020 Forecast for Other Program Support includes establishing a Project Management Office (PMO) to oversee all planning and operations associated with EPSS. Forecast is based on an estimate that 14 new, incremental full time employees will be needed to staff the PMO. Forecast for 2023 to 2026 is based on 2022 forecast plus escalation.

Workpaper Table 4-38
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Chapter 4.6: MWC BH Additional Patrols - 2022 Expense Forecast
(Thousands of Nominal Dollars)

Line No.	MWC BH - Additional Patrols - 2022 Expense Forecast:	May	June	July	August	September	October	November	December	Total 2022 MWC BH Forecast	Assumptions
1	Average 2021 Cost Per EPSS Enabled Circuits for Additional Patrols	$ 25.98	$ 25.98	$ 25.98	$ 25.98	$ 25.98	$ 25.98	$ 25.98	$ 25.98		1, 4
2	Number of EPSS Circuits for Post-Outage Patrols	800	800	800	800	800	550	400	300		2, 4
3	Efficiency Factor	80%	80%	80%	80%	80%	80%	80%	80%		3
4	MWC BH - Additional Patrols	$ 16,624	$ 16,624	$ 16,624	$ 16,624	$ 16,624	$ 11,429	$ 8,312	$ 6,234	$ 109,095	

Forecast Assumptions and Details:

1) Average 2021 Cost Per EPSS Enabled Circuits for Additional Patrols:

Month	2021 Recorded Cost	Number of EPSS Enabled Circuits	Cost Per EPSS Enabled Circuit
September	$ 4,640	160	$ 29.00
October	$ 3,672	160	$ 22.95
		Average:	$ 25.98

2) PG&E anticipates conducting additional post-outage patrols from May to September for approximately 800 EPSS enabled circuits, then ramping down to 550 in October, 400 in November, and 300 in December. PG&E also anticipates that there could be EPSS outages between Jan and April, but has not yet determined to what extent additional patrols will be needed during those months, so this forecast only reflects additional patrol activities for EPSS related outages between May and December.

3) PG&E applied an efficiency factor of 80%, based on 20-25% reduction in outage duration and sizes that were observed in the optimized circuits at the end of 2021.

4) At the time the forecast was developed for additional patrols associated with EPSS enabled circuits, approximately 160 circuits were enabled for EPSS and the plan was to enable approximately 800 circuits by 2022. By the end of 2021, approximately 170 circuits were enabled and the current plan is to grow number of circuits planned for programming and potential enablement for EPSS to 988 in 2022.

PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC DISTRIBUTION MAINTENANCE
Project Summary – Enhanced Powerline Safety Settings

Project Title: Enhanced Powerline Safety Settings (EPSS)
Major Work Categories: Expense MWC BA, FZ, GC, BH, IG
Planning Order Numbers: 5060717, 5062069, 5062070, 5062072, 5060569, 5062076, 5060568, 5061270, 5062073, 5062074, 5062075, 5060969, 5062077, 5275512, 5275772, 5277112, 5277113, 5277114, 5277115, 5277116, 5277117
Project Start Date: July 2021
Project Completion Date: On-going
Operative Date (only applies to Capital): N/A

Project Description

The purpose of PG&E's Enhanced Powerline Safety Settings (EPSS) program is to reduce wildfire risk by minimizing the probability of an ignition event when a fault occurs on an electric distribution line in high fire risk areas during periods of elevated fuels and weather related wildfire risk. The risk of an ignition event occurs every time there is a fault of any magnitude (fault current),[1] including failures that could emit sparks from overhead assets. Utilities have devices on their system to prevent prolonged fault current by de-energizing the relevant distribution line, much like a household fuse in an electric panel will de-energize for safety. The longer duration that a fault current event occurs, the more wildfire risk is present.

PG&E launched the EPSS program in July 2021. PG&E created this program in response to the historic drought and associated fuel conditions to mitigate the risk of an ignition event that could occur when there is a fault that throws off sparks from overhead electric lines. EPSS mitigates the risk of an ignition by increasing the sensitivity and speed of system protective devices on circuits in High Fire Threat District (HFTD) and High Fire Consequence Area (HFRA) areas (and select circuits adjacent to those areas) so that if an object contacts a distribution line power is automatically shut off within one tenth of a second, reducing the potential for an ignition.

EPSS-enabled settings provide a layer of protection on days when the wind speeds are low. EPSS is especially important during hot-dry summer days, when there are low winds but continued low relative humidity, low fuel moistures levels, and where the volume of dry vegetation, in close proximity to the distribution lines, increases the risk of an ignition becoming a large wildfire.

Figure PG&E-1 below demonstrates how EPSS works.

[1] Fault current is described as abnormal electric current, and usually occurs when electric lines contact external objects or other unintended electric equipment. For example, these incidents can occur when vegetation contacts distribution lines and/or structures; when animals and birds touch or traverse the lines and/or structures; or when, due to other reasons, a component or piece of equipment fails on the circuit.

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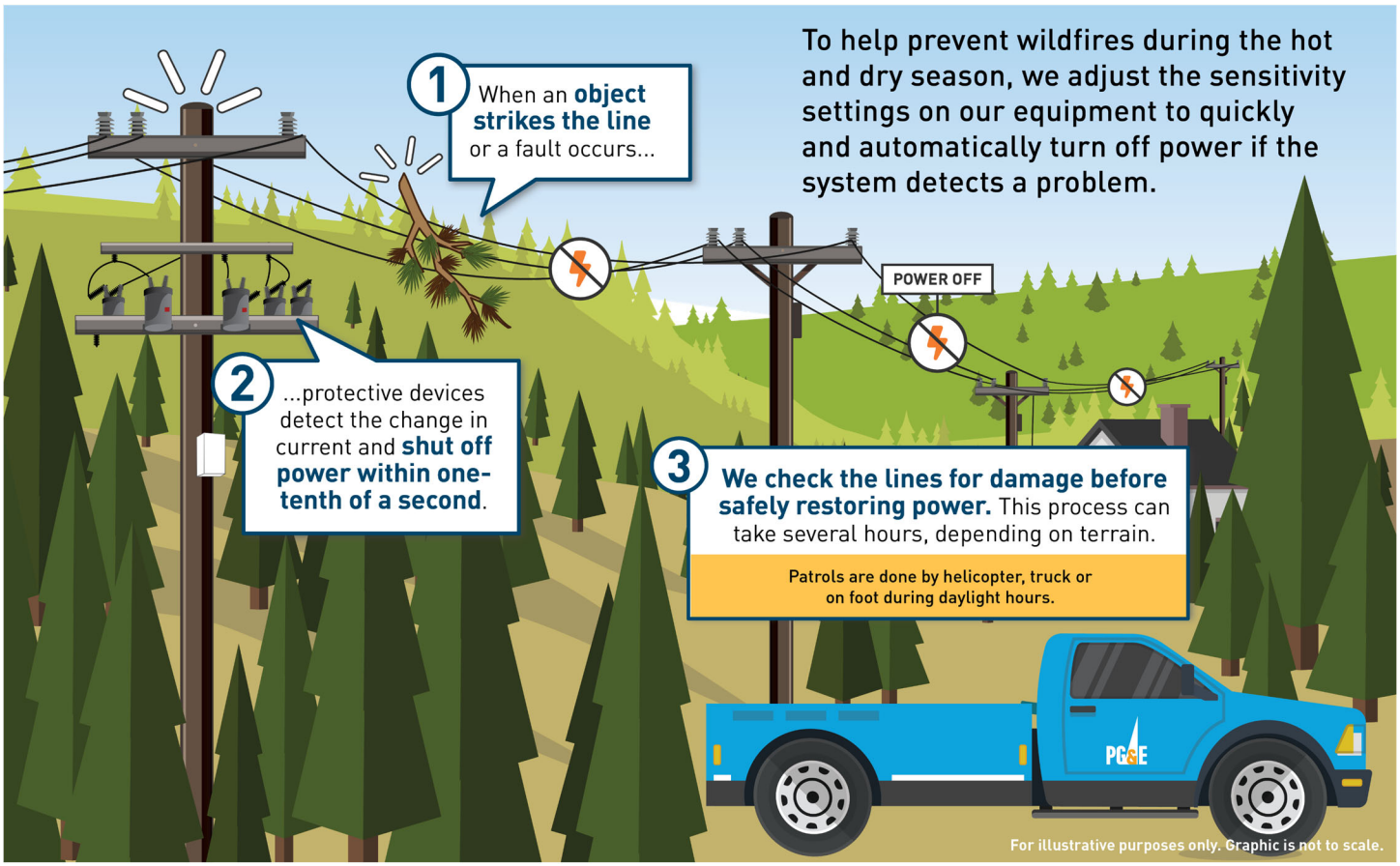
Project Summary – Enhanced Powerline Safety Settings

FIGURE PG&E-1:



In 2021, PG&E implemented the EPSS program on approximately 11,500 miles of distribution circuits, or 45% of the circuits in HFTD areas. These circuits were identified by PG&E's Public Safety Specialist team, who have extensive public safety and fire fighting experience, in collaboration with Division Superintendents, local District Storm room personnel, Electric Operations Maintenance & Construction, Restoration, Compliance, Meteorology staff and Vegetation Management personnel, with considerations of historical fire and weather data, terrain, potential ignition fuel, and ingress and egress factors.

Since its implementation, the EPSS program has had a dramatic impact on wildfire safety. ignitions from electrical equipment were 80 percent lower (compared to the past three-year average) on EPSS-enabled circuits and 40 percent lower in HFTD areas, as indicated in Figure PG&E-2 below [2]:

[2] 2022 WMP, Section 7.3.6.8.

PACIFIC GAS AND ELECTRIC COMPANY
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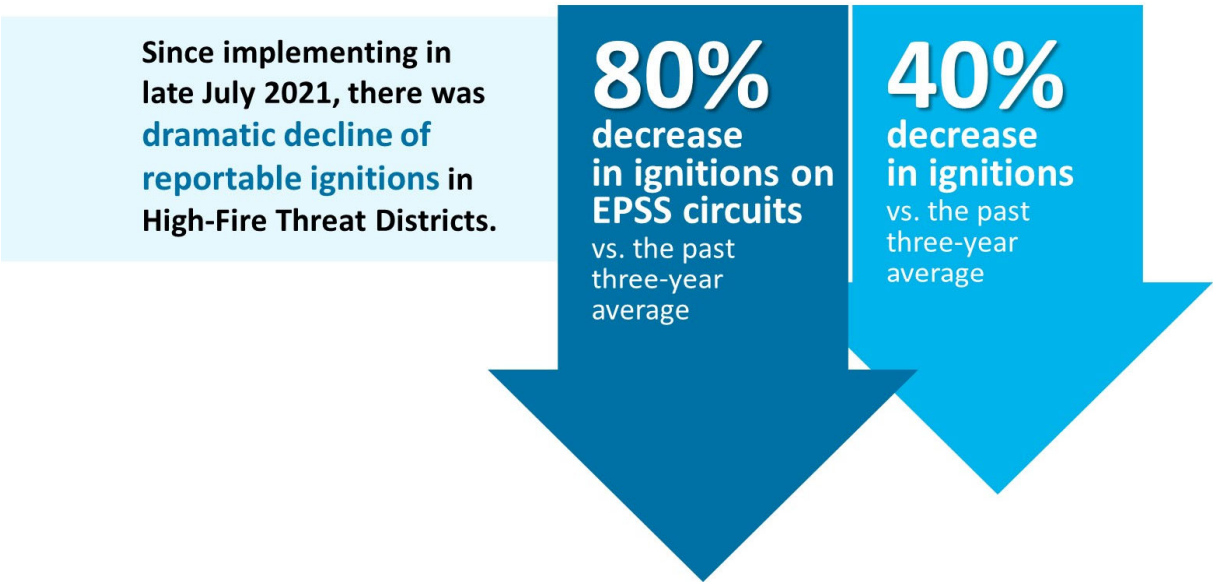
Project Summary – Enhanced Powerline Safety Settings

FIGURE PG&E-2:



During the 2023 GRC period, PG&E anticipates that EPSS will continue to evolve as we gain further experience with the program, including the opportunity to further optimize the device settings to improve customer reliability based on operating experience. PG&E also envisions EPSS as part of an integrated wildfire risk mitigation solution that will protect against vegetation caused and other ignitions while undergrounding work progresses and as the scope of Enhanced Vegetation Management is reduced.

Justification

The increased sensitivity to faults of EPSS enabled circuits reduces the likelihood of ignitions, but also can lead to power outages that impact more customers and are harder to restore than when EPSS protective devices are in normal settings. PG&E's EPSS forecast includes funding for activities that respond to and/or decrease the effect of outages on EPSS enabled circuits. For example, PG&E's forecast funds for post outage patrols on EPSS circuits to ensure that the system is safe and power is restored to customers as quickly as possible. The forecast also includes funding for various customer support activities including: outreach and education initiatives to help prepare customers for outages on EPSS enabled circuits outages; increased advertising and customer notifications to raise awareness of EPSS and alert customers to EPSS outages; and programs to provide and/or subsidize temporary or permanent back up power to vulnerable residential customers, including Medical Baseline (MBL) customers and critical facilities such as schools in areas experiencing a significant number of EPSS related outages.

Given the expansion of EPSS in 2022, PG&E is taking proactive action to reduce outage impacts, including additional patrol and restoration resources to shorten the duration of EPSS related outages, as well as providing community and customer support. PG&E will be refining our outreach programs to provide more tailored information to various customer groups. We are also taking action to provide better support to these

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Project Summary – Enhanced Powerline Safety Settings

key customers and stakeholders to provide timely and useful information and minimize the impact of these outages. Program support in 2022 to help prepare customers for EPSS outages will include:

- Partnering with our Community Based Organizations (CBO) on customer outreach and education efforts focused on emergency preparedness. Customers on PG&E's MBL Program and customers with access and functional needs are key audiences for this outreach. This will include training customers on making a plan in case of a prolonged power outage and educating them on the variety of resources and services available to support them.
- Continuing our partnership with 211, a free, confidential calling and texting service available to support PG&E customers 24/7. 211 is available to connect individuals with local social services specific to their community.
- Encouraging customers living in high fire risk area who are reliant on power for medical or independent living needs to contact their local California Disability Disaster Access & Resource Center (DDARC) or disabilitydisasteraccess.org for assistance with emergency planning and resources. Note that due to the shorter duration of EPSS outages, these program services are designed to prepare customers ahead of time for outages and will not be providing support during the outage.

To help improve our communications, both before and during outages to all potentially impacted customers, our efforts include:

- Improving the notifications that we provide to customers during outages, with more accurate information about when they can expect power to be restored.
- Increasing our outreach and communications to impacted customers, including via email and direct mail.
- Increasing our social media and local media outreach efforts to grow awareness, including posts on social media sites, such as Nextdoor and Facebook.
- Utilizing paid advertising on local radio and social feeds.
- Refining our EPSS dedicated web page with additional information and resources. (pge.com/epss)

Furthermore, PG&E plans to implement customer resiliency programs for customers impacted by EPSS. Some of these programs are expanded versions of programs that were originally designed for customers in areas impacted by PSPS events.

For example, PG&E offers a Generator and Battery Rebate program. This program provides rebates to MBL, well pump, and essential small business customers located in Tiers 2 or 3 HFTD areas to purchase generators and/or battery storage for use in the event of an outage. Eligible California Alternative Rates for Energy and/or Federal Electric Rates Assistance customers receive an additional $200 rebate. Rebates cannot exceed the price of the product.

Further, to help mitigate the impacts of outages on K 12 schools in areas impacted by EPSS outages PG&E will seek to establish temporary generation solutions that will include interconnection (Automatic Transfer Switches) and either Tier 4 Diesel Generation or Battery Energy Storage Systems for the schools that are forecasted to be most heavily impacted by EPSS related outages.

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Finally, PG&E plans to introduce a new permanent backup power offering, the Fixed Power Solutions (FPS) pilot program, for our most vulnerable customers, critical facilities, and schools. PG&E will provide financial incentives to residential customers that help buy down the cost of permanent solar and storage installations. PG&E plans to focus the residential FPS offering on MBL, low income, rental, and other customers located in HFTD areas who face financial barriers to installing expensive permanent backup power solutions. The non-residential portion of the FPS pilot will offer technical assistance and financial incentives to help buy down the cost of equipment installations, which will help reduce the number of critical facilities and schools that are negatively impacted by EPSS.

The FPS pilot helps customers plan and implement a resilience solution so that they can power important resources during long-duration outages due to EPSS or other extreme weather events. FPS is necessary to provide long term mitigation of EPSS at the lowest cost to customers in situations where a grid-based solution may be infeasible or cost prohibitive. In addition, PG&E's prioritization of MBL customers aligns with the Commission's directive in D.21-06-034 for the electric investor-owned utilities to administer programs that "support resiliency for customers that rely on electricity to maintain necessary life functions, including for durable medical equipment and assistive technology."[3]

Cost

EPSS program costs consist of the cost for activities directly associated with PG&E's powerline safety settings adjusted to be more sensitive in reducing the risk of an ignition from overhead powerline faults. This includes the Emergency Operations Center (EOC), additional patrols for fast trip settings, customer care support and mitigation in the event of an EPSS outage.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

		Recorded						Forecast					
MWC	**MAT**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**Total**
BA - Control Center Work	BAF	-	-	-	-	-	2,998	1,696	1,749	1,803	1,857	1,911	12,013
	BAH	-	-	-	-	-	-	456	470	485	499	514	2,424
FZ - Reprogram Devices and Engineering	FZA	-	-	-	-	-	1,396	6,189	2,063	2,126	2,189	2,254	16,216
	FZE	-	-	-	-	-	651	980	-	-	-	-	1,631
GC - Substation Support	GC2	-	-	-	-	-	-	808	833	859	884	911	4,295
BH - Additional Patrols	BHE	-	-	-	-	-	12,658	109,095	112,510	106,502	99,834	91,510	532,108
IG - Customer Support Activities and Other Program Support	IG#	-	-	-	-	-	502	29,697	33,504	34,529	35,561	36,611	170,404
		-	**-**	**-**	**-**	**-**	**18,203**	**148,921**	**151,129**	**146,302**	**140,825**	**133,710**	**739,090**

[3] D.21-06-034, Ordering Paragraph 3 and p. A10.

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ELECTRIC DISTRIBUTION MAINTENANCE
Project Summary – Enhanced Powerline Safety Settings

Benefits

The primary benefits of the EPSS program is to reduce frequency of ignition events on the primary distribution system during periods of elevated wildfire risk. Since July 2021, on EPSS-enabled lines, there was an 80 percent reduction in CPUC-Reportable Ignitions on EPSS enabled circuits in HFTD/HFRA areas as compared to the 3 year average.

In some PSPS events in 2021, circuits that did not meet PG&E's PSPS planned de-energization criteria thresholds but were located in areas under Red Flag Warning and elevated fire risk were temporarily EPSS enabled. These EPSS-enabled circuits provided an added layer of protection against wildfire risk under Red Flag Warning conditions. Although PSPS and EPSS are both effective wildfire mitigation tools, they are unrelated operationally in how they are executed. PSPS is a planned de-energization of circuits within a geographic area that is based on forecasted meteorological conditions and thresholds as set forth in our PSPS protocols. In contrast, outages that occur when EPSS setting are enabled on protection devices are unplanned and only occur when an external event occurs on the distribution line causing a fault on the circuit.

In 2022, PG&E will expand the program to enable EPSS mode on 25,500 circuit miles of the distribution system, including most HFTD and HFRA areas and select circuits in buffer zones adjacent to those areas. All circuits in HFTD and HFRA areas, as well as a limited number of circuits within non HFTD areas that are immediately adjacent to HFTD or HFRA areas have been risk ranked based on the overall wildfire consequence of an ignition occurring on that circuit. Programming of EPSS settings into the 4,276 protection devices along these circuits will be prioritized based on this risk ranking. Once the devices are programmed, they will be capable of being enabled into EPSS mode. The EPSS program is expected to continue through the 2023 GRC period due to the continuing presence of high fire risk conditions.

EPSS program is still in an evolving state. In 2022, we will look to further optimize the device settings to improve customer reliability. We will also apply the best practices for Customer, Agency, and External Communications and Engaging Vulnerable Communities learned through our implementation of PSPS events to our EPSS strategy. Data gathered during three months of operation in 2021 and enablement throughout a full wildfire season in 2022 will allow us to further mature the program for the development of future plans and new strategies. We will continue our benchmarking efforts with other utilities, particularly our CA peers, to inform how we operationalize the program in future years. Additionally, the need for and scope of EPSS in subsequent years will be interdependent with other wildfire mitigation initiatives and as EPSS matures in parallel with other initiatives, we will be able to better define future plans and new strategies in the next five years.

Alternatives Considered

1. **Status Quo –** Maintaining the status quo is not seen as a viable option. It will limit PG&E's ability to reduce wildfire risk by minimizing the probability of an ignition event when a fault occurs on an electric distribution line in high fire risk areas during periods of elevated fuels and weather related wildfire risk.

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2. **Defer implementation to future years –** It's important that PG&E continue to enhance or develop tools to reduce wildfire risk, so deferring implementation of key programs or enhancements is not seen as a viable option.

For these reasons and benefits described in this project summary, PG&E did not choose either of these alternatives.

Workpaper Table 04-39
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Estimated Costs from PG&E's 2022 WMP Report Compared to GRC Forecast Costs (2022-2023, Updated February 25, 2022) - Wildfire Mitigations
(Thousands of Nominal Dollars)

Line No.	MAT GRC	2023 GRC Mitigation Name	2023 GRC RISK ID	2023 GRC Exh. 4, Ch.	MAT WMP	2022 WMP Initiative Number	2022 WMP Initiative Description	2022 WMP Estimated Costs 2022	2023	Total (2022-2023)	2023 GRC Forecast (February 25, 2022) 2022	2023	Total (2022-2023)	Total WMP 2022-2023	Total GRC 2022-2023	Difference (WMP- GRC)
1						7.3.5.2	7.3.5.2 Detailed inspections and management practices for vegetation clearances around distribution electrical lines and	$ 690,054	$ 90,562	$ 780,616						
2						7.3.5.5	7.3.5.5 Fuel management (including all wood management) and reduction of "slash" from vegetation management	71750	$ 11,496	$ 83,246						
3						7.3.5.6	7.3.5.6 Improvement of inspections	$ 35,312	$ 8,623	$ 43,935						
4						7.3.5.7	7.3.5.7 Remote sensing inspections of vegetation around distribution electric lines and equipment	$ 11,000	$ 2,340	$ 13,340						
5						7.3.5.19	7.3.5.19 Vegetation management system	$ 79,000	$ -	$ 79,000						
6						7.3.5.20	7.3.5.20 Additional vegetation management practices beyond regulatory requirements and recommendations	$ 29,500	$ 5,000	$ 34,500						
7	IGJ	Enhanced Vegetation Management	WLDFR-M001	9	HN#, IG#	Various See above	Various See above	$ 916,616	$ 118,021	$ 1,034,637	$ 916,600	$ 118,022	$ 1,034,622	$ 1,034,637	$ 1,034,622	$ 15
8	08W	System Hardening	WLDFR-M002	4.3	08W	7.3.3.17.1	7.3.3.17.1 Updates to grid topology to minimize risk of ignition in HFTDs, System Hardening, Distribution	$ 977,250	$ 1,457,955	$ 2,435,205	$ 977,250	$ 1,457,955	$ 2,435,205	$ 2,435,205	$ 2,435,205	$ (0)
9	08W	System Hardening - Butte	WLDFR-M002	23	08W	7.3.3.17.6	7.3.3.17.6 Updates to grid topology to minimize risk of ignition in HFTDs, Butte County Rebuild	$ 138,750	$ 142,522	$ 281,272	$ 52,875	$ 54,072	$ 106,947	$ 281,272	$ 106,947	$ 174,325
10	95F	Butte County Rebuild (A)	WLDFR-M014	23	95F	7.3.3.17.6	7.3.3.17.6 Updates to grid topology to minimize risk of ignition in HFTDs, Butte County Rebuild	$ -	$ -	$ -	$ 85,875	$ 88,450	$ 174,325	$ -	$ 174,325	$ (174,325)
11	I System Hardening							$ 1,116,000	$ 1,600,477	$ 2,716,477	$ 1,116,000	$ 1,600,477	$ 2,716,477	$ 2,716,477	$ 2,716,477	$ (0)
12	2AR	Non-Exempt Surge Arrester Replacement	WLDFR-M003	11	2AR	7.3.3.17.3	7.3.3.17.3 Updates to grid topology to minimize risk of ignition in HFTDs, Surge Arrestor	$ 33,172	$ 17,706	$ 50,878	$ 16,804	$ -	$ 16,804	$ 50,878	$ 16,804	$ 34,074
13	2AP	Expulsion Fuse Replacement	WLDFR-M004	4.3	2AP	7.3.3.7	7.3.3.7 Expulsion fuse replacement	$ 35,000	$ 35,000	$ 70,000	$ 15,388	$ 15,752	$ 31,140	$ 70,000	$ 31,140	$ 38,860
14	AB6	PSPS Event (Distribution)	WLDFR-M005	4.2	AB6	7.3.6.5-D	7.3.6.5-D PSPS events and mitigation of PSPS impacts , Distribution	$ 68,814	$ 70,944	$ 139,758	$ 70,782	$ 72,998	$ 143,780	$ 139,758	$ 143,780	$ (4,022)
15	AB6	EP&R Field Operations	WLDFR-M006	4.2						$ -	$ -	$ -	$ -	$ -	$ -	$ -
16	AB6	EP&R Field Ops Tech	WLDFR-M006	4.2						$ -	$ 106	$ -	$ 106	$ -	$ 106	$ (106)
17	AB6	PSPS - EP&R Field Ops Tech Expense	WLDFR-M006	4.2						$ -	$ 212	$ -	$ 212	$ -	$ 212	$ (212)
18	AB6	PSPS Collateral/Segment Creations Exp	WLDFR-M006	4.2						$ -	$ 106	109	$ 215	$ -	$ 215	$ (215)
19	AB6	PSPS EP&R Field Ops Misc.	WLDFR-M006	4.2						$ -	$ 265	$ -	$ 265	$ -	$ 265	$ (265)
20	AB6	PSPS Field Exercise Dist. Exp	WLDFR-M006	4.2						$ -	$ 2,546	$ 2,625	$ 5,171	$ -	$ 5,171	$ (5,171)
21	AB6	PSPS Pre-flights Expense	WLDFR-M006	4.2						$ -	$ 1,114	$ 1,149	$ 2,262	$ -	$ 2,262	$ (2,262)
22	AB6	EP&R Field Operations (Includes Tech, Training and Other Misc.)	WLDFR-M006	4.2						$ -	$ 6,903	$ -	$ 6,903	$ -	$ 6,903	$ (6,903)
23	AB6	Field Ops Subtotal	WLDFR-M006	4.2	AB6	7.3.6.4-D 7.3.10.3 7.3.9.1 7.3.9.5	7.3.6.4-D Protocols for PSPS re-energization, Distribution 7.3.10.3 Cooperation with suppression agencies 7.3.9.1 Adequate and trained workforce for service restoration 7.3.9.5 Preparedness and planning for service restoration	$ 10,936	$ 9,304	$ 20,240	$ 11,252	$ 3,883	$ 15,135	$ 20,240	$ 15,135	$ 5,105
24																
25	AB#	Generation Enablement and Deployment PMO	WLDFR-M006	4.3	IG#	7.3.3.11.1	7.3.3.11.1 Mitigation of impact on customers and other residents affected during PSPS event, Generation for PSPS Mitigation	$ 2,000	$ 2,060	$ 4,060	$ 2,063	$ 1,957	$ 4,020	$ 4,060	$ 4,020	$ 40
26	AB6	PSPS Increased Helicopter EU (Dist)	WLDFR-M006	4.2	AB6	7.3.9.5	7.3.9.5 Preparedness and planning for service restoration	$ 14,527	$ 15,411	$ 29,938	$ 14,944	$ 15,411	$ 30,355	$ 29,938	$ 30,355	$ (417)
27	AB6	PSPS PMO & Projects	WLDFR-M006	4.2	AB6	7.3.6.4-D	7.3.6.4-D Protocols for PSPS re-energization, Distribution	$ 5,921	$ 6,284	$ 12,205	$ 6,093	$ 6,284	$ 12,377	$ 12,205	$ 12,377	$ (172)
28	AB6	Wildfire Public Engagement Team	WLDFR-M006	4.2	AB6	7.3.9.2 7.3.10.1	7.3.9.2 Community outreach, public awareness, and communications efforts 7.3.10.1 Community engagement	$ 930	$ 958	$ 1,888	$ 957	$ 987	$ 1,943	$ 1,888	$ 1,943	$ (55)
29	AB6	CRC Preparedness Program	WLDFR-M006	4.2	IG#	7.3.3.11.1	7.3.3.11.1 Mitigation of impact on customers and other residents affected during PSPS event, Generation for PSPS Mitigation	$ 14,700	$ 15,703	$ 30,403	$ 15,226	$ 15,703	$ 30,929	$ 30,403	$ 30,929	$ (526)
30	Subtotal PSPS Impact Initiatives (Expense)							$ 49,014	$ 49,720	$ 98,734	$ 50,534	$ 44,225	$ 94,760	$ 98,734	$ 94,760	$ 3,974
31	21A	PSPS Field Ops Tech. Capital	WLDFR-M006	4.2				$ -	$ -	$ -	$ 994	$ -	$ 994	$ -	$ 994	$ (994)
32	21A	PSPS Capital Equipment	WLDFR-M006	4.2						$ -	$ 1,987	$ -	$ 1,987	$ -	$ 1,987	$ (1,987)
33	21A	Field Ops Capital Subtotal	WLDFR-M006	4.2	21A	7.3.6.4-D	7.3.6.4-D Protocols for PSPS re-energization, Distribution	$ 4,940	$ 3,250	$ 8,190	$ 2,981	$ -	$ 2,981	$ -	$ 2,981	$ (2,981)
34																
35	21A	CRC Preparedness Program	WLDFR-M006	4.2	IG#	7.3.3.11.1	7.3.3.11.1 Mitigation of impact on customers and other residents affected during PSPS event, Generation for PSPS Mitigation	$ 241	$ 262	$ 503	$ 255	$ 262	$ 517	$ 503	$ 517	$ (14)
36	49H	PSPS Reduction Initiatives - Sectionalizer Device Install/Replace	WLDFR-M006	4.3	49H	7.3.3.8.1	7.3.3.8.1 Grid topology improvements to mitigate or reduce PSPS events, Distribution Line Sectionalizing	$ 10,452	$ 5,949	$ 16,401	$ 20,919	$ 11,933	$ 32,852	$ 16,401	$ 32,852	$ (16,451)
37	49M	PSPS Reduction Initiatives - Temporary Distribution Microgrids	WLDFR-M006	4.3	49M	7.3.3.11.1	7.3.3.11.1 Mitigation of impact on customers and other residents affected during PSPS event, Generation for PSPS Mitigation	$ 13,902	$ -	$ 13,902	$ 13,558	$ -	$ 13,558	$ 13,902	$ 13,558	$ 344
38	Impact Initiatives (Capital)							$ 29,535	$ 9,461	$ 38,996	$ 37,713	$ 12,195	$ 49,908	$ 30,806	$ 52,890	$ (22,084)
39	FZA	SA&FI - Line Sensors	WLDFR-M07A	4.3	FZA	7.3.2.2.5	7.3.2.2.5 Continuous monitoring sensors, Line Sensor Devices	$ -	$ -	$ -	$ 2,576	$ 3,437	$ 6,013	$ -	$ 6,013	$ (6,013)
40	AB6	SA&FI - Weather Stations	WLDFR-M07B	4.1	AB6	7.3.2.1.3	7.3.2.1.3 Advanced weather monitoring and weather stations, Weather Stations	$ 1,595	$ 1,715	$ 3,310	$ 1,641	$ 1,764	$ 3,405	$ 3,310	$ 3,405	$ (95)
41	AB6	SA&FI - Wildfire Command Center (WSOC)	WLDFR-M07C	4.1	AB6	7.3.2.7	7.3.2.7 Other, Wildfire Safety Operations Center (WSOC)	$ 6,981	$ 7,139	$ 14,120	$ 7,181	$ -	$ 7,181	$ 14,120	$ 7,181	$ 6,939
42	AB6	SA&FI - Cameras	WLDFR-M07D	4.1	AB6	7.3.2.1.4	7.3.2.1.4 Advanced weather monitoring and weather stations, Wildfire Cameras	$ 11,211	$ 8,002	$ 19,213	$ 11,532	$ 8,234	$ 19,766	$ 19,213	$ 19,766	$ (553)
43	AB6	SA&FI - Satellite Fire Detection	WLDFR-M07E	4.1	AB6	7.3.2.1.5	7.3.2.1.5 Advanced weather monitoring and weather stations, Fire Detection & Alerting	$ 341	$ 352	$ 693	$ 351	$ 362	$ 713	$ 693	$ 713	$ (19)
44	AB6	SA&FI - Sensor IQ	WLDFR-M07F	4.3	AB#	7.3.2.2.4	7.3.2.2.4 Continuous monitoring sensors, Sensor IQ	$ -	$ 3,676	$ 3,676	$ -	$ 3,783	$ 3,783	$ 3,676	$ 3,783	$ (106)
45	AB6	SA&FI - Partial Voltage Detection	WLDFR-M07G	4.1	AB6	7.3.2.2.2	7.3.2.2.2 Continuous monitoring sensors, SmartMeter™ Partial Voltage Detection (Formerly Known as Enhanced Wires Down Detection)	$ -	$ -	$ -	$ 85	$ 233	$ 318	$ -	$ 318	$ (318)
46	AB6	SA&FI - SOPP Improvements	WLDFR-M07H	4.1	AB6	7.3.2.6	7.3.2.6 Weather forecasting and estimating impacts on electric lines and equipment	$ 592	$ 605	$ 1,197	$ 2,029	$ -	$ 2,029	$ 1,197	$ 2,029	$ (832)

Workpaper Table 04-39
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 4, Wildfire Risk Mitigations
Estimated Costs from PG&E's 2022 WMP Report Compared to GRC Forecast Costs (2022-2023, Updated February 25, 2022) - Wildfire Mitigations
(Thousands of Nominal Dollars)

Line No.	MAT GRC	2023 GRC Mitigation Name	2023 GRC RISK ID	2023 GRC Exh. 4, Ch.	MAT WMP	2022 WMP Initiative Number	2022 WMP Initiative Description	2022 WMP Estimated Costs 2022	2023	Total (2022-2023)	2023 GRC Forecast (February 25, 2022) 2022	2023	Total (2022-2023)	Total WMP 2022-2023	Total GRC 2022-2023	Difference (WMP- GRC)
47	AB6	SA&FI - Advanced Fire Modeling	WLDFR-M07I	4.1	AB6	7.3.2.4 7.3.1.5 7.3.2.1.2	7.3.2.4 Continuous monitoring sensors, Sensor IQ 7.7.3.1.5 Advanced weather monitoring and weather stations, Fire Detection and Alerting 7.3.2.1.2 Advanced weather monitoring and weather stations, Fuel Moisture Sampling and Modeling (To be	$ 5,981	$ 6,166	$ 12,147	$ 6,152	$ 6,345	$ 12,497	$ 12,147	$ 12,497	$ (350)
48	AB6	SA&FI - Meteorology	WLDFR-M07J	4.1	AB6	7.3.2.6	7.3.2.6 Weather forecasting and estimating impacts on electric lines and equipment	$ 516	$ 425	$ 941	$ 531	$ 438	$ 969	$ 941	$ 969	$ (28)
49	AB6	SA&FI - Fire Potential Index	WLDFR-M07K	4.1	AB6	7.3.2.4	7.3.2.4 Continuous monitoring sensors, Sensor IQ	$ 150	$ 155	$ 305	$ 159	$ 174	$ 333	$ 305	$ 333	$ (29)
50	Subtotal Situational Awareness and Forecasting Initiatives (Expense)							$ 27,368	$ 28,234	$ 55,602	$ 32,236	$ 24,769	$ 57,005	$ 55,602	$ 57,005	$ (1,403)
51	49I	SA&FI - Line Sensors	WLDFR-M07A	4.3	49I	7.3.2.2.5	7.3.2.2.5 Continuous monitoring sensors, Line Sensor Devices	$ 7,813	$ 8,006	$ 15,819	$ 8,037	$ 8,254	$ 16,291	$ 15,819	$ 16,291	$ (472)
52	21A	SA&FI - Weather Stations	WLDFR-M07B	4.1	21A	7.3.2.1.2	7.3.2.1.2 Advanced weather monitoring and weather stations, Fuel Moisture Sampling and Modeling (To be removed)	$ 6,181	$ 3,156	$ 9,338	$ 6,377	$ 3,270	$ 9,647	$ 9,338	$ 9,647	$ (310)
53	21A	SA&FI - Wildfire Command Center (WSOC)	WLDFR-M07C	4.1	21A	7.3.2.7	7.3.2.2.7 Continuous monitoring sensors, DTS Fast	$ 125	$ -	$ 125	$ 129	$ -	$ 129	$ 125	$ 129	$ (4)
54	21A	SA&FI - Sensor IQ	WLDFR-M07F	4.3	N/A	7.3.2.2.4	7.3.2.2.4 Continuous monitoring sensors, Sensor IQ	$ -	$ 10,507	$ 10,507	$ -	$ 10,507	$ 10,507	$ 10,507	$ 10,507	$ 0
55	21A	SA&FI - Partial Voltage Detection	WLDFR-M07G	4.1	N/A	7.3.2.2.2	7.3.2.2.2 Continuous monitoring sensors, SmartMeter™ Partial Voltage Detection (Formerly Known as Enhanced Wires Down Detection)	$ -	$ -	$ -	$ 627		$ 627	$ -	$ 627	$ (627)
56	21A	SA&FI - Advance Fire Modeling	WLDFR-M07I	4.1	N/A	7.3.2.4 7.3.1.5 7.3.2.1.2	7.3.2.4 Forecast of a fire risk index, fire potential index, or similar 7.3.2.1.5 Advanced weather monitoring and weather stations, Fire Detection & Alerting 7.3.2.1.2 Advanced weather monitoring and weather stations, Fuel Moisture Sampling and Modeling	$ 5,981	$ 6,166	$ 12,147	$ 6,152	$ 6,345	$ 12,497	$ 12,147	$ 12,497	$ (350)
57	21A	SA&FI - Meteorology	WLDFR-M07J	4.1	21A	7.3.2.6	7.3.2.6 Weather forecasting and estimating impacts on electric lines and equipment	$ 1,023	$ 1,045	$ 2,068	$ 1,055	$ 1,083	$ 2,138	$ 2,068	$ 2,138	$ (70)
58	49I	SA&FI - EFD	WLDFR-M011	4.3	49I	7.3.2.2.3	7.3.2.2.3 Continuous monitoring sensors, Distribution Fault Anticipation Technology and Early Fault Detection	$ 4,517	$ 5,271	$ 9,788	$ 4,647	$ 5,434	$ 10,082	$ 9,788	$ 10,082	$ (294)
59	49I	SA&FI - DFA	WLDFR-M012	4.3	49I	7.3.2.2.3	7.3.2.2.3 Continuous monitoring sensors, Distribution Fault Anticipation Technology and Early Fault Detection	$ 10,062	$ 8,695	$ 18,757	$ 10,351	$ 8,965	$ 19,316	$ 18,757	$ 19,316	$ (559)
60	Subtotal Situational Awareness and Forecasting Initiatives (Capital)							$ 35,702	$ 42,846	$ 78,548	$ 37,375	$ 43,859	$ 81,234	$ 78,548	$ 81,234	$ (2,686)
61	AB6	Safety and Infrastructure Protection Teams (SIPT)	WLDFR-M008	4.1	AB6	7.3.2.5 7.3.6.2 7.3.6.6	7.3.2.5 Personnel monitoring areas of electric lines and equipment in elevated fire risk conditions 7.3.6.2 Crew-accompanying ignition prevention and suppression resources and services 7.3.6.6 Stationed and on-call ignition prevention and suppression resources and services	$ 24,207	$ 25,139	$ 49,345	$ 24,899	$ 25,867	$ 50,766	$ 49,345	$ 50,766	$ (1,421)
62	21A	SIPT - Capital Equipment	WLDFR-M008	4.1	21A	7.3.2.5 7.3.6.2 7.3.6.6	7.3.2.5 Personnel monitoring areas of electric lines and equipment in elevated fire risk conditions 7.3.6.2 Crew-accompanying ignition prevention and	$ 1,150	$ 239	$ 1,389	$ 1,187	$ 248	$ 1,435	$ 1,389	$ 1,435	$ (46)
63	AB6	Community Wildfire Safety Program Project Management Office	WLDFR-M009	4.4	AB6	7.3.10.5	7.3.10.5 Other, PMO and General Wildfire Support	$ 15,446	$ 15,891	$ 31,337	$ 14,994	$ 13,460	$ 28,454	$ 31,337	$ 28,454	$ 2,883
64	49A	Additional System Automation and Protection	WLDFR-M10A	4.3	49A	7.3.3.9.1	7.3.3.9.1 Installation of system automation equipment	$ 6,719	$ -	$ 6,719	$ -	$ -	$ -	$ 6,719	$ -	$ 6,719
65	49T	Additional System Automation and Protection - FuseSavers	WLDFR-M10B	4.3	49T	7.3.3.9.2	7.3.3.9.2 Installation of system automation equipment, Single phase reclosers	$ 4,400	$ 4,400	$ 8,800	$ 2,764	$ 2,940	$ 5,704	$ 8,800	$ 5,704	$ 3,096
66	49R	Additional System Automation and Protection - REFCL	WLDFR-M10C	4.3	49R	7.3.3.17.4	7.3.3.17.4 Updates to grid topology to minimize risk of ignition in HFTDs, Rapid Earth Current Fault Limiter	$ -	$ -	$ -	$ 16,876	$ 17,331	$ 34,207	$ -	$ 34,207	$ (34,207)
67	Subtotal Additional System Automation and Protection (Capital)							$ 11,119	$ 4,400	$ 15,519	$ 19,640	$ 20,271	$ 39,911	$ 15,519	$ 39,911	$ (24,392)
68	07C	Pole Programs – Replace Tree Attachments	WLDFR-M013	12	N/A	7.3.3.6	7.3.3.6 Distribution pole replacement and reinforcement, including with composite poles	$ -	$ -	$ -	$ 3,303	$ 3,296	$ 6,599	$ -	$ 6,599	$ (6,599)
69	AB#	System Hardening - Remote Grid (A)	WLDFR-M017	4.3	AB#	7.3.3.17.5	7.3.3.17.5 Updates to grid topology to minimize risk of ignition in HFTDs, Remote Grid	$ 2,200	$ 1,423	$ 3,623	$ 1,423	$ 1,464	$ 2,887	$ 3,623	$ 2,887	$ 737
70	KAT/KAP	System Hardening - Remote Grid (A)	WLDFR-M017	4.3	N/A	7.3.3.17.5	7.3.3.17.5 Updates to grid topology to minimize risk of ignition in HFTDs, Remote Grid	$ 624	$ 1,589	$ -	$ 617	$ 953	$ 1,571	$ -	$ 1,571	$ (1,571)
71	Subtotal System Hardening - Remote Grid (Expense)							$ 2,824	$ 3,012	$ 5,836	$ 2,040	$ 2,417	$ 4,457	$ 3,623	$ 4,457	$ (834)
72		Enhanced Powerline Safety Settings	WLDFR-M019	4.6	09B/48D	7.3.6.8	7.3.6.8 Protective equipment and device setting:	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
73		Enhanced Powerline Safety Settings	WLDFR-M019	4.6	Various	7.3.6.8 7.3.3.11.4	7.3.6.8 Protective equipment and device settings 7.3.3.11.4 Fixed Power Solutions	$ 148,992	$ 151,177	$ 300,169	$ 148,921	$ 151,129	$ 300,050	$ 300,169	$ 300,050	$ 119
74		**TOTAL MITIGATIONS - Expense**						**$ 1,258,462**	**$ 465,650**	**$ 1,724,112**	**$ 1,261,262**	**$ 453,150**	**$ 1,717,393**	**$ 1,724,112**	**$ 1,717,393**	**$ 6,719**
75		**TOTAL MITIGATIONS - Capital**						**$ 1,261,438**	**$ 1,709,867**	**$ 2,971,305**	**$ 1,247,156**	**$ 1,695,835**	**$ 2,942,992**	**$ 2,971,305**	**$ 2,942,992**	**$ 28,313**
76																
77	(A)	PG&E is forecasting expense amounts related to the Remote Grid pilot projects. The expense amounts cover costs for the Remote Grid team and operations and maintenance.														
78		To the extent a remote grid project is conducted, the capital funding will come from MAT 08W.														
79	(B)	2022 forecast costs for Butte County Rebuild will be recovered in the Catastrophic Emergency Memorandum Account (CEMA) proceeding.														

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE

Testimony: ☐ **Workpapers:** ☒ **SOQ:** ☐

Exhibit Number: 4 **Chapter Number:** 4

Chapter Title: Wildfire Mitigations

Witness Name: Matthew Pender

Page No.	Line No.	Item	As Filed	As Corrected
Errata as of November 5, 2021				
WP 4-11	All	Workpapers updated to reflect pre-fling errata	Adjustments to MWC 48 and 2F forecasts in lines 8, 9	All pre-filing errata adjustments incorporated into lines 1-6
WP 4-13 to WP 4-14	28-50	Workpapers updated to reflect pre-fling errata – line 28 removed, renumbered subsequent lines.	Line 28 MWC 2F forecast 35,980	Line removed and totals adjusted
WP 4-24	91	Covered OH Conductor - Tree Wire (Feet)	blank	9,525
WP 4-24	98	Covered OH Conductor - Tree Wire (Feet) Total	570,214	579,739
WP 4-25	6	Covered Conductor Feet	6,917	3,162
WP 4-25	20	Covered Conductor Feet	10,718	7,061
WP 4-26	74	Covered Conductor Feet	7,603	7,437

Page No.	Line No.	Item	As Filed	As Corrected
WP 4-26	78	Covered Conductor Feet	3,802	blank
WP 4-26	92	Covered Conductor Feet	2,957	2,446
WP 4-26	106	Covered Conductor Feet subtotal	745,906	734,015
WP 4-26	108	Covered Conductor Feet	28,492	53,011
WP 4-26	109	Covered Conductor Feet	24,480	35,165
WP 4-26	110	Covered Conductor Feet	91,133	Blank
WP 4-26	116	Covered Conductor Feet	60,839	141,268
WP 4-26	118	Covered Conductor Feet	91,133	90,974
WP 4-26	121	Covered Conductor Feet	29,849	106,920
WP 4-26	122	Covered Conductor Feet	3,762	176,563
WP 4-26	123	Covered Conductor Feet	649,907	1,012,638
WP 4-28	28	Footnote (B) Butte County rebuild miles	19.6 miles	16.38 miles
WP 4-67	Table 1	Table 1 Oct 21-23 and Oct 25-28 had “Cost per Event” cells merged	Oct 21-23: – Oct 25-28: $28,522 Total: $65,897	Oct 21-23: $10,184 Oct 25-28: $28,522 Total: $76,081
WP 4-126	2nd paragraph	Full-Time Equivalents (FTE)	The Generation Enablement and Development organization is comprised of 10 Full-Time Equivalents (FTE)	The Generation Enablement and Development organization is comprised of 14 Full-Time Equivalents (FTE)

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
EXHIBIT (PG&E-4) ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING
CHAPTER 5, EMERGENCY PREPARDNESS AND RESPONSE

TABLE OF CONTENTS

Workpaper Table 5-1
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 5
Emergency Preparedness & Response
Expenses by Major Work Category
(Thousands of Nominal Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	Reference
1	AB	Misc Expense	6,296	4,740	5,574	6,045	7,556	4,209	4,208	26,451	WP 5-3, WP 5-4
2	JV	Maintain IT Apps & Infra	(73)								WP 5-5
3	**Total**		**6,223**	**4,740**	**5,574**	**6,045**	**7,556**	**4,209**	**4,208**	**26,451**	

Workpaper Table 5-2
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 5
Emergency Preparedness & Response
Expenses by Major Work Category
(Thousands of Base Year Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast
1	AB	Misc Expense	6,860	5,083	5,825	6,147	7,556	4,127	4,031	24,821
2	JV	Maintain IT Apps & Infra	(76)							
3	**Total**		**6,784**	**5,083**	**5,825**	**6,147**	**7,556**	**4,127**	**4,031**	**24,821**

Workpaper Table 5-3
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 5, Emergency Preparedness & Response (EP&R)
Major Work Category AB - Recorded Walk
MWC AB, EP&R Expenses
(Thousands of Nominal Dollars)

Line No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$ 6,296**			
2		EP&R Strategy & Execution	**$ (1,556)**		As the EP&R organization matures, lower cost levels due to lower expenses for Planning; completion of some projects in 2016 resulted in lower IT expenditures; lower costs were also incurred for EOC modifications and Training; due to a large number of weather related events, EP&R was not able to complete the planned level of company-wide exercises, resulting in lower expense levels.	WP 5-5 Line 2
3		Net Change	$ (1,556)			
4	**2017**	**Recorded Adjusted**	**$ 4,740**			
5		EP&R Strategy & Execution	**$ 835**		Increase driven primarily by the exercise team with the design, planning, and delivery support for EP&R corporate exercises: Catastrophic Earthquake Functional Exercise and the GridEx IV / Cyber Exercise Series.	WP 5-5 Line 2
6		Net Change	$ 835			
7	**2018**	**Recorded Adjusted**	**$ 5,574**			
8		EP&R Strategy & Execution	**$ 471**		No significant change	WP 5-5 Line 2
9		Net Change	$ 471			
10	**2019**	**Recorded Adjusted**	**$ 6,045**			
11		EP&R Strategy & Execution	**$ 1,511**		Increase driven by Strategy & Execution training team with a significant increase to provide comprehensive ICS training to PG&E EOC employees, certified by California Office of Emergency Services (CalOES) California Specialized Training Institute (CSTI) to support stronger compliance and operational improvement in enterprise emergency response.	WP 5-5 Line 2
12		Net Change	$ 1,511			
13	**2020**	**Recorded Adjusted**	**$ 7,556**			

Workpaper Table 5-4
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 5, Emergency Preparedness & Response (EP&R)
Major Work Category AB - Forecast Walk
MWC AB, EP&R Expenses
(Thousands of Nominal Dollars)

Line No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$ 7,556**			
2		EP&R Strategy & Execution	$ (3,348)		Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast. Due to the constrain, Strategy and Execution's expense forecast in 2021 is lower than normal at $4.2 million per year.	WP 5-5 Line 2
3		**Net Change**	**$ (3,348)**			
4	**2021**	**Forecast**	**4,209**			
5		EP&R Strategy & Execution	(0)		Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast. Due to the constrain, Strategy and Execution's expense forecast in 2022 is lower than normal at $4.2 million per year.	WP 5-5 Line 2
6		**Net Change**	**(0)**			
7	**2022**	**Forecast**	**4,208**			
8		EP&R Strategy & Execution	5,073		Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast. Due to the constrain, Strategy and Execution's expense forecast in 2022 is lower than normal.	WP 5-5 Line 2
9		EP&R Field Operations - Core Work	7,099		EP&R moved this program from Ch. 4.2 to Ch. 5 beginning in 2023 due to the nature of the work categorized as non-wildfire.	WP 5-5 Line 5
10		EP&R Field Operations - Technology, Training, and Other	600		EP&R moved this program from Ch. 4.2 to Ch. 5 beginning in 2023 due to the nature of the work categorized as non-wildfire.	WP 5-5 Line 6
11		Wildfire Safety Operations Center/Hazard Awareness and Warning Center	7,385		EP&R moved this program from Ch. 4.1 to Ch. 5 beginning in 2023 due to the nature of the work categorized as non-wildfire.	WP 5-5 Line 7
12		Numeric Weather Prediction and SOPP Model Automation	2,087		EP&R moved this program from Ch. 4.1 to Ch. 5 beginning in 2023 due to the nature of the work categorized as non-wildfire.	WP 5-5 Line 8
13		**Net Change**	**22,243**			
14	**2023**	**Forecast**	**26,451**			

Workpaper Table 5-5
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 5, Emergency Preparedness & Response (EP&R)
Summary by Activity - Expense
(Thousands of Dollars)

Line No.	Expense	MWC	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	Notes	Reference
1												
2	**EP&R Strategy & Execution**	AB	$ 6,296	$ 4,740	$ 5,574	$ 6,045	$ 7,556	$ 4,209	$ 4,208	$ 9,281		WP 5-13
3	Technology - Response	JV	$ (73)	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
4	**All Hazards**											
5	EP&R Field Operations - Core Work	AB	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,099	(1)	WP 4-8 Line 12; WP 5-20
6	EP&R Field Operations - Technology, Training, and Other	AB	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 600	(1)	WP 4-8 Lines 13-14; WP 5-20
7	Wildfire Safety Operations Center/Hazard Awareness and Warning Center	AB	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,385	(1)	WP 4-6 Line 1; WP 4-61
8	Numeric Weather Prediction and SOPP Model Automation	AB	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,087	(1), (2)	WP 4-6 Line 7; WP 4-41
9	**Total**		**$ 6,223**	**$ 4,740**	**$ 5,574**	**$ 6,045**	**$ 7,556**	**$ 4,209**	**$ 4,208**	**$ 26,451**		

Notes:
(1) Costs for this activity were included in Chapter 4 and recovered in WMBA and are moving to EP&R starting in 2023.
(2) NWPU and SOPP are synonymous terms, as the project continues to evolve it is being referenced more as NWPU. NWPU/SOPP can be found in the Meteorology Project Summary.

Workpaper Table 5-6
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 5
Emergency Preparedness & Response
Capital Expenditures by Major Work Category
(Thousands of Nominal Dollars)

			Capital Expenditures											
No.	**MWC**	**MWC Description**	**2016 Recorded Adjusted**	**2017 Recorded Adjusted**	**2018 Recorded Adjusted**	**2019 Recorded Adjusted**	**2020 Recorded Adjusted**	**2021 Forecast**	**2022 Forecast**	**2023 Forecast**	**2024 Forecast**	**2025 Forecast**	**2026 Forecast**	**Reference**
1	21	Misc Capital	3,595	1,640	219	715	518	2,046	1,966	5,502	5,409	5,457	5,626	WP 5-10, WP 5-11
2		**Grand Total**	**3,595**	**1,640**	**219**	**715**	**518**	**2,046**	**1,966**	**5,502**	**5,409**	**5,457**	**5,626**	

Workpaper Table 5-7
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 5
Emergency Preparedness & Response
Forecast Capital Expenditures Summary
(Thousands of Nominal Dollars)

		Capital Expenditures							
Line No.	**Description**	**2020 CWIP**	**2021 Forecast**	**2022 Forecast**	**2023 Forecast**	**2024 Forecast**	**2025 Forecast**	**2026 Forecast**	**Reference**
1	Projects > $3 Million*	1,689	2,046	1,966	5,393	5,221	5,266	5,429	WP 5-8
2	Other Work	-	-	-	108	188	191	196	WP 5-9
3	**Total**	**1,689**	**2,046**	**1,966**	**5,502**	**5,409**	**5,457**	**5,626**	

4 * Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.

Workpaper Table 5-8
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 5
Emergency Preparedness & Response
Recorded CWIP and Forecast Capital Expenditures Details - Projects Over $3 Million*
(Thousands of Nominal Dollars)

					CWIP	Capital Expenditures							
Line No.	Planning Order	Description	MWC	Operative Date	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Subtotal	Reference
	MWC - 21	**Misc Capital**											
1	5515859	EP&R S&E Core Capital	21		1,689	2,046	-	-	-	-	-	3,735	
2	5544468	S&E Capital Projects	21		-	-	1,966	2,143	2,075	2,093	2,160	10,438	
3	5544479	SYSPLAN ED 21A EPNDR-C004	21		-	-	-	3,250	3,146	3,173	3,269	12,838	
4	**Total**				**1,689**	**2,046**	**1,966**	**5,393**	**5,221**	**5,266**	**5,429**	**27,011**	WP 5-12
5		**Grand Total**			**1,689**	**2,046**	**1,966**	**5,393**	**5,221**	**5,266**	**5,429**	**27,011**	

6 * Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.

Workpaper Table 5-9
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 5
Emergency Preparedness & Response
Recorded and Forecast Capital Expenditures Details - Other Work*
(Thousands of Nominal Dollars)

			Capital Expenditures											
Line No.	MWC	MWC Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference
1	21	Misc Capital	-	-	-	-	-	-	-	108	188	191	196	WP 5-12
2	**Grand Total**		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**108**	**188**	**191**	**196**	

3 * Excludes projects greater than $3M

Workpaper Table 5-10
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #5, Emergency Preparedness & Response (EP&R)
Major Work Category 21 - Recorded Walk
MWC 21 - EP&R Capital
(Thousands of Nominal Dollars)

Line No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$ 3,595**			
2		EP&R Strategy and Execution Capital Projects	**$ (1,956)**		Decrease mainly driven by completion of Phase 2 of the PGE.com upgrade project in 2016. This was partially offset by higher IT for Basecamp Improvement costs for: for the additional scope of achieving ten simultaneous base camp deployments by the end of 2017; purchase of cargo and microwave tower trailers; purchase and configuration of multiple communication carts; field line of sight tests for multiple locations; network reservations and deployment guidelines, and procuring enough satellite, MTT, and Cradlepoint to support 5 additional sites.	WP 5-12 Line 2
3		Net Change	$ (1,956)			
4	**2017**	**Recorded Adjusted**	**$ 1,640**			
5		EP&R Strategy and Execution Capital Projects	**$ (1,421)**		Decrease driven by delays in projects related to Basecamp Improvements due to a shift in focus to prioritize and stand up the Wildfire Safety Operations Center.	WP 5-12 Line 2
6		Net Change	$ (1,421)			
7	**2018**	**Recorded Adjusted**	**$ 219**			
8		EP&R Strategy and Execution Capital Projects	**$ 496**		Increase due to the Basecamp Improvement projects that were delayed from the previous year were able to ramp up.	WP 5-12 Line 2
9		Net Change	$ 496			
10	**2019**	**Recorded Adjusted**	**$ 715**			
11		EP&R Strategy and Execution Capital Projects	**$ (197)**		Recorded amounts reduced driven by delays in Emergency Center Upgrades and the alternate EOC Vacaville due to extensive Wildfire events and PSPS EOC Activations.	WP 5-12 Line 2
12		Net Change	$ (197)			
13	**2020**	**Recorded Adjusted**	**$ 518**			

Workpaper Table 5-11
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #5, Emergency Preparedness & Response (EP&R)
Major Work Category 21 - Forecast Walk
MWC 21 - EP&R Capital
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$ 518**			
2		EP&R Strategy and Execution Capital Projects	$ 1,528		Capital projects such as Earthquake Early Warning and IT Basecamp were delayed to 2021 due to labor challenges as a result of COVID-19.	WP 5-12 Line 2
3		**Net Change**				
4	**2021**	**Forecast**	**$ 2,046**			
5		EP&R Strategy and Execution Capital Projects	$ (80)		No significant change	WP 5-12 Line 2
6		**Net Change**				
7	**2022**	**Forecast**	**$ 1,966**			
8		EP&R Strategy and Execution Capital Projects	$ 177		No significant change	WP 5-12 Line 2
9		EP&R Field Operations	$ 3,250		EP&R moved this program from Ch. 4.2 to Ch. 5 beginning in 2023 due to the nature of the work categorized as non-wildfire.	WP 5-12 Line 4
10		Wildfire Safety Operations Center/Hazard Awareness and Warning Center	$ 108		EP&R moved this program from Ch. 4.1 to Ch. 5 beginning in 2023 due to the nature of the work categorized as non-wildfire.	WP 5-12 Line 5
11		**Net Change**	**$ 3,536**			
12	**2023**	**Forecast**	**$ 5,502**			
13		EP&R Strategy and Execution Capital Projects	$ (68)		No significant change	WP 5-12 Line 2
14		EP&R Field Operations	$ (104)		No significant change	WP 5-12 Line 4
15		Wildfire Safety Operations Center/Hazard Awareness and Warning Center	$ 80		No significant change	WP 5-12 Line 5
16		**Net Change**	**$ (92)**			
17	**2024**	**Forecast**	**$ 5,409**			
18		EP&R Strategy and Execution Capital Projects	$ 18		No significant change	WP 5-12 Line 2
19		EP&R Field Operations	$ 27		No significant change	WP 5-12 Line 4
20		Wildfire Safety Operations Center/Hazard Awareness and Warning Center	$ 2		No significant change	WP 5-12 Line 5
21		**Net Change**	**$ 47**			
22	**2025**	**Forecast**	**$ 5,457**			
23		EP&R Strategy and Execution Capital Projects	$ 67		No significant change	WP 5-12 Line 2
24		EP&R Field Operations	$ 96		No significant change	WP 5-12 Line 4
25		Wildfire Safety Operations Center/Hazard Awareness and Warning Center	$ 5		No significant change	WP 5-12 Line 5
26		**Net Change**	**$ 169**			
27	**2026**	**Forecast**	**$ 5,626**			

Workpaper Table 5-12
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 5, Emergency Preparedness & Response (EP&R)
Summary by Activity - Capital
(Thousands of Dollars)

Line No.		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026		
1	**MWC 21 - EP&R Capital**	**Recorded**	**Recorded**	**Recorded**	**Recorded**	**Recorded**	**Forecast**	**Forecast**	**Forecast**	**Forecast**	**Forecast**	**Forecast**	**Notes**	**Reference**
2	**EP&R Strategy and Execution Capital Projects**	$ 3,595	$ 1,640	$ 219	$ 715	$ 518	$ 2,046	$ 1,966	$ 2,143	$ 2,075	$ 2,093	$ 2,160		WP 5-13
3	**All Hazards**													
4	EP&R Field Operations	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,250	$ 3,146	$ 3,173	$ 3,269	(1)	WP 4-19 Line 6; WP 5-26
5	Wildfire Safety Operations Center/Hazard Awareness and Warning Center	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 108	$ 188	$ 191	$ 196	(1)	WP 4-20 Line 2; WP 4-61
6	**Total**	**$ 3,595**	**$ 1,640**	**$ 219**	**$ 715**	**$ 518**	**$ 2,046**	**$ 1,966**	**$ 5,502**	**$ 5,409**	**$ 5,457**	**$ 5,626**		

Notes:
(1) Costs for this activity were included in Chapter 4 and recovered in WMBA and are moving to EP&R starting in 2023.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 5, EP&R
Project Summary – EP&R Strategy and Execution

Project Title: EP&R Strategy and Execution
Major Work Categories: AB, 21
Planning Order Numbers: 5058276, 5058277, 5058278, 5058279, 5058280, 5058281, 5058282, 5515859, 5544468
Project Start Date: Ongoing
Project Completion Date: Ongoing
Operative Date (only applies to Capital): N/A

Project Description

The EP&R Strategy and Execution (S&E) organization is responsible for a wide range of activities including: developing scalable plans and systems for responding to hazards; developing roles and responsibilities for emergency response efforts; working with internal and external stakeholders; leading business continuity efforts and external emergency preparedness events; maintaining the Emergency Operations Center (EOC) and alternate emergency centers; and measuring and evaluating PG&E emergency response efforts. This team publishes the annual Company Emergency Response Plan, (CERP) that provides guidance on managing emergencies of all kinds and works with the LOBs to develop CERP annexes; leads continuous improvement projects that improve emergency response functions; and tracks metrics on emergency readiness.

In 2020, the organization was re-organized to cover the five principles of Emergency Management to drive greater focus on the core EM areas, de-centralize command increasing leader effectiveness and support stronger compliance and operational improvement in enterprise emergency response.

The S&E programs have been identified in the 2020 RAMP filing as cross-cutting factors to reduce the impact of a catastrophic or severe risk event as a control or a mitigation. If a catastrophic or severe risk event occurs, S&E activates PG&E's EOC and would then initiate the S&E controls to help mitigate the impact of these events such as: coordinated responses between the lines of business to re-energize electric lines and re-pressurize gas pipelines; deploying and staffing base camps to enhance restorations efforts for customers; coordinated customer outreach activities; and communications with third-party responder agencies.

Inadequate emergency planning or response could have significant safety, reliability, and regulatory impacts. S&E advances PG&E's response to emergencies with the controls and mitigations described in this chapter. The forecast includes Control programs, Mitigation programs, and associated Labor as outlined below.

Controls

SYSPLAN EP&R AB6 EPNDR-C000 (5058276, 5058278, 5058279, 5058280, 5058281, 5058282):

1. Emergency Planning and Process Improvement:
   Aligns PG&E emergency operations plans and standards with accepted emergency management industry practices and utility industry best practices. The Company Emergency Operations Plan (CERP) is reviewed and updated annually to reflect changes in emergency response structure and process. Functional and Hazard specific annexes are extensions of the CERP and communicate the unique response structure and processes for each Line of Businesses (LOBs) and hazard. Examples include the Electric Annex, Earthquake Annex, and the Cybersecurity Annex.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 5, EP&R
Project Summary – EP&R Strategy and Execution

2. Training:
The Training team develops the Company Training Program for emergency preparedness for EOC operations and continuous process improvement for all aspects of the EOC. The activities of the training team also includes, developing roles and responsibilities for the emergency response EOC, training curriculum for EOC processes and positions, and supporting curriculum development for line of business emergency management teams.
Training programs will be built around emergency management industry best practices for accreditation and in collaboration with Cal OES. The emergency training program is aligned with National Incident Management System, California Standardized Emergency Systems, and foundational ICS guidance provided by the FEMA's Emergency Management Institute and the California Specialized Training Institute (CSTI). Current training course include the following:

- ICS 100 – Introduction to the Incident Command System
- ICS 200 – Basic Incident Command System for Initial Response
- IS 700 – An Introduction to the National Incident Management System
- IS 800 – National Response Framework, An Introduction
- G606 – Standardized Emergency Management System
- ICS 300 - Intermediate ICS for Expanding Incidents
- ICS 400 - Advanced ICS for C&G Staff
- G 775 - EOC Management and Operations
- G 191 - ICS Field/EOC Interface
- G 626 - EOC Action Planning
- G 197 - Integrating Access and Functional needs into Emergency Planning
- ICS Position-specific workshops.

3. Exercises:
EOC exercises enhance emergency response coordination capabilities among emergency management organization which includes the EOC, Regional Emergency Center (REC), Operations Emergency Center (OEC) staff, and coordination center personnel. Using the Homeland Security Exercise and Evaluation Program (HSEEP), they develop exercises designed to test the effectiveness of current enterprise emergency response plans and procedures. 2021 exercises include Cybersecurity Tabletop Exercise (TTX), Wildfire Annex TTX, Regional PSPS Exercise Series (Bay Central/South Region TTX and 5 Day Full Scale Exercise, Northern Region TTX and 5 Day Full Scale Exercise), and Grid-Ex IV.

4. Prevention:
Leading the enterprise-wide business continuity efforts, including conducting the Threat Hazard Identification Risk Assessment (THIRA) for identified enterprise risks, the 3-year Business Impact Analysis (BIA), and the maintenance of business continuity plans. Fusion software/services will be utilized to make the BIA process and BCP template more operational and functional for a business continuity incident.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 5, EP&R
Project Summary – EP&R Strategy and Execution

5. Response:
   Response efforts include maintaining the EOC and multiple emergency response technology outlined below:

   a. Early Earthquake Warning (EEW):
      The Earthquake Early Warning (EEW) Program uses technology and monitoring systems to create an alert before shaking waves are generated by an earthquake and provides an expected location of impact. Using sophisticated computational algorithms with input from seismic sensor networks along the West Coast, EEW technology can provide the user anywhere from a few seconds to tens of seconds advance notice before ground shaking occurs at their location.
   b. Debris Flow Modeling:
      PG&E's debris flow hazard prediction model integrates PG&E infrastructure, past debris flow datasets, local jurisdictional precipitation data, U.S. Geological Survey model results, and other datasets. The model was created to calculate debris flow thresholds and integrate these thresholds with PG&E's precipitation forecasts to rapidly predict the location and severity of debris flows in wildfire burn areas prior to and during major storm events. PG&E's debris flow susceptibility maps show the relative probabilities for debris flow triggering within individual basins and along drainages with a focus on the zones of greatest concern.
      A Debris Flow Watch is issued during a winter storm event when a heightened state of awareness and monitoring is recommended. A Debris Flow Warning is issued when continued monitoring of rainfall throughout the storm event indicates the potential for short-duration, intense precipitation that poses a heightened likelihood for initiation of debris flows within vulnerable slopes.
   c. Portable Rain Gauge:
      To further improve PG&E's debris flow model estimates for wildfire burn zones in northern California, Geosciences and Emergency Preparedness and Response (EP&R) are augmenting the collection and monitoring of rainfall intensity in the fire burn zones. This information combined with systematic field reconnaissance (including visual and LiDAR-based mapping) will help establish threshold rainfall intensities for debris flow initiation (currently ¼ inch in 15 min).
      The installation of portable real-time rain gauges (using cellular or satellite technology) will improve our capability to monitor high concern areas in remote locations and augment NWS and PG&E Meteorology precipitation radar and local weather station data. These types of instruments are ideally suited to record rainfall in environmentally sensitive areas as part of PG&E's wildfire monitoring program as well. Long-term monitoring provides situational awareness of potentially hazardous earth movements during the recovery period.
   d. Dynamic Automated Seismic Hazard (DASH)
      The DASH system is an automated earthquake reporting system that generates rapid, facility specific damage estimates for use in prioritizing initial inspections. DASH reports are distributed automatically via company email approximately 15 minutes after an earthquake to subscribers and are archived at www/DASH on the PG&E intranet. The initial report is not reviewed by Geosciences subject matter experts (SMEs). However, within 15 minutes of the initial report, Geosciences SMEs review and distribute subsequent DASH reports. Earthquake Notification and DASH Reporting Timeline for the automatically generated earthquake notification text message and automatic release of the initial DASH report by email.

DASH capabilities provide the following major benefits:

- Within minutes of a major earthquake, DASH subscribers receive the best available information on the potential impact to PG&E facilities to provide awareness
- DASH automatically prioritizes affected PG&E facilities, based on factors such as customer impact, enabling efficient and data driven first response where needed most
- DASH facilitates effective emergency response planning and preparedness via a library of known earthquake scenarios likely to occur within PG&E's service area.

e. Mass Emergency Notification Systems (2):
   i. Everbridge: PG&E's Employee Mass Emergency Notification System. This system replaced the older Send Word Now vendor at the beginning of 2021. Everbridge provides quick and efficient emergency messages via email, text and phone call to alert employees and contractors with specific direction and actions to take, protecting their health and safety. Additionally, Everbridge is open to other internal users to provide emergency notifications, including: EOC activations, PSPS notifications to external stakeholders, and dam failure notifications to partners.
   ii. LiveSafe: A mobile application (SaaS) two-way safety communications incident reporting platform intended to help employees stay safe in every day and high-risk scenarios. Employees can send GPS-tagged incident reports to Corporate Security by text, image, video, or audio - monitored 24/7 as well as get real-time information on emergency situations such as protests, facility impacts, active shooter situations and more by enabling location services. The application is utilized by employees who work outside their home have been required to perform a daily health screening since near the start of the COVID-19 pandemic.

6. Recovery:
   Recovery efforts manages the After-Action Reports (AAR) and process improvements to support the development and creation of AARs for All Hazards EOC Incidents. The Californian Public Utilities Commission (CPUC) General Order 166 requires select AAR information be submitted annually to the CPUC in the GO 166 filing. The AAR data collection and analysis provides PG&E potential corrective action items to improve our response plans. Other Recovery initiatives include the development of Strategy & Execution's Key Performance Indicators (KPIs), as well as track KPIs for projects tied to safety, compliance, and risk.

Mitigations
SYSPLAN EP&R AB6 EPNDR-M000 (5058277, 5515859, 5544468):

1. Base Camp Project:
   a. Base Camp Process Improvement - Improve personnel accountability and operations surrounding base camp activations, including check in and check out of employees. Implement IT controls and processes to account for personnel entering and exiting the base camp. Using technology for check in and check out will help PG&E account for all personnel entering and exiting the camp and will improve safety if a base camp needs to be evacuated by confirming that all personnel can be accounted for. Required equipment includes ruggedized devices that can be used at multiple entry/exit points.
   b. Mobile Command Vehicles - Future enhancements and improvements include a prescribed lifecycle of the mobile command vehicle fleet, microwave tower trailer enhancements and refinements to satellite

network connectivity, including a lifecycle of aging satellite assets. The lifecycle of the mobile command vehicle fleet will begin in 2023, lasting until 2026. Lastly, we work to responsibly position the company and the program to sunset aging technologies to replace with appropriate emerging technology based upon evolving mission requirements.

c. Emergency Communications Equipment - The Information Technology Emergency Communications (ITEC) Program continues to support the EP&R organization, ensuring that the Company is positioned to support all-hazards emergencies and planned events. To effectively support this strategy, the ITEC Program employs a vast array of technology to ensure there are communications solutions for all responding Incident Management teams, field personnel and aviation assets. The technology portfolio consists of emergency communications trailers, mobile microwave tower trailers, portable satellite systems and cellular routers, and is complimented by approximately 5000 pieces of computing peripherals. To respond to All Hazards emergencies, PG&E must operate and maintain a technology portfolio that supports field expedient communications safely and effectively across multiple platforms utilizing different network offerings. The risk of not providing adequate communications has a negative impact to safely and effectively responding to emergency events. All field personnel need to have the ability to communicate effectively during emergencies, regardless of size and scale of response and these solutions are effective in doing so, even in extreme austere environments.

2. Check-in/Check-out with Salesforce:
   Develop and implement technology-based processes and tools for personnel check in and check out function at the EOC. This mitigation supports employee and external agencies' safety and incident documentation.

3. Secondary Emergency Roles Enterprise-wide:
   Implement secondary emergency roles for enterprise employees to increase bench depth of emergency center staffing. This mitigation supports employee safety, fatigue management, and adds consistency in the use of SEMS/ICS as an emergency response framework across the enterprise.

4. Mutual Aid Enhancements:
   Develop guidance for acquiring and training mutual assistance resources. Improve mutual assistance program to onboard, process, track, demobilize and compensate mutual assistance utilities. This mitigation improves the efficiency and safety of additional resources acquired through PG&E's mutual assistance agreements.

Justification

The need for the Strategy and Execution organization is expected to increase in magnitude due to large scale emergency events that invoke key EP&R programs – Emergency Operations Center (EOC) and preparedness via Company Exercises. The team has established controls in place to ensure adequate Company response to all hazards in a safe and efficient manner, while being transparent with customers and regulatory agencies.

The controls in place influence multiple PG&E risks, by enhancing PG&E's response capabilities to large-scale emergency events through maintenance of a trained workforce for service restoration, community outreach,

customer support during emergencies and coordinated interaction with Federal, State, County, City and Tribal Agencies for all types of emergencies that can occur.

Cost

For the 2023 Control forecast, the Training estimate is based on the number of certifiable NIMS/SEMS training courses and classes expected to be delivered. The Response program comprises most of the technology tools that are required to enhance the experience during responses, such as mass emergency notification system for internal/external notifications when activations occur. 2023 forecast for Response is based on vendor costs for subscriptions, annual maintenance, and upgrade needs. The remainder of the 2023 Control forecast is labor cost based on headcount needs to support the operation.

For the 2023 Mitigation forecast, part of the expense portion reflects annual service contracts for satellite and cellular services related to emergency response technologies and the O&M costs required to service and maintain the equipment. The remainder of the Mitigation expense forecast is labor cost based on headcount needs to support the programs. A large majority of the 2023 capital cost will be appropriated towards the lifecycle of the mobile command vehicle fleet. The remaining portion is to be used for continued technology improvements in support of all-hazards emergencies.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast							
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	Workpaper Reference
EXPENSE													
Various POs	6,296	4,740	5,574	6,045	7,556	4,209						34,420	
PO 5058277							1,894	4,176				6,070	
PO 5058276							517	1,140				1,657	
PO 5058278							62	137				199	
PO 5058279							1,033	2,278				3,311	
PO 5058280							83	182				265	
PO 5058281							103	228				331	
PO 5058282							517	1,139				1,656	
												-	
Expense Total	**6,296**	**4,740**	**5,574**	**6,045**	**7,556**	**4,209**	**4,208**	**9,281**	**-**	**-**	**-**	**47,909**	**WP 5-5 Line 2**
CAPITAL													
PO 5515859	3,595	1,640	219	715	518	2,046						8,733	
PO 5544468							1,966	2,143	2,075	2,093	2,160	10,437	
Capital Total	**3,595**	**1,640**	**219**	**715**	**518**	**2,046**	**1,966**	**2,143**	**2,075**	**2,093**	**2,160**	**19,170**	**WP 5-12 Line 2**
TOTAL PROJECT COST	**6,296**	**4,740**	**5,574**	**6,045**	**8,074**	**6,255**	**6,174**	**11,424**	**2,075**	**2,093**	**2,160**	**67,079**	

Benefits

PG&E benefits from the Strategy and Execution organization to:

- Protect the health and welfare of the public, PG&E responders, and others
- Protect property of the public, PG&E and others

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- Inform customers, governmental agencies and representatives, the news media and other constituencies
- Restore gas and electric service and power generation
- Restore critical business functions and move to resume business as usual

Additionally, these priorities are maintained through all phases of response to an emergency and implemented through consistent incident management, planning and response concepts, and maintaining processes and procedures. Scalable staffing model provides emergency support as needed across the enterprise to better serve our customers and reduce risk of an emergency incident. The programs in Strategy and Execution allows PG&E to respond to all emergency incidents safely, transparently and with a strong sense of urgency and aligns PG&E's planning and response efforts with the needs of the communities it serves. The programs provide PG&E cost avoidance of increased compliance and safety risk.

Alternatives Considered

1. If Strategy and Execution organization reduces any of its programs, PG&E will increase the consequences of emergency risk and may face costly consequences due to non-compliance and safety risks. Reducing the programs is not an acceptable solution given the current threat landscape, increased extreme weather events, and wildfire risk.

2. The Strategy and Execution organization can expand many of its programs and advance the technology used in the Response team. The results will result in reducing risk for the organization however will increase the forecast dollars.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 5, EP&R
Project Summary – EP&R Field Operations – Core Work

Project Title: EP&R Field Operations – Core Work
Major Work Categories: AB, IG
Planning Order Numbers:

- Chapter 4.2 (PSPS): 5052731, 5049334, 5052657, 5052660, 5052658, 5052659, 5052753, 5057156
- Chapter 5 (All-Hazards): 5058318, 5058142

Project Start Date: Various
Project Completion Date: Various
Operative Date (only applies to Capital): N/A

Project Description

EP&R Field Operations – Core Work comprises of several expense orders, each outlined below:

Circuit Pre-Flights Project (PO# 5052731)

Restoration times are critical information for customers and state, local, and tribal partners during Public Safety Power Shutdown (PSPS) events. The current calculation methodology for forecasting and allocating air and ground resources to patrol, restore and communicate Estimated Time of Restoration (ETOR) did not meet the timeliness expectations of stakeholders. In 2020 95 percent of customers were restored within 24 hours against the CPUC requirement of 100 percent.

The PSPS circuit pre-flights project will identify which High Fire Risk Area (HFRA) additions, and Tier 2 and Tier 3 High Fire Threat District (HFTD) portions of circuits must be patrolled by air and which must be patrolled by ground. It will also capture the number of circuit miles patrolled by air and ground and capture the time needed to patrol the circuits. This patrol method, time, and miles information is important for developing effective strategies to manage air and ground resource needs to effectively patrol and restore 100 percent of the PSPS circuits within 24 hours per the CPUC regulatory requirement.

The scope of this project includes:

- Flying portions of circuits in Tier 2 and Tier 3 HFTD areas and HFRA additions to identify and capture changes in terrain (i.e., fire or reduced canopy now flyable)
- Identifying portions of the circuit that must be patrolled by air
- Identifying portions of the circuit that must be patrolled by ground
    - IF ground patrol, then identify which portions the circuit must be walked/hiked and which can be driven
- Capture the time to patrol (Air, Drive, Walk)
- Increase the number of resources capable of air patrols and improve the expertise/experience with air patrols

Justification:

This project is non-mandated. The data collected is required to improve the FORCE model calculation methodology to improve resource modeling, planning, and allocation during PSPS events to ensure a more accurate ETOR forecast and improve overall restoration time. The current FORCE model calculation methodology uses poles per circuit; this will switch to miles per circuit. The circuits will include percentage breakdown between helicopter and ground patrol. Understand and develop an as accurate as possible miles per hour per ground crew patrol rate (this varies based on terrain/accessability) and

miles per hour per helicopter patrol rate to improve accuracy of resource allocations and improve overall patrol and restoration times.

PSPS Field Exercise Distribution Expense (PO# 5049334)

The project is to support Wildfire Mitigation Plan (WMP) and internal training requirements to perform annual field exercises with PG&E's distribution organization. Field exercises provide field groups including Distribution Control Centers and patrol resources with real world PSPS training scenarios to physically execute. They include actual patrols (both air and ground) on pre-identified distribution circuits that have been simulated as having been de-energized in a PSPS Event. Participants are expected to execute using the latest available processes and procedures including technology updates that have been developed to allow for functional validation, and as needed, provide field inputs for potential modifications.

Justification:
WMP and internal training requirements require PG&E to perform annual field exercises. These exercises are conducted system wide to ensure that PG&E has the available and well trained workforce required to safely and efficiently execute real PSPS events to support our commitment of making PSPS Events "shorter", by reducing customer impact duration.

This training is broken into two internally mandated training modules and expected to be performed yearly (or within 90 days for new hires) and supports training for the following:

- Utility Standard: PSPS-1000S: Public Safety Power Shutoff (PSPS) and accompanying procedure PSPS-1000P-01: Public Safety Power Shutoff for Electric Transmission and Distribution

PSPS Collateral/Segment Creations (PO# 5052657)

This project is to support the enhancement of PG&E's Segment Guides for distribution circuits (Segment Guides). These guides are the primary reference documents that Distribution Control Centers and field patrol personnel utilize for alignment in executing "step restoration" efforts during PSPS restoration.

"Step restoration" is the breaking up of a given distribution circuit into incremental "segments" that, once patrolled, are energized individually rather than waiting to patrol the entire circuit (and then energizing all customers at once). Step restoration provides for safer and more efficient customer restoration.

The Segment Guides contain alphabetical designations of each distribution circuit within HFRA based on main line SCADA devices. These segments are then reviewed by electrical connectivity (source to load) and then prioritized by critical infrastructure and customer impact when possible (i.e., if two segments share a common source, the one with higher critical infrastructure/customer impact would be prioritized ahead of the other, hence potentially "B" vs. "C" for segment designations in this case).

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 5, EP&R
Project Summary – EP&R Field Operations – Core Work

Justification:
The present state of the Segment Guides does not provide enough information to support other business processes, or the future automatic creation of the guides and corresponding maps. An enhancement is needed to update the present information within the Segment Guides, add more data fields, and electronically link the information to other business processes.

Enhancing the information associated with the Segment Guides will:

- Provide for a standardized methodology and communication process during PSPS activities (required for the safe and efficient execution of events).
- Provide improved visibility of the restoration priorities by adding details about the involved customers.
- Place priority for critical infrastructure based on latest CPUC guidance.
- Support more efficient customer restoration by improving alignment on priorities and facilitating execution of “step restoration” methodology.
- Provide data to other platforms.
- Ensure consistency between the event planning groups and field operations while managing portions of the distribution system impacted by PSPS.

While non-mandated, as noted in the justification section this project is critical to supporting PG&E’s goal of safely and efficiently executing PSPS Events.

PSPS Field Operations Miscellaneous (PO# 5052660, 5052661)

This project is for items including (but not limited to) the additional subject matter expert support needed to develop and formalize strategic activities associated with enhancing and improving the overall PSPS processes and procedures to provide for the safe and efficient execution of PSPS activities.

Justification:
There are many technologies and processes that continue to be explored and developed. This funding stream allows for identification and pursuit of emergent technologies and processes to better PSPS response may not have been identified in the previous year’s budget process.

Benefit: Provides funding for subject matter expert resource availability and other miscellaneous expenses needed to accommodate the development of both the short term and long term PSPS initiatives/projects, processes and standards needed to support the safe and efficient execution of PSPS activities. This input is required to ensure that initiatives/projects and processes align with cross-functional business needs from the start to end user perspective and that associated standards and procedures are updated as needed prior to their implementation. While non-mandated, as noted in the justification section, this subject matter expert support provides for additional bandwidth in availability of obtaining the critical inputs needed to operationalize and execute on the numerous PSPS projects that are in flight for 2021 and beyond. This support also provides for providing critical inputs/needs from the end user into the upstream process to ensure the selected initiative is operationally executable.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 5, EP&R
Project Summary – EP&R Field Operations – Core Work

PSPS Field Ops Training Program Expense (PO# 5052658)

Develop and deliver training on based on needs identified during field exercises and gaps in performance. Training includes, but is not limited to, emerging technology, tools and skills required for Field Operations to successfully and safely prepare for in advance of PSPS restoration events. Timing and frequency of training is in alignment with PSPS season and can/will be adjusted as needed. Training is delivered in person, or through web based and virtual platforms.

Justification:
To retain and train qualified workforce to conduct service restoration in response to emergencies, including short-term contracting strategy and implementation. In alignment with WMP and regulatory requirements to deploy a trained and ready workforce to execute PSPS Restoration efforts safely and efficiently. Provide additional training for Mutual Assistance crews as needed and Public Safety Specialists ongoing training support. This is to help ensure the internal workforce remains in a steady state of emergency readiness and has the skills and abilities to react and respond to incidents within the service territory. With a trained workforce, we can deploy resources with confidence that restoration efforts are being conducted efficiently and safely, in compliance with standards and regulations.

EP&R Field Ops (PO# 5052659, 5058318)

The Public Safety Specialist (PSS) team utilizes the Salesforce database platform to capture activity and regulatory compliance engagement. Additionally, the database is aligned with supporting the First Responder Web Portal (FRP) – Compliance mandate CPUC 11-07-004, for external public safety partners (first responders).

FRP enables PG&E to:

- Support the needs of the First Responder community by providing a way to contact PG&E's Emergency Preparedness team and sharing EP&R related resources on the portal like training materials, Liaison activity details and interactive Maps.
- Address CPUC mandate to share the requested first response information though reporting.

Emergency Preparedness Application in Safety Org is a Outreach tracking system build for PG&E EP&R Team Public Safety Specialists to

- Track outreach efforts to First Responder groups
- Monitors PG&E Compliance to Regulations

In 2020, the following major capabilities were put in place:

- Ability to capture new compliance mandate 'CCR 1726.3.1' at Event & Account level and to track new compliance mandate 'CCR 1726.3.1' at agency level through report and dashboard.
- Electric Public Safety Specialists integration into FRA application. Optimized Wildfire incident capturing and tracking within the application.
- Ability to identify Account/Agency that are in Gas Storage Area using the identifier "Agency in PG&E Gas Storage Area"
- For CPUC Mandate created a autogenerated custom report 'Weekly CPUC Fire Incidents' that is sent to individual Salesforce and non-salesforce users.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 5, EP&R
Project Summary – EP&R Field Operations – Core Work

- Ability to Send First Responder Portal Map Refresh Email via Salesforce. This will replace the use of external third party system that is used currently to send portal refresh emails.
- For CPUC Compliance – Provided an ability to track 'First Responder Portal Refresh' email activity on Community Contact records.

Justification:
Support of the Salesforce platform is critical in ensuring regulatory compliance, associated with Gas mandates (AB 56, 49 CFR 192.615/616, CPUC 11-07-004, and CPUC General Order 112F), Electric mandates (AB1650/CPUC 768.6), and Wildfire Mitigation Planning outreach and engagement. Costs would support Salesforce licensing fees, database maintenance costs, hosting fees, and non-project application enhancements (NPAE) needs. Additionally, the platform is critical in facilitating the FRP, in support of external public safety partners (gas transmission pipeline infrastructure identification needs).

For the expense portion of the forecast through 2022, the costs reflect annual service contracts for satellite and cellular services related to PSPS and the O&M costs required to service and maintain the equipment.

Costs associated with support of the Salesforce platform will ensure compliance risks are negated and related activities are accurately reported. Additionally, external public safety partners will continue to have access to the FRP, which will enhance safety for first responders and the communities served by PG&E.

EP&R Distribution Support Headcount (PO# 5052753, 5057156, 5058142)

The PSS team serves as an all-hazard response group, to maintain established relationships with external agency partners and to support emergency planning and information sharing during emergencies. In this capacity, the PSS team serves as the PG&E Agency Representative to coordinate and integrate PG&E's response with the Agency Having Jurisdiction (AHJ) during active incidents.

In addition to serving as an Agency Representative for all hazard responses (wildfires, PSPS events, gas/electric emergencies) and supporting HFRA/system hardening efforts, the PSS group supports the following types of outreach, compliance, and training needs:

- First Responder Workshops
- Winters Gas Release & Detection Training
- Gas Ops Vegetation Management (O&M) Outreach/training
- AB56 Outreach/Training
- Public Safety Liaison Meetings (outreach and PSS overview training)
- TD 1464 Training (Internal/External)
- AB1650
- CPUC 11-07-004 (Triennial Regulatory Workshop)
- CWSP/PSPS Wildfire Working Sessions/Outreach
- Defensible Space Inspections - PRC-4291
- Basic Wildland fire Safety course
- Power Generation's CERP/Dam Safety/and phone tree training
- Live Fire Mobile Training Simulators

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 5, EP&R
Project Summary – EP&R Field Operations – Core Work

Justification:
Funding of the PSS group is critical to ensuring all-hazard emergency response, regulatory compliance and public safety outreach needs of PG&E are successfully achieved.

Cost

Costs are based on historical expenditures experienced on existing programs or similar programs.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

		Recorded					Forecast				
	GRC Section	2016	2017	2018	2019	2020	2021	2022	2023	Total	Workpaper Reference
EXPENSE											
Circuit Pre-Flights Project (PO# 5052731)	4.2				189	1,775	1,081	1,114	1,149	5,307	WP 4-8 Line 21
PSPS Field Exercise Distribution Expense (PO# 5049334)	4.2				2,431	1,073	2,470	2,546	2,625	11,145	WP 4-8 Line 16
PSPS Collateral/Segment Creations (PO# 5052657)	4.2					249	103	106	109	568	WP 4-8 Line 15
PSPS Field Operations Miscellaneous (PO# 5052660, 5052661)	4.2					108	257	265		630	WP 4-8 Line 13
PSPS Field Ops Training Program Expense (PO# 5052658)	4.2					18	103	106		227	WP 4-8 Line 13
Field Ops Labor (PO# 5052753)	4.2					3,691	9,974			9,974	WP 4-8 Line 12
Field Ops Labor (PO# 5057156)	4.2							6,903		6,903	WP 4-8 Line 12
Field Ops Labor (PO# 5058142)	5								7,099	7,099	WP 5-5 Line 5
EP&R Field Ops (PO# 5052659)	4.2					92	206	212		510	WP 4-8 Line 14
EP&R Field Ops (PO# 5058318)	5								600	600	WP 5-5 Line 6
										-	
Expense Total		**-**	**-**	**-**	**2,620**	**7,007**	**14,194**	**11,252**	**11,582**	**42,964**	

Benefits

These projects improve multiple key areas, mainly focused on ensuring that PG&E has an available and well trained workforce needed to safely and efficiently execute real PSPS events to support our commitment of making PSPS events "shorter", by reducing customer impact duration.:

	Customer Experience	Safety	Compliance	Operational Excellence
Circuit Pre-Flights Project (PO# 5052731)	X	X	X	X
PSPS Field Exercise Distribution Expense (PO# 5049334)	X	X		
PSPS Collateral/Segment Creations (PO# 5052657)	X	X		
PSPS Field Operations Miscellaneous (PO# 5052660, 5052661)	X	X		
PSPS Field Ops Training Program Expense (PO# 5052658)	X	X		
EP&R Distribution Support Headcount (PO# 5052753, 5058142)	X	X	X	X
EP&R Field Ops (PO# 5052659, 5058318)	X	X	X	X

Alternatives Considered

Do Less – As PSPS execution is extremely complex and impactful, lesser focus on these programs was deemed inadequate to ensure that we have the available and well trained workforce required to support our goals and CPUC requirements for safely and efficiently executing the activities associated with PSPS events.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 5, EP&R
Project Summary – EP&R Field Operations – Technology

Project Title: EP&R Field Operations – Technology
Major Work Categories: 21
Planning Order Numbers: 5544479, 5536139, 5539641
Project Start Date: 01/2021
Project Completion Date: 12/2026
Operative Date (only applies to Capital): Operative as installed

Project Description

The goal of this project is to continue to provide the appropriate complement of IT solutions enabling a safe, scalable and expedient response for planned and unplanned events. The Information Technology Emergency Communications (ITEC) Program is supporting the LOB in taking an all-hazards response posture in support of the Public Safety Power Shutoff (PSPS) strategy and program. In order to adequately support PSPS, the ITEC Program employs a vast array of radio and network products to ensure there are communications solutions for all responding Incident Management teams, field personnel and aviation assets. The centerpiece of this effort utilizes radio technology. Current efforts are underway to improve the UHF and VHF Radio coverage footprint and we are building mission-specific crossband repeaters to improve ground-to-air communications to aerial patrollers. In addition to the field radio and communication improvements, there is an effort underway to assess and improve storm room and OEC capabilities.

Future enhancements and improvements include a continued improvement of the UHF and VHF Radio solution set as well as deploying an increased amount of cross banding technology for use in ground-to-air radio communications. Additional project deliverables include building a small number of tactical communications trailers in support of PSPS and the new regional organizational changes in coming years. We will also look to continue to improve the capabilities in the Storm rooms, division OEC's and REC's.

The ITEC expense forecast will uallow Public Safety Specialist teams to utilize the Salesforce database platform to capture activity and regulatory compliance engagement. Additionally, the database is aligned with supporting the First Responder Web Portal (FRP) – Compliance mandate CPUC 11-07-004, for external public safety partners (first responders).

First Responder Portal enables PG&E to:

- Support the needs of the First Responder community by providing a way to contact PG&E Emergency Preparedness team and sharing EP&R related resources on the portal like Training material, Liaison activity details and interactive Maps.
- Address CPUC mandate to share the requested first response information though reporting

Emergency Preparedness Application in Safety Org is an Outreach tracking system built for PG&E EP&R Team Public Safety Specialists to:

- Track outreach efforts to First Responder groups
- Monitor PG&E compliance with regulations

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 5, EP&R
Project Summary – EP&R Field Operations – Technology

In 2020, the following major capabilities were put in place:

- Ability to capture new compliance mandate 'CCR 1726.3.1' at Event & Account level and to track new compliance mandate 'CCR 1726.3.1' at agency level through report and dashboard.
- Electric Public Safety Specialists integration into FRA application. Optimized Wildfire incident capturing and tracking within the application.
- Ability to identify Account/Agency that are in Gas Storage Area using the identifier "Agency in PG&E Gas Storage Area"
- For CPUC Mandate created a autogenerated custom report 'Weekly CPUC Fire Incidents' that is sent to individual Salesforce and non-salesforce users.
- Ability to Send First Responder Portal Map Refresh Email via Salesforce. This will replace the use of external third party system that is used currently to send portal refresh emails.
- For CPUC Compliance – Provided an ability to track 'First Responder Portal Refresh' email activity on Community Contact records.

Justification

In order to safely and effectively respond to all hazards emergencies and PSPS events, we must operate and maintain a technology portfolio that supports field expedient communications across multiple platforms utilizing different network offerings. These solutions must also be fully mission capable in challenging locations as a large portion of PG&E's high fire threat areas are in rural and often mountainous locations, not conducive to reliable communications.

Failure to provide adequate communications would have a negative impact on safely and PG&E's ability to effectively patrol and restore power after a PSPS Event. All field personnel need to have the ability to communicate effectively during PSPS events and these solutions are effective, even in challenging environments.

EP&R Field Operations Technology is a mitigation for the Wildfire risk.

Cost

For the 2023 capital costs identified below, approximately $3,250,000 will be used for continued radio system improvements and enhancements as the evolving PSPS mission dictates, as well as additions, enhancements and lifecycle of aging Emergency communications technology. Radio system improvements and enhancements are to address radio coverage gaps in high fire threat areas and extremely austere terrain. This will improve and address the safety of employees and contractors during PSPS restoration and patrol. The improvements in emergency communications technology are to address the increasing demands of bandwidth and application availability during PSPS and all hazards IT emergency response.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 5, EP&R
Project Summary – EP&R Field Operations – Technology

Major Project Spending Estimates
(Thousands of Nominal Dollars)

		Recorded					Forecast							
	GRC Section	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	Workpaper Reference
CAPITAL														
5544479	5	-	-	-	-	-	-	-	3,250	3,146	3,173	3,269	12,838	WP 5-12, Line 4
5536139	4.2	-	-	-	757	1,376	2,056	1,987	-	-	-	-	6,176	WP 4-19 Line 6
5539641	4.2	-	-	-	-	-	1,028	994	-	-	-	-	2,022	WP 4-19 Line 6
Capital Total		**-**	**-**	**-**	**757**	**1,376**	**3,084**	**2,981**	**3,250**	**3,146**	**3,173**	**3,269**	**21,037**	

Benefits

- Improving communications during all-hazards response and PSPS allows for a safer and faster patrol and restoration of electric services during PSPS. Effective communication technology will enable employees to communicate even from deep canyons and remote locations. This technology keeps the employee safe above and adds a degree of efficiency during PSPS; in the pastemployees deep in the forest would have had to drive out of the forest to communicate. Our efforts in this space are focused to reduce that need, making employees safer and more effective.

Alternatives Considered

IT has historically met with our partner carrier providers at AT&T and Verizon to see what offerings, if any, they have in this space. Both carriers provided information on services that they offered. After review, our PG&E teams determined that the carrier-provided services could not provide an adequate or effective solution set in the PG&E PSPS and all-hazards environment.

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE

Testimony ___ Workpapers _X_ SOQ ___

Exhibit Number: _PG&E-4_ Chapter Number: _5_

Chapter Title: _Emergency Preparedness And Response_

Witness Name: _Angie Gibson_

Page No.	Line No.	Item	As Filed	As Corrected
Errata as of November 5, 2021				
WP 5-1	1 & 3	2022 and 2023 Forecast and Total	2022 Forecast $4,215 2023 Forecast $26,534	2022 Forecast $4,208 2023 Forecast $26,451
WP 5-2	1 & 3	2022 and 2023 Forecast and Total	2022 Forecast $4,038 2023 Forecast $24,898	2022 Forecast $4,031 2023 Forecast $24,821
WP 5-4	7	2022 Forecast	$4,215	$4,208
WP 5-4	8	2023 EP&R Strategy & Execution	$5,100	$5,037
WP 5-4	9	2023 EP&R Field Operations - Core Work	$7,119	$7,099
WP 5-4	10	2023 EP&R Field Operations - Technology, Training, and Other	$602	$600
WP 5-4	11	2023 Wildfire Safety Operations Center/Hazard Awareness and Warning Center	$7,405	$7,385
WP 5-4	12	2023 Numeric Weather Prediction and SOPP Model Automation	$2,093	$2,087
WP 5-4	13	Net Change	$22,319	$22,243

WP 5-4	14	2023 Forecast	$26,534	$26,451
WP 5-5	2	2022 Forecast - EP&R Strategy & Execution	$4,215	$4,208
WP 5-5	2	2023 Forecast - EP&R Strategy & Execution	$9,315	$9,281
WP 5-5	5	2023 Forecast - EP&R Field Operations - Core Work	$7,119	$7,099
WP 5-5	6	2023 Forecast - EP&R Field Operations - Technology, Training, and Other	$602	$600
WP 5-5	7	2023 Forecast - Wildfire Safety Operations Center/Hazard Awareness and Warning Center	$7,405	$7,385
WP 5-5	8	2023 Forecast - Numeric Weather Prediction and SOPP Model Automation	$2,093	$2,087
WP 5-5	9	2023 Forecast Total	$26,534	$26,451
WP 5-5	9	2022 Forecast Total	$4,215	$4,208
WP 5-18	Major Project Spending Estimates	PO 5058277 2022 Forecast	$1,897	$1,894
WP 5-18	Major Project Spending Estimates	PO 5058277 2023 Forecast	$4,192	$4,176
WP 5-18	Major Project Spending Estimates	PO 5058277 Total	$6,089	$6,070
WP 5-18	Major Project Spending Estimates	PO 5058276 2022 Forecast	$518	$517

WP 5-18	Major Project Spending Estimates	PO 5058276 2023 Forecast	$1,144	$1,140
WP 5-18	Major Project Spending Estimates	PO 5058276 Total	$1,662	$1,657
WP 5-18	Major Project Spending Estimates	Expense PO	PO 5058289	PO 5058279
WP 5-18	Major Project Spending Estimates	PO 5058289 2022 Forecast	$1,035	$1,033
WP 5-18	Major Project Spending Estimates	PO 5058289 2023 Forecast	$2,287	$2,278
WP 5-18	Major Project Spending Estimates	PO 5058289 Total	$3,322	$3,311
WP 5-18	Major Project Spending Estimates	PO 5058280 2023 Forecast	$183	$182
WP 5-18	Major Project Spending Estimates	PO 5058280 Total	$266	$265
WP 5-18	Major Project Spending Estimates	PO 5058281 2023 Forecast	$229	$228
WP 5-18	Major Project Spending Estimates	PO 5058281 Total	$332	$331
WP 5-18	Major Project Spending Estimates	PO 5058282 2023 Forecast	$1,143	$1,139
WP 5-18	Major Project Spending Estimates	PO 5058282 Total	$1,660	$1,656

s	Major Project Spending Estimates	Expense 2022 Total	$4,215	$4,208
WP 5-18	Major Project Spending Estimates	Expense 2023 Total	$9,315	$9,281
WP 5-18	Major Project Spending Estimates	Expense Total	$47,950	$47,909
WP 5-25	Major Project Spending Estimates	Field Ops Labor (PO# 5058142) 2023 Forecast	$7,119	$7,099
WP 5-25	Major Project Spending Estimates	Field Ops Labor (PO# 5058142) Total	$7,119	$7,099
WP 5-25	Major Project Spending Estimates	EP&R Field Ops (PO# 5058318) 2023 Forecast	$602	$600
WP 5-25	Major Project Spending Estimates	EP&R Field Ops (PO# 5058318) Total	$602	$600
WP 5-25	Major Project Spending Estimates	Expense Total 2023 Forecast	$11,604	$11,582
WP 5-25	Major Project Spending Estimates	Expense Total Total	$42,986	$42,964

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
EXHIBIT (PG&E-4) ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING
CHAPTER 6, ELECTRIC EMERGENCY RECOVERY

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PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
EXHIBIT (PG&E-4) ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING
CHAPTER 6, ELECTRIC EMERGENCY RECOVERY

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Workpaper Table 6-1
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 6
Electric Emergency Recovery
Expenses by Major Work Category
(Thousands of Nominal Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	Reference	Note
1	BH	E Dist Routine Emergency	60,812	57,422	59,196	71,327	67,075	59,274	59,361	73,678	WP 6-3, WP 6-4	
2	IF	E Dist Major Emergency	44,184	52,362	28,836	117,555	30,973	60,202	60,898	62,788	WP 6-5, WP 6-6	(1)
3	**Total**		**104,996**	**109,784**	**88,032**	**188,882**	**98,049**	**119,477**	**120,259**	**136,466**		

(1) MWC IF 2021-23 forecast includes costs recovered in Catastrophic Event Memorandum Account and do not tie to supporting workpapers.

Workpaper Table 6-2
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 6
Electric Emergency Recovery
Expenses by Major Work Category
(Thousands of Base Year Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast
1	BH	E Dist Routine Emergency	68,225	62,601	62,323	72,458	67,075	58,022	56,290	67,666
2	IF	E Dist Major Emergency	49,486	57,137	30,610	118,555	30,973	59,488	58,531	58,640
3	**Total**		**117,711**	**119,738**	**92,932**	**191,013**	**98,049**	**117,511**	**114,820**	**126,306**

Workpaper Table 6-3
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 6, Electric Emergency Recovery
Expense Walk by Major Work Category
MWC BH - Routine Emergency Expense
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**60,812**			
2		All programs	(3,390)		The decrease is primarily due to a higher volume of major emergencies, reducing the costs recorded to routine emergencies.	WP 6-7, Line No. 7
3		**Net Change**	**(3,390)**			
4	**2017**	**Recorded Adjusted**	**57,422**			
5		All programs	1,774		The increase is primarily due to higher contract spend.	WP 6-7, Line No. 7
6		**Net Change**	**1,774**			
7	**2018**	**Recorded Adjusted**	**59,196**			
8		All programs	12,131		The increase was primarily driven by an increase in number of jobs completed which caused increased spend on contracting, labor, and materials.	WP 6-7, Line No. 7
9		**Net Change**	**12,131**			
10	**2019**	**Recorded Adjusted**	**71,327**			
11		All programs	(4,251)		The decrease is attributed to lower volume of jobs completed. The cost of material and contracting charges are lower.	WP 6-7, Line No. 7
12		**Net Change**	**(4,251)**			
13	**2020**	**Recorded Adjusted**	**67,075**			

Workpaper Table 6-4
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 6, Electric Emergency Recovery
Expense Walk by Major Work Category
MWC BH - Routine Emergency Expense
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**67,075**			
2		Three-Year Average	706		A 3-year average of recorded costs (2018-2020) was used to forecast expenditures associated with Routine Emergency work. The 3-year average of recorded expenditures methodology for Routine Emergencies takes into account all of the varying factors that have been experienced in the past three years.	WP 6-7, Line No. 4
3		Escalation	1,830		Escalation added to the forecast year	WP 6-7, Line No. 5
4		Forecasting Adjustment	(10,337)		Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast.	WP 6-7, Line No. 6
5		**Net Change**	**(7,801)**			
6	**2021**	**Forecast**	**59,274**			
7		Escalation	1,880		Escalation added to the forecast year	WP 6-7, Line No. 5
8		Forecasting Adjustment	(1,793)		Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast.	WP 6-7, Line No. 6
8		**Net Change**	**87**			
9	**2022**	**Forecast**	**59,361**			
10		Escalation	1,930		Escalation added to the forecast year	WP 6-7, Line No. 5
11		Forecasting Adjustment	12,387		For 2023, there were minor variances between the planned forecast needed and final GRC forecast due to a minor difference in escalation calculations used.	WP 6-7, Line No. 6
12		**Net Change**	**14,317**			
13	**2023**	**Forecast**	**73,678**			

Workpaper Table 6-5
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 6, Electric Emergency Recovery
Expense Walk by Major Work Category
MWC IF - Major Emergency Expense (MEBA Only)
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**44,184**			
2		All programs	178,006		The increase in cost is primarily attributable to bad weather conditions during Jan-Feb; which required increased work to restore customers' power. This in turn resulted in higher contracting and materials costs. In addition, standard rate increases in both M&C and Restoration contributed to the increase.	WP 6-8, Line No. 1
3		CEMA Adjustment	(169,828)		The recorded expenditures for 2016 to 2017 have been adjusted to remove all Catastrophic Event Memorandum Account (CEMA) qualifying costs, including CEMA straight-time labor costs.	WP 6-8, Line No. 2
4		**Net Change**	**8,178**			
5	**2017**	**Recorded Adjusted**	**52,362**			
6		All programs	(111,407)		The decrease in costs is primarily attributable to favorable weather conditions as compared to 2017, that required less expense work to restore customers' power.	WP 6-8, Line No. 1
7		CEMA Adjustment	87,882		The recorded expenditures for 2017 to 2018 have been adjusted to remove all Catastrophic Event Memorandum Account (CEMA) qualifying costs, including CEMA straight-time labor cost.	WP 6-8, Line No. 2
8		**Net Change**	**(23,525)**			
9	**2018**	**Recorded Adjusted**	**28,836**			
10		All programs	75,445		The increase in costs is primarily attributable to unfavorable weather as compared to 2018. This required more frequent OEC activation and resouces allocated to support customer power restoration.	WP 6-8, Line No. 1
11		CEMA Adjustment	13,273		The recorded expenditures for 2018 to 2019 have been adjusted to remove all Catastrophic Event Memorandum Account (CEMA) qualifying costs, including CEMA straight-time labor cost.	WP 6-8, Line No. 2
12		**Net Change**	**88,718**			
13	**2019**	**Recorded Adjusted**	**117,555**			
14		All programs	128,440		The increase in costs is primarily attributable to unprecedented wildfire events due to high wind and dry conditions, as compared to the previous year, that required more resources to restore customers' power.	WP 6-8, Line No. 1
15		CEMA Adjustment	(215,022)		The recorded expenditures for 2019 to 2020 have been adjusted to remove all Catastrophic Event Memorandum Account (CEMA) qualifying costs, including CEMA straight-time labor cost.	WP 6-8, Line No. 2
16		**Net Change**	**(86,582)**			
17	**2020**	**Recorded Adjusted**	**30,973**			

Workpaper Table 6-6
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 6, Electric Emergency Recovery
Expense Walk by Major Work Category
MWC IF - Major Emergency Expense (MEBA Only)
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**30,973**			
2		All programs	10,492		The 2021 forecast was based on 5-year average of recorded costs (2015-2019), after removing all CEMA charges (including CEMA straight-time labor cost) and adjusted for escalation. The analysis was completed in June 2020 before the 2020 recorded costs were available. 2020 recorded costs were lower than the historical averages applied to the 2021 forecast calculation.	WP 6-8, Line No. 10
3		**Net Change**	**10,492**			
4	**2021**	**Forecast**	**41,465**			
5		All programs	35		The 2022 forecast is based on 5-year average of recorded costs (2016-2020), after removing all CEMA charges (including CEMA straight-time labor cost) and adjusted for escalation. The five-year average cost forecasting methodology resulted in a smaller increase from the 2021 forecast due to use of different averaging basis.	WP 6-8, Line No. 10
6		**Net Change**	**35**			
7	**2022**	**Forecast**	**41,501**			
8		All programs	1,207		The 2023 forecast is based on 5-year average of recorded costs (2016-2020), after removing CEMA charges (including CEMA straight-time labor cost) and adjusted for escalation. The increase is due to escalation.	WP 6-8, Line No. 10
9		**Net Change**	**1,207**			
10	**2023**	**Forecast**	**42,708**			

Workpaper Table 6-7
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 6, Electric Emergency Recovery
MWC BH - Routine Emergency Forecast Details
(Thousands of Nominal Dollars)

Line No.	Description	Recorded 2016	Recorded 2017	Recorded 2018	Recorded 2019	Recorded 2020	Forecast 2021	Forecast 2022	Forecast 2023	Assumptions	Reference
1	Routine Emergency Expense - Recorded Adjusted	60,812	57,422	59,196	71,327	67,075					
2	Adjustment of Recorded to Base Year	7,632	5,325	3,606	2,140	-				(1)	
3	**Averaging Basis**	68,444	62,747	62,802	73,466	67,075					Line 1 + Line 2
4	Three Year Recorded Average (2018-2020, in 2020 Dollars)						67,781	67,781	67,781	(2)	Average of Line 3
5	Future Year Escalation						1,830	3,710	5,640	(3)	Chapter 2
6	Forecasting Adjustment						(10,337)	(12,130)	257	(4)	Chapter 2
7	**Final Recorded and Forecast**	**60,812**	**57,422**	**59,196**	**71,327**	**67,075**	**59,274**	**59,361**	**73,678**		

Forecast Assumptions and Details

1) The recorded dollars are adjusted to reflect 2020 Base Year dollars for the 3-year averaging basis.

2) A 3-year average of recorded costs (2018-2020) was used to forecast expenditures associated with Routine Emergency work. The 3-year average of recorded expenditures methodology for Routine Emergencies takes into account all of the varying factors that have been experienced in the past three years.

3) The forecast basis for 2021-2023 uses the three year average (2018-2020) plus escalation.

4) Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added in 2021 and 2022 to ensure the total forecasts did not exceed the POR forecast. For 2023, there were minor variances between the planned forecast needed and final GRC forecast due to a minor difference in escalation calculations used.

Workpaper Table 6-8
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 6, Electric Emergency Recovery
MWC IF - Major Emergency Forecast Details (MEBA Only)
(Thousands of Nominal Dollars)

Line No.	Description	Recorded Adjusted 2016	Recorded Adjusted 2017	Recorded Adjusted 2018	Recorded Adjusted 2019	Recorded Adjusted 2020	Forecast 2021	Forecast 2022	Forecast 2023	Assumptions	Reference
1	MEBA and CEMA Emergency Expense - Recorded Adjusted	119,133	297,139	185,732	261,177	389,618					
2	CEMA Cost Removal	(74,949)	(244,777)	(156,895)	(143,622)	(358,644)				(1)	
3	**Recorded Adjusted**	44,184	52,362	28,836	117,555	30,973					Line 1 + Line 2
4	Overhead (OH) cost removal	(19,991)	(21,680)	(13,517)	(31,663)	-				(2)	
5	Adjust to 2020 Dollars	3,037	2,845	933	2,577	-				(3)	
6	**Averaging Basis: 2022-2023**	27,230	33,527	16,252	88,469	30,973					Line 3 + Line 4 + Line 5
7	2021 Forecast						41,465			(4)	
8	Five Year Recorded Average (2016-2020) - Adjusted, some OH removed (in 2020 Dollars)							39,290	39,290	(5)	Average of Line 6
9	Forecast Escalation							2,211	3,418	(6)	Chapter 2
10	**Final Recorded Adjusted and Forecast**	**44,184**	**52,362**	**28,836**	**117,555**	**30,973**	**41,465**	**41,501**	**42,708**		

Forecast Assumptions and Details

(1) The recorded expenditures have been adjusted to remove all Catastrophic Event Memorandum Account (CEMA) qualifying costs, including CEMA straight-time labor costs.
(2) Beginning in 2020, PG&E reduced the number of overhead (OH) costs recorded to MWC IF. In order to derive a forecast that is consistent with the current cost model structure, the recorded costs prior to year 2020, or 2016-2019 are re-stated to remove these specific overhead costs to develop the appropriate forecast averaging basis for 2021-2023.
(3) In order to accurately reflect the expenditures required on a forecast basis, the recorded dollars for averaging purposes have been adjusted to 2020 base year dollars.
(4) The 2021 Forecast was based on an analysis completed in June 2020, using 5-year average of 2016-2019 recorded excluding specific OH costs, and 2020 forecast.
(5) A 5-year average of recorded adjusted costs (2016-2020) was used to forecast expenditures associated with Major Emergency work. A 5-year average of recorded expenditures is an appropriate indicator of future spend for Major Emergencies because the number and severity of major emergencies is unpredictable from year to year.
(6) 2022-2023 forecasts are escalated. Refer to Exhibit (PG&E-4), Chapter 2 for details on escalation calculation.

Workpaper Table 6-9
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 6
Electric Emergency Recovery
Capital Expenditures by Major Work Category
(Thousands of Nominal Dollars)

			Capital Expenditures												
No.	MWC	MWC Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference	Note
1	17	E Dist Routine Emergency	171,406	183,903	187,744	212,620	247,499	193,244	233,354	239,188	246,137	253,271	260,615	WP 6-13, WP 6-14	
2	95	E Dist Major Emergency	46,303	62,705	33,078	72,935	64,253	76,351	78,014	79,996	82,287	84,639	87,058	WP 6-15, WP 6-16	(1)
3		**Grand Total**	**217,709**	**246,608**	**220,822**	**285,555**	**311,753**	**269,595**	**311,368**	**319,184**	**328,424**	**337,910**	**347,674**		

(1) MWC 95 2021-26 forecast includes costs recovered in Catastrophic Event Memorandum Account and do not tie to supporting workpapers.

Workpaper Table 6-10
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 6
Electric Emergency Recovery
Forecast Capital Expenditures Summary
(Thousands of Nominal Dollars)

		Capital Expenditures							
Line No.	**Description**	**2020 CWIP**	**2021 Forecast**	**2022 Forecast**	**2023 Forecast**	**2024 Forecast**	**2025 Forecast**	**2026 Forecast**	**Reference**
1	Projects > $3 Million*	302	158,096	311,368	319,184	328,424	337,910	347,674	WP 6-11
2	Other Work	3	111,499	-	-	-	-	-	WP 6-12
3	**Total**	**305**	**269,595**	**311,368**	**319,184**	**328,424**	**337,910**	**347,674**	
4	* Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.								

Workpaper Table 6-11
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 6
Electric Emergency Recovery
Recorded CWIP and Forecast Capital Expenditures Details - Projects Over $3 Million*
(Thousands of Nominal Dollars)

Line No.	Planning Order	Description	MWC	Operative Date	CWIP 2020 Recorded Adjusted	Capital Expenditures 2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Subtotal	Reference
	MWC - 17	**E Dist Routine Emergency**											
1	5500789	Correct Maint OH Elec Cap CC	17		19	8,434	-	-	-	-	-	8,454	
2	5500818	EmerResponse OH ElectCapital-FR	17		36	9,237	-	-	-	-	-	9,273	
3	5500820	EmerResponse OH ElectCapital-KE	17		-	4,711	-	-	-	-	-	4,711	
4	5500821	EmerResponse OH ElectCapital-LP	17		(23)	4,416	-	-	-	-	-	4,393	
5	5500822	EmerResponse OH ElectCapital-MI	17		-	3,184	-	-	-	-	-	3,184	
6	5500823	EmerResponse OH ElectCapital-NB	17		20	4,273	-	-	-	-	-	4,293	
7	5500824	EmerResponse OH ElectCapital - SO	17		-	3,469	-	-	-	-	-	3,469	
8	5500825	EmerResponse OH ElectCapital-NV	17		-	8,139	-	-	-	-	-	8,139	
9	5500826	EmerResponse OH ElectCapital-PN	17		-	5,667	-	-	-	-	-	5,667	
10	5500827	EmerResponse OH ElectCapital-SA	17		-	4,029	-	-	-	-	-	4,029	
11	5500830	EmerResponse OH ElectCapital-SI	17		-	6,704	-	-	-	-	-	6,704	
12	5500831	EmerResponse OH ElectCapital-ST	17		17	7,193	-	-	-	-	-	7,209	
13	5500832	EmerResponse OH ElectCapital-YO	17		233	7,752	-	-	-	-	-	7,985	
14	5502580	EmerResponse UG ElectCapital-DI	17		-	3,195	-	-	-	-	-	3,195	
15	5502582	EmerResponse UG ElectCapital-MI	17		-	3,880	-	-	-	-	-	3,880	
16	5502586	EmerResponse UG ElectCapital-FR	17		-	3,576	-	-	-	-	-	3,576	
17	5505259	EmerResponse OH ElectCapital - HB	17		-	4,720	-	-	-	-	-	4,720	
18	5508676	Emer greater than $100k -SF	17		-	6,195	-	-	-	-	-	6,195	
19	5513643	EmerResponse Damage Claim - FR	17		0	5,085	-	-	-	-	-	5,085	
20	5513656	EmerResponse Damage Claim - YO	17		-	3,292	-	-	-	-	-	3,292	
21	5543481	SYSPLAN ED 17B	17		-	-	128,398	131,608	135,432	139,357	143,398	678,194	
22	5543482	SYSPLAN ED 17C	17		-	-	48,116	49,319	50,752	52,223	53,738	254,149	
23	5543483	SYSPLAN ED 17D	17		-	-	38,009	38,959	40,091	41,253	42,449	200,762	
24	5543484	SYSPLAN ED 17P	17		-	-	16,316	16,724	17,210	17,709	18,222	86,181	
25	5544392	SYSPLAN ED 17#	17		-	-	2,514	2,577	2,651	2,728	2,807	13,278	
26	**Total**				**302**	**107,151**	**233,354**	**239,188**	**246,137**	**253,271**	**260,615**	**1,340,018**	WP 6-17
	MWC - 95	**E Dist Major Emergency**											
27	5505804	95A Major Emgcy OH Cap-CC	95		-	5,126	-	-	-	-	-	5,126	
28	5505807	95A Major Emgcy OH Cap-FR	95		-	4,149	-	-	-	-	-	4,149	
29	5505808	95A Major Emgcy OH Cap-KE	95		-	3,004	-	-	-	-	-	3,004	
30	5505810	95A Major Emgcy OH Cap-ST	95		-	5,678	-	-	-	-	-	5,678	
31	5505811	95A Major Emgcy OH Cap-YO	95		-	4,817	-	-	-	-	-	4,817	
32	5505812	95A Major Emgcy OH Cap-NV	95		-	4,452	-	-	-	-	-	4,452	
33	5505814	95A Major Emgcy OH Cap-SI	95		-	8,177	-	-	-	-	-	8,177	
34	5543614	CEMA Straight Time	95		-	15,541	15,945	16,375	16,817	17,271	17,738	99,687	
35	5543615	SYSPLAN MajorEmergency 95A	95		-	-	58,698	60,166	61,914	63,708	65,556	310,042	
36	5543617	SYSPLAN MajorEmergency 95B	95		-	-	3,371	3,456	3,556	3,659	3,765	17,807	
37	**Total**				**-**	**50,945**	**78,014**	**79,996**	**82,287**	**84,639**	**87,058**	**462,940**	WP 6-18
38		**Grand Total**			**302**	**158,096**	**311,368**	**319,184**	**328,424**	**337,910**	**347,674**	**1,802,958**	

39 * Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.

Workpaper Table 6-12
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 6
Electric Emergency Recovery
Recorded and Forecast Capital Expenditures Details - Other Work*
(Thousands of Nominal Dollars)

			Capital Expenditures											
Line No.	MWC	MWC Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference
1	17	E Dist Routine Emergency	74,671	79,528	84,162	98,404	109,428	86,093	-	-	-	-	-	WP 6-17
2	95	E Dist Major Emergency	21,584	61,861	32,359	51,490	23,427	25,406	-	-	-	-	-	WP 6-18
3	**Grand Total**		**96,255**	**141,390**	**116,520**	**149,894**	**132,855**	**111,499**	**-**	**-**	**-**	**-**	**-**	

4 * Excludes projects greater than $3M

Workpaper Table 6-13
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 6, Electric Emergency Recovery
Capital Walk by Major Work Category
MWC 17 - Routine Emergency Capital
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**171,406**			
2		All Programs	12,497		The increase is primarily driven by an increase in the volume of work (higher number of outages) compared to the previous year and the increase in labor costs, which is driven by an increase in standard rates in both Maintenance and Construction and Restoration, and an increase in contract costs. In addition, billing credits resulting from 3rd party damage claims increased.	WP 6-17, Line No. 8
3		**Net Change**	**12,497**			
4	**2017**	**Recorded Adjusted**	**183,903**			
5		All Programs	3,841		The increase is primarily driven by to higher contracting and material spend.	WP 6-17, Line No. 8
6		**Net Change**	**3,841**			
7	**2018**	**Recorded Adjusted**	**187,744**			
8		All Programs	24,876		The increase is primarily driven by a higher volume of work with increased labor, contracting and material costs.	WP 6-17, Line No. 8
9		**Net Change**	**24,876**			
10	**2019**	**Recorded Adjusted**	**212,620**			
11		All Programs	34,879		The increase is primarily driven by higher volume which in turn contributed to higher labor costs and overhead costs.	WP 6-17, Line No. 8
12		**Net Change**	**34,879**			
13	**2020**	**Recorded Adjusted**	**247,499**			

Workpaper Table 6-14
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 6, Electric Emergency Recovery
Capital Walk by Major Work Category
MWC 17 - Routine Emergency Capital
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**247,499**			
2		Three Year Average	(25,607)		A 3-year average of recorded costs (2018-2020) was used to forecast expenditures associated with Routine Emergency work. The 3-year average of recorded expenditures methodology for Routine Emergencies takes into account all of the varying factors that have been experienced in the past three years.	WP 6-17, Line No. 5
3		Escalation	5,991		Escalation added to the forecast year	WP 6-17, Line No. 6
4		Forecast Adjustment	(34,639)		Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast.	WP 6-17, Line No. 7
5		**Net Change**	**(54,255)**			
6	**2021**	**Forecast**	**193,244**			
7		Escalation	5,471		Escalation added to the forecast year	WP 6-17, Line No. 6
8		Forecast Adjustment	34,639		No forecast adjustment in 2022	WP 6-17, Line No. 7
9		**Net Change**	**40,110**			
10	**2022**	**Forecast**	**233,354**			
11		Escalation	5,834		Escalation added to the forecast year	WP 6-17, Line No. 6
12		**Net Change**	**5,834**			
13	**2023**	**Forecast**	**239,188**			
14		Escalation	6,949		Escalation added to the forecast year	WP 6-17, Line No. 6
15		**Net Change**	**6,949**			
16	**2024**	**Forecast**	**246,137**			
17		Escalation	7,135		Escalation added to the forecast year	WP 6-17, Line No. 6
18		**Net Change**	**7,135**			
19	**2025**	**Forecast**	**253,271**			
20		Escalation	7,344		Escalation added to the forecast year	WP 6-17, Line No. 6
21		**Net Change**	**7,344**			
22	**2026**	**Forecast**	**260,615**			

Workpaper Table 6-15
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 6, Electric Emergency Recovery
Capital Walk by Major Work Category
MWC 95 - Major Emergency Capital
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**46,303**			
2		All programs	222,658		The increase in cost is primarily attributable to bad weather conditions during Jan-Feb; which required increased work to restore customers' power. This in turn led to higher contracting costs and material related costs.	WP 6-18, Line No. 1
3		CEMA Adjustment	(206,257)		The recorded expenditures for 2016 to 2017 have been adjusted to remove Catastrophic Event Memorandum Account (CEMA) qualifying costs.	WP 6-18, Line No. 2
4		**Net Change**	**16,401**			
5	**2017**	**Recorded Adjusted**	**62,705**			
6		All programs	30,805		The increase in cost is primarily attributed to the 2017 wildfire activites continued into 2018 (e.g. wildfire rebuild), partially offset by the favorable weather conditions, when compared to the previous year.	WP 6-18, Line No. 1
7		CEMA Adjustment	(60,432)		The recorded expenditures for 2017 to 2018 have been adjusted to remove CEMA qualifying costs.	WP 6-18, Line No. 2
8		**Net Change**	**(29,626)**			
9	**2018**	**Recorded Adjusted**	**33,078**			
10		All programs	(71,256)		The decrease in capital costs is primarily driven by wildfire contract cost adjustments, partially offset by the higher spend due to unfavorable weather.	WP 6-18, Line No. 1
11		CEMA Adjustment	111,113		The recorded expenditures for 2018 to 2019 have been adjusted to remove CEMA qualifying costs.	WP 6-18, Line No. 2
12		**Net Change**	**39,857**			
13	**2019**	**Recorded Adjusted**	**72,935**			
14		All programs	10,249		The increase in costs is primarily attributable to unprecedented wildfire events due to high wind and dry conditions, as compared to the previous year, that required more resources to restore customers' power.	WP 6-18, Line No. 1
15		CEMA Adjustment	(18,931)		The recorded expenditures for 2019 to 2020 have been adjusted to remove CEMA qualifying costs.	WP 6-18, Line No. 2
16		**Net Change**	**(8,682)**			
17	**2020**	**Recorded Adjusted**	**64,253**			

Workpaper Table 6-16
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 6, Electric Emergency Recovery
Capital Walk by Major Work Category
MWC 95 - Major Emergency Capital
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**64,253**			
2		All Programs	(3,443)		The 2021 forecast was based on a 5-year average of recorded costs (2015-2019), after removing CEMA charges, and further adjusting for escalation and aligning to authorized targets.	WP 6-18, Line No. 9
3		**Net Change**	**(3,443)**			
4	**2021**	**Forecast**	**60,810**			
5		All Programs	1,260		The 2022 forecast is based on 5-year average of recorded costs (2016-2010), after removing CEMA charges and adjusted for escalation. The five-year average cost forecasting methodology resulted in smaller than inflation increase from the 2021 forecast due to different averaging basis.	WP 6-18, Line No. 9
6		**Net Change**	**1,260**			
7	**2022**	**Forecast**	**62,069**			
8		All Programs	1,552		The 2023 forecast is based on 5-year average of recorded costs (2016-2010), after removing CEMA charges and adjusted for escalation. The increase is due to escalation.	WP 6-18, Line No. 9
9		**Net Change**	**1,552**			
10	**2023**	**Forecast**	**63,621**			
11		All Programs	1,848		The increase from 2023 to 2024 is due to escalation.	WP 6-18, Line No. 9
12		**Net Change**	**1,848**			
13	**2024**	**Forecast**	**65,470**			
14		All Programs	1,898		The increase from 2024 to 2025 is due to escalation.	WP 6-18, Line No. 9
15		**Net Change**	**1,898**			
16	**2025**	**Forecast**	**67,367**			
17		All Programs	1,953		The increase from 2025 to 2026 is due to escalation.	WP 6-18, Line No. 9
18		**Net Change**	**1,953**			
19	**2026**	**Forecast**	**69,321**			

Workpaper Table 6-17
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 6, Electric Emergency Recovery
MWC 17 - Routine Emergency Forecast Details
(Thousands of Nominal Dollars)

Line No.		Recorded 2016	Recorded 2017	Recorded 2018	Recorded 2019	Recorded 2020	Forecast 2021	Forecast 2022	Forecast 2023	Forecast 2024	Forecast 2025	Forecast 2026	Assumptions	Reference
1	Routine Emergency Capital - Recorded Adjusted	171,406	183,903	187,744	212,620	247,499								
2	Adjustment of Recorded to Base Year	21,513	17,053	11,434	6,379								(1)	
3	**Averaging Basis**			199,178	218,999	247,499								Line 1 + Line 2
4	2021 Forecast Base						221,892						(2)	
5	Three Year Recorded Average (2018-2020, in 2020 Dollars)							221,892	221,892	221,892	221,892	221,892	(3)	Average of Line 3
6	Escalation to 2022-2023 Dollars						5,991	11,462	17,296	24,245	31,379	38,724	(4)	Chapter 2
7	Forecasting Adjustment						(34,639)						(5)	Chapter 2
8	**Final Recorded and Forecast**	**171,406**	**183,903**	**187,744**	**212,620**	**247,499**	**193,244**	**233,354**	**239,188**	**246,137**	**253,271**	**260,615**		

Forecast Assumptions and Details

(1) In order to accurately reflect the expenditures required on a forecast basis, the recorded dollars for averaging purposes have been adjusted to 2020 base year dollars.

(2) The 2021 Forecast was based on a 3-year recorded average (2018-2020).

(3) A 3-year average of recorded costs (2018-2020) was used to forecast expenditures associated with Routine Emergency work. The 3-year average of recorded expenditures methodology for Routine Emergencies takes into account all of the varying factors that have been experienced in the past three years.

(4) The forecast basis for 2021-2026 uses a 3-year recorded average (2018-2020) plus escalation.

(5) Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast.

Workpaper Table 6-18
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 6, Electric Emergency Recovery
MWC 95 - Major Emergency Forecast Details (MEBA Only)
(Thousands of Nominal Dollars)

Line No.	MWC Description	Recorded Adjusted 2016	Recorded Adjusted 2017	Recorded Adjusted 2018	Recorded Adjusted 2019	Recorded Adjusted 2020	Forecast 2021	Forecast 2022	Forecast 2023	Forecast 2024	Forecast 2025	Forecast 2026	Assumptions	Reference
1	MEBA and CEMA Emergency Expense - Recorded Adjusted	55,964	278,622	309,428	238,172	248,421								
2	CEMA Cost Removal	(9,661)	(215,918)	(276,350)	(165,237)	(184,168)							(1)	
3	**Recorded Adjusted**	46,303	62,705	33,078	72,935	64,253								Line 1 + Line 2
4	Adjust to 2020 Dollars	5,811	5,814	2,014	2,188	-							(2)	
5	**Averaging Basis: 2022-2026**	52,115	68,519	35,093	75,123	64,253								Line 3 + Line 4 + Line 5
6	2021 Forecast						67,149						(3)	
7	Five Year Recorded Average (2016-2020) - Adjusted, all OH included (in 2020 Dollars)							59,021	59,021	59,021	59,021	59,021	(4)	Average of Line 4
8	Forecast Escalation and Other Adjustment						(6,339)	3,049	4,601	6,449	8,347	10,300	(5),(6)	Chapter 2
9	**Final Recorded Adjusted and Forecast**	**46,303**	**62,705**	**33,078**	**72,935**	**64,253**	**60,810**	**62,069**	**63,621**	**65,470**	**67,367**	**69,321**		

Forecast Assumptions and Details

(1) The recorded expenditures have been adjusted to remove all Catastrophic Event Memorandum Account (CEMA) qualifying costs, including CEMA straight-time labor cost.

(2) In order to accurately reflect the expenditures required on a forecast basis, the recorded dollars for averaging purposes have been adjusted to 2020 base year dollars.

(3) The 2021 Forecast was based on an analysis completed in June 2020, using 5-year average of 2016-2019 recorded, and 2020 forecast.

(4) A 5-year average of recorded adjusted costs (2016-2020) was used to forecast expenditures associated with major emergency work. A 5-year average of recorded expenditures is an appropriate indicator of future spend for Major Emergencies because the number and severity of major emergencies is unpredictable from year to year.

(5) 2021 - Internal Adjustment

(6) Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to 2021 to ensure the total forecasts did not exceed the POR forecast. 2022-2026 forecasts are escalated. Refer to Exhibit (PG&E-4), Chapter 2 for details on escalation calculation.

Operations Emergency Center (OEC) Activation Requirements

SUMMARY

This utility standard defines PG&E's Operations Emergency Center (OEC) activation criteria, as well as the key roles and responsibilities for proactively managing customer restoration and communication, accelerating PG&E's response time to emergency events, and reducing subjectivity in the decision-making process.

Required criteria include, but are not limited to:

- Pre-staging resources.
- Managing estimated times of arrival (ETAs) and estimated times of restoration (ETORs).
- Assessing and repairing dispatch functions.

TARGET AUDIENCE

This standard applies to all electric distribution employees responsible for emergency response and activation of electric emergency centers.

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REQUIREMENTS

1 OEC Activation

OEC activation may occur under any of the following criteria. (Costs associated with OEC Criteria 1.1.1–1.1.3 below may be charged to the Major Emergency Balancing Account [MEBA][1]. See Attachment 1 for a summary of major emergency and pre-event criteria.)

1.1 A major emergency event where:

1. A division exceeds the total number of outages (transformer and above[2]) noted in Table 1 on Page 2; and

[1] Charging to MEBA requires that OEC activation occur at some point in response to the event, but not all OEC activations will result in charges to MEBA.
[2] Transformer or higher device level.

Operations Emergency Center (OEC) Activation Requirements

1.1 (continued)

2. The outages are stable[3] and the majority of outages are unassigned; and

3. A PG&E OEC is activated.

Table 1. OEC Outage Triggers

DIVISION	Real Time Outage Management Tool (OMT) Outage Trigger[4] (Transformer and Above)
CENTRAL COAST	9
DE ANZA	5
DIABLO	5
EAST BAY	5
FRESNO	8
KERN	5
LOS PADRES	6
MISSION	5
NORTH BAY	5
HUMBOLDT	7
SONOMA	5
NORTH VALLEY	8
PENINSULA	5
SACRAMENTO	6
SAN FRANCISCO	5
SAN JOSE	5
SIERRA	9
STOCKTON	6
YOSEMITE	8

1.2 A pre-event where:

1. A PG&E division's Distribution System Operations (DSO) Storm Outage Prediction Project (SOPP) forecast is at **Category 2** or above, and PG&E predicts that the event will ultimately meet the requirements of Criteria 1.1, above.[5]

2. A wildfire event that does not meet the criteria outlined in 1.1 above and where;

[3] Stable: Indicates outages that continue for approximately 30 minutes.
[4] Trigger numbers are derived by taking the 4-hour period outage average and increasing that number by 50%.
[5] For costs to be eligible for MEBA, the requirements of Criteria 1.1 must be ultimately met in response to the event. If the requirements of Criteria 1.1 are **not** ultimately met, the costs previously charged to MEBA must be removed from MEBA and reclassified as a Routine Emergency.

Operations Emergency Center (OEC) Activation Requirements

1.2 (continued)

a. PG&E de-energizes electric distribution facilities to mitigate public safety risk and/or first responder risk, including at the request of responding agencies, such as CAL-FIRE, U.S. Forest Service, and/or City or County government; and

b. PG&E mobilizes resources from outside the affected district to address the wildfire event.

1.3 An electric director directs an OEC activation.

1.4 Electric leadership below the director level requests an OEC activation.

2 Process

2.1 Once OEC activation criteria are met, electric dispatch personnel must contact the electric superintendent or delegate to request that Auto-ETOR be turned off and the OEC be activated.

2.2 The electric superintendent must notify all stakeholders on the Activation Check List via email/epage that the OEC has been activated and begin developing intelligence summaries and conducting conference call briefings.

3 High-Level Roles and Responsibilities

3.1 Emergency Operations Center (EOC) On-Call/Commander

1. Monitors outage activity for the system.

2. Interacts with respective superintendent/director(s).

3. May direct activation of OECs, based on the criteria outlined in Section 1, “OEC Activation,” starting on Page 1.

3.2 Restoration and Compliance Operations and and System Operations and Control Leadership

1. Ensure that electric dispatchers dispatch all immediate response (IR) tags within 10 minutes.

2. Ensure that electric dispatchers contact troublemen, if a tag is not acknowledged or an ETA is not entered within 4 hours of dispatch.

3. Ensure that staffing at the Control Center and Electric Dispatch is adequate to support escalated outage activity.

3.3 Electric Dispatch Personnel

1. Monitor and manage electric trouble tags for all troublemen.

Operations Emergency Center (OEC) Activation Requirements

3.3 (continued)

2. Monitor and manage all outages requiring 911 standby handling, and maintain a list of 911 standby resources.

3. Communicate to the OEC incident commander (IC), if there is a need to transfer any portion of dispatch to an OEC. If so, the restoration supervisor and/or the IC must communicate to all stakeholders that a transfer will be made.

4. Escalate to the OEC assessment lead, if field resources are not available to respond to outages in a timely manner. (A trigger point is when multiple tags are assigned to the same resource.)

3.4 Distribution Operators

1. Monitor and manage the assessment and restoration process during routine emergencies, and support the restoration and minimization of customer impact, via field switching.

2. Interact with the night/on-call supervisor to obtain necessary crew resources.

3. Escalate to the supervisor, if field resources are not available to respond to outages in a timely manner.

4. Interact with OECs to transfer outage communication, assessment, and restoration responsibilities.

3.5 Maintenance and Construction (M&C) Leadership

1. Monitor outage activity for the assigned area of coverage, and oversee field assessment and restoration activities.

2. Interact with the on-call/night supervisor, control center supervisor, and electric dispatch personnel to gain increased understanding of the outage situation.

3. Activate the OEC in the Outage Management Tool (OMT).

4. Designate staff to support customer outage communications.

5. Staff emergency roles to develop and execute a restoration strategy and to manage stakeholder communications and logistics.

6. Designate staff (as needed) to support the transition of dispatch work back to OEC dispatch personnel.

7. Direct district storm rooms to manage outage communications in OMT, and check the in/out process.

Operations Emergency Center (OEC) Activation Requirements

3.6 District Storm Rooms Personnel

1. Maintain check in/out support 24 hours a day/7 days a week (24/7) throughout the event, and document real time resource staffing.

2. Maintain accurate documentation of all work locations and work statuses, using the work location log and work packets.

3.7 Emergency Recovery Program Management

1. Validate the orders created to ensure that activations meet naming conventions.

2. Review all OEC activations to validate that triggers have been met.

3. Provide financial management guidance and oversight to the finance section chief during OEC activations.

4. Validate that costs recorded qualify for MEBA, in accordance with program accounting criteria through periodic cost reviews.

4 Implementing OEC "Alert/Communications Only" Activations

4.1 Only implement OEC "Alert/Communications Only" activations in the following cases, each of which is considered a routine emergency as opposed to a major emergency:

1. Pre-staging of resources based on EOC direction.

2. Resource support for other impacted OECs.

3. Significant media impacts.

4. Large non-incident major events (e. g., conventions).

5. Outages involving potentially significant environmental impact(s).

6. Emergencies requiring additional support, but not meeting MEBA criteria.

END of Requirements

Operations Emergency Center (OEC) Activation Requirements

DEFINITIONS

District storm room (DSR): Responds to local and escalated emergency events and is generally located in a service planning and maintenance yard. Manages local restoration efforts during all levels of emergencies.

Distribution System Operations Storm Outage Prediction Program (DSO SOPP): Developed to link adverse weather conditions to outage and resource needs. The DSO SOPP model combines historical weather and outage data with weather forecasts to predict the number of transformer levels and above sustained outages (SOs), per division, for each of the next 4 days. Provides an estimate of the resources needed to respond to the level of predicted outages. The primary adverse weather threats modeled are: wind, rain, low snow, and heat. The forecasted threats are assigned Category Level 1, 2, 3, 4, or 5, based on how the predicted level of storm outages (SOs) compares with the long-term historical level of SOs for each division or area.

Emergency Operations Center (EOC): Pre-designated facility established by an agency or jurisdiction to coordinate overall agency or jurisdictional response and support to an emergency.

Emergency Recovery Program: Organization responsible for emergency financial activities, including analysis, forecasting, and cost validation.

Estimated time of arrival (ETA): Projected time it will take for a resource to arrive.

Estimated time of restoration (ETOR): Projected time it will take for service to be restored to customers.

Incident levels: Support PG&E in understanding the complexity of incidents and the actions that may be employed at each level (e.g., emergency center activations, resources, etc.).

To ensure consistent and well-coordinated responses to emergencies, PG&E has adopted the following incident classification system:

- Level 1 – Routine
- Level 2 – Elevated
- Level 3 – Serious
- Level 4 – Severe
- Level 5 – Catastrophic

Operations Emergency Center (OEC) Activation Requirements

DEFINITIONS (continued)

Major emergency: Electric distribution facilities that are an imminent hazard or have caused an outage during a Level 2-5 emergency. Repair/replace costs for by these facilities are recorded as Major Work Categories IF and 95.

Major Emergency Balancing Account (MEBA): A two-way balancing account mechanism to recover costs for responding to major emergencies and catastrophic events where expenditures cannot be recovered through the Catastrophic Event Memorandum Account (CEMA) mechanism, because a required declaration is absent.

Operations Emergency Center (OEC): Provides oversight and support at a divisional level. Directs and coordinates the personnel necessary to assess damages, secure hazardous situations, restore service, and communicate status information internally and externally. OECs report to their region's Region Emergency Center (REC).

Outage Management Tool (OMT): A web-based application used by the emergency management organization to gather and report information on customer outages, damage assessments, service restoration, and crew movements during emergency events that affect the PG&E system.

Routine emergency: An emergency that requires repairing or replacing electric distribution facilities that are an imminent hazard or have caused an outage during a Level 1 emergency. These costs are recorded in Major Work Categories BH and 17.

IMPLEMENTATION RESPONSIBILITIES

Area electric directors are responsible for communicating and implementing this standard.

GOVERNING DOCUMENT

NA

COMPLIANCE REQUIREMENT / REGULATORY COMMITMENT

NA

REFERENCE DOCUMENTS

Developmental References:

NA

Supplemental References:

NA

Operations Emergency Center (OEC) Activation Requirements

APPENDICES

NA

ATTACHMENTS

Attachment 1, “Major Emergency Balancing Account (MEBA) Criteria”

DOCUMENT RECISION

NA

DOCUMENT APPROVER

Jason Regan, Director, Emergency Management and Performance

DOCUMENT OWNER

Angie Gibson, Manager, Emergency Management and Public Safety

DOCUMENT CONTACT

Angie Gibson, Manager, Emergency Management and Public Safety

REVISION NOTES

Where?	What Changed?
NA	This is a new utility standard.

Workpaper Table 6-19
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 6, Electric Emergency Recovery
Summary - Total Expense and Capital Expenditures
(Thousands of Nominal Dollars)

Line No.	Description	Recorded Adjusted 2016	Recorded Adjusted 2017	Recorded Adjusted 2018	Recorded Adjusted 2019	Recorded Adjusted 2020	Forecast 2021	Forecast 2022	Forecast 2023	Reference
1	**Expense**									
2	MWC BH - Routine Emergency	60,812	57,422	59,196	71,327	67,075	59,274	59,361	73,678	WP 6-7 Line 7
3	MWC IF- Major Emergency (MEBA)	44,184	52,362	28,836	117,555	30,973	41,465	41,501	42,708	WP 6-8 Line 10
4	MWC IF-CEMA Straight Time						18,737	19,397	20,079	WP 6-28 Line 8
5	**Total Expense**	**104,996**	**109,784**	**88,032**	**188,882**	**98,049**	**119,477**	**120,259**	**136,466**	

Line No.	Description	Recorded Adjusted 2016	Recorded Adjusted 2017	Recorded Adjusted 2018	Recorded Adjusted 2019	Recorded Adjusted 2020	Forecast 2021	Forecast 2022	Forecast 2023	Forecast 2024	Forecast 2025	Forecast 2026	Reference
	Capital												
6	MWC 17 - Routine Emergency	171,406	183,903	187,744	212,620	247,499	193,244	233,354	239,188	246,137	253,271	260,615	WP 6-17 Line 8
7	MWC 95 - Major Emergency (MEBA)	46,303	62,705	33,078	72,935	64,253	60,810	62,069	63,621	65,470	67,367	69,321	WP 6-18 Line 9
8	MWC 95 - CEMA Straight Time						15,541	15,945	16,375	16,817	17,271	17,738	WP 6-28 Line 2
9	**Total Capital**	**217,709**	**246,608**	**220,822**	**285,555**	**311,752**	**269,594**	**311,368**	**319,184**	**328,424**	**337,910**	**347,674**	

Workpaper Table 6-20
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 6, Electric Emergency Recovery
CEMA Straight-time Forecast Details
(Thousands of Nominal Dollars)

Line No.				Recorded	Recorded	Recorded	Recorded	Recorded	Base Year	Base Year	3 Year Avg (Base Year)	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast
1	**Organization**	**Capital/Expense**	**MWC**	**2016**	**2017**	**2018**	**2019**	**2020**	**2018**	**2019**	**2018-2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
2	Electric Operations	Capital	95	$911	$13,878	$14,700	$13,338	$15,508	$16,065	$13,779	$15,117	$15,541	$15,945	$16,375	$16,817	$17,271	$17,738
3	Gas Operations	Capital	3Q	$0	$555	$1,756	$2,575	$1,516	$1,845	$2,624	$1,995	$2,017	$2,051	$2,098	$2,151	$2,200	$2,251
4	Gas Operations	Capital	50	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
5	Generation	Capital	3Q	$0	$0	$0	$326	$8	$0	$333	$114	$116	$119	$121	$124	$127	$129
6			**Capital Total**	**$ 911**	**$ 14,433**	**$ 16,455**	**$ 16,240**	**$ 17,032**	**$ 17,910**	**$ 16,736**	**$ 17,226**	**$ 17,674**	**$ 18,114**	**$ 18,595**	**$ 19,092**	**$ 19,598**	**$ 20,118**
7	Customer Care	Expense	IG	$0	$0	$0	$345	$38	$0	$356	$131	$135	$140	$144			
8	Electric Operations	Expense	IF	$2,648	$16,253	$10,539	$15,272	$27,268	$11,228	$15,758	$18,085	$18,737	$19,397	$20,079			
9	Gas Operations	Expense	LX	$0	$1,845	$2,248	$4,751	$523	$2,395	$4,903	$2,607	$2,685	$2,780	$2,878			
10	Generation	Expense	LX	$0	$0	$0	$193	$30	$0	$199	$76	$78	$81	$84			
11			**Expense Total**	**$ 2,648**	**$ 18,098**	**$ 12,787**	**$ 20,561**	**$ 27,859**	**$ 13,623**	**$ 21,215**	**$ 20,899**	**$ 21,636**	**$ 22,398**	**$ 23,186**	**N/A**	**N/A**	**N/A**
12																	
13			**Grand Total**	**$ 3,558**	**$ 32,531**	**$ 29,242**	**$ 36,801**	**$ 44,891**	**$ 31,534**	**$ 37,951**	**$ 38,125**	**$ 39,310**	**$ 40,513**	**$ 41,780**	**$ 19,092**	**$ 19,598**	**$ 20,118**

Forecast Assumptions and Details

(1) In order to accurately reflect the expenditures required on a forecast basis, the recorded dollars for averaging purposes have been adjusted to 2020 base year dollars. Recorded 2018 and 2019 are escalated to Base Year 2020 using the base year escalation factors listed below.

(2) The forecast is based on a 3-year average of base year dollars (2018-2020)

(3) The 3-year average of base year dollars is then escalated based on the escalation factors listed below.

Organization	**Capital/Expense**	**MWC**	**Base Year Factor 2018**	**Base Year Factor 2019**	**Escalation 2021**	**Escalation 2022**	**Escalation 2023**	**Escalation 2024**	**Escalation 2025**	**Escalation 2026**
Electric Operations	Capital	95	109.29%	103.30%	102.80%	102.60%	102.70%	102.70%	102.70%	102.70%
Gas Operations	Capital	3Q	105.06%	101.90%	101.10%	101.70%	102.30%	102.50%	102.30%	102.30%
Gas Operations	Capital	50	105.06%	101.90%	101.10%	101.70%	102.30%	102.50%	102.30%	102.30%
Generation	Capital	3Q	106.80%	102.10%	102.20%	102.10%	102.20%	102.20%	102.20%	102.20%
Customer Care	Expense	IG	106.54%	103.18%	103.06%	103.28%	103.28%	0.00%	0.00%	0.00%
Electric Operations	Expense	IF	106.54%	103.18%	103.02%	103.52%	103.52%	0.00%	0.00%	0.00%
Gas Operations	Expense	LX	106.54%	103.18%	103.02%	103.52%	103.52%	0.00%	0.00%	0.00%
Generation	Expense	LX	106.54%	103.18%	103.02%	103.52%	103.52%	0.00%	0.00%	0.00%

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
EXHIBIT (PG&E-4) ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING
CHAPTER 7, DISTRIBUTION SYSTEM OPERATIONS

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PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
EXHIBIT (PG&E-4) ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING
CHAPTER 7, DISTRIBUTION SYSTEM OPERATIONS

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Table 7-1
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 7
Distribution System Operations
Expenses by Major Work Category
(Thousands of Nominal Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	Reference (A)
1	BA	E Dist Operate System	21,038	15,676	17,450	22,597	30,017	23,055	23,089	29,478	WP 7-3, WP 7-4
2	DD	Provide Field Service	20,377	18,764	19,328	19,658	23,204	18,620	18,685	23,776	WP 7-5, WP 7-6
3	HG	Elec Trans Ops Engr & Tech	338	319	1,355	859	2,074	4,385	7,638	5,392	WP 7-7, WP 7-8
4	JV	Maintain IT Apps & Infra	553	786	(766)						
5	**Total**		**42,306**	**35,545**	**37,366**	**43,114**	**55,294**	**46,061**	**49,412**	**58,646**	

Table 7-2
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 7
Distribution System Operations
Expenses by Major Work Category
(Thousands of Base Year Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast
1	BA	E Dist Operate System	23,759	17,232	18,575	23,177	30,017	22,441	21,732	26,826
2	DD	Provide Field Service	23,069	20,605	20,548	20,248	23,204	18,087	17,538	21,562
3	HG	Elec Trans Ops Engr & Tech	380	339	1,379	851	2,074	4,390	7,472	5,148
4	JV	Maintain IT Apps & Infra	594	828	(764)					
5	**Total**		**47,801**	**39,004**	**39,738**	**44,276**	**55,294**	**44,917**	**46,742**	**53,536**

Workpaper Table 7-3
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 7, Distribution System Operations
Expenses by Major Work Category BA - Recorded Walk
MWC BA - Electric Distribution Operation Activities
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$21,038**			
2		Distribution Operators	($5,123)		Reduction is primarily related to the completion of the DCC Consolidation Project that resulted in reduction of operators and apprentices and related attrition prior to the initiation of additional hiring to train new apprentices.	WP 7-9 Line 2
3		Power Quality (PQ) and Distribution Operations Engineers	($239)		Reduction in engineers to meet operational requirements.	WP 7-9 Line 5
4		**Net Change**	**($5,362)**			
5	**2017**	**Recorded Adjusted**	**$15,676**			
6		Distribution Operators	$1,874		Increase in cost is primarily driven by apprentices completing apprenticeship and taking on operator jobs.	WP 7-9 Line 2
7		Power Quality (PQ) and Distribution Operations Engineers	($100)		Minor change in engineering charges.	WP 7-9 Line 5
8		**Net Change**	**$1,774**			
9	**2018**	**Recorded Adjusted**	**$17,450**			
10		Distribution Operators	$4,640		Increase in cost is primarily due to overtime charges to meet operational needs and wage increases with union costs.	WP 7-9 Line 2
11		Power Quality (PQ) and Distribution Operations Engineers	$508		Additional cost is due to increase in engineering headcount and work related to grid operations	WP 7-9 Line 5
12		**Net Change**	**$5,147**			
13	**2019**	**Recorded Adjusted**	**$22,597**			
14		Distribution Operators	$6,942		Additional cost is due to increase in overtime to meet operational needs, higher labor rates, additional apprentices, and indirect costs related to implementing covid related measures (3 temporary sites and 1 sequestration center).	WP 7-9 Line 2
15		Power Quality (PQ) and Distribution Operations Engineers	$478		Additional cost is due to increase in engineers headcount and work related to grid operations	WP 7-9 Line 5
16		**Net Change**	**$7,420**			
17	**2020**	**Recorded Adjusted**	**$30,017**			

Workpaper Table 7-4
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 7, Distribution System Operations
Expenses by Major Work Category BA - Forecast Walk
MWC BA - Electric Distribution Operation Activities
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$30,017**			
2		Distribution Operators	($3,471)		The decreased 2021 forecast reflects the higher 2020 operating costs during Covid, not expected to continue through 2021.	WP 7-9 Line 2
3		Power Quality (PQ) and Distribution Operations Engineers	($928)		The decreased 2021 forecast reflects the higher 2020 operating costs during Covid, not expected to continue through 2021.	WP 7-9 Line 5
4		Forecast Adjustment	($2,562)		Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast.	WP 7-9 Line 8
5		**Net Change**	**($6,961)**			
6	**2021**	**Forecast**	**$23,055**			
7		Distribution Operators	$34		2022 forecast was calculated by using 2021 forecast with escalation. Underestimated the operating cost.	WP 7-9 Line 2
8		Power Quality (PQ) and Distribution Operations Engineers	$4		2022 forecast was calculated by using 2021 forecast with escalation. Underestimated the operating cost.	WP 7-9 Line 5
9		Forecast Adjustment	($4)		Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast.	WP 7-9 Line 8
10		**Net Change**	**$34**			
11	**2022**	**Forecast**	**$23,089**			
12		Distribution Operators	$2,599		2023 forecast is based on anticipated charging of operators and apprentices completing apprenticeship and reduction of overtime.	WP 7-9 Line 2
13		Power Quality (PQ) and Distribution Operations Engineers	$1,224		Based on historical costs and charging percentage.	WP 7-9 Line 5
14		Forecast Adjustment	$2,565		No forecast adjustment for 2023	WP 7-9 Line 8
15		**Net Change**	**$3,824**			
16	**2023**	**Forecast**	**$29,478**			

Workpaper Table 7-5
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 7, Distribution System Operations
Expenses by Major Work Category DD - Recorded Walk
MWC DD - Field Service
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$20,377**			
2		Outages on Customer Equipment (MAT DDH)	($513)		Reduction in cost due to fewer hours charged with slight increase in units completed.	WP 7-10 Line 1
3		Swing Service, Disconnects/Reconnects (MAT DDJ)	($1,121)		Reduction in cost due to fewer hours charged with slight increase in units completed.	WP 7-10 Line 2
4		Schedule and Dispatch (MAT DD#)	$21		No significant change	WP 7-10 Line 3
5		**Net Change**	**($1,612)**			
6	**2017**	**Recorded Adjusted**	**$18,764**			
7		Outages on Customer Equipment (MAT DDH)	$85		No significant change	WP 7-10 Line 1
8		Swing Service, Disconnects/Reconnects (MAT DDJ)	$1,051		More units completed with more hours charged.	WP 7-10 Line 2
9		Schedule and Dispatch (MAT DD#)	($572)		2017 cost includes one time charge of camera purchase for security purpose. Reduction in cost in 2018 is due to cost not incurred.	WP 7-10 Line 3
10		**Net Change**	**$563**			
11	**2018**	**Recorded Adjusted**	**$19,328**			
12		Outages on Customer Equipment (MAT DDH)	($141)		No significant change - Fewer hours charged offset by some rate increase	WP 7-10 Line 1
13		Swing Service, Disconnects/Reconnects (MAT DDJ)	($95)		No significant change - Fewer hours charged offset by some rate increase	WP 7-10 Line 2
14		Schedule and Dispatch (MAT DD#)	$567		Cost increase is primarily due to more double charged with double rate increase to meet operation needs.	WP 7-10 Line 3
15		**Net Change**	**$330**			
16	**2019**	**Recorded Adjusted**	**$19,658**			
17		Outages on Customer Equipment (MAT DDH)	$571		Cost increase is primarily due to rate increase.	WP 7-10 Line 1
18		Swing Service, Disconnects/Reconnects (MAT DDJ)	$1,908		Cost increase is primarily due to higher units completed and rate increase.	WP 7-10 Line 2
19		Schedule and Dispatch (MAT DD#)	$1,066		Cost increase is a result of staffing up an additional dispatch center to provide social distancing and business continuity due to Covid.	WP 7-10 Line 3
20		**Net Change**	**$3,546**			
21	**2020**	**Recorded Adjusted**	**$23,204**			

Workpaper Table 7-6
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 7, Distribution System Operations
Expenses by Major Work Category DD - Forecast Walk
MWC DD - Field Service
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$23,204**			
2		Outages on Customer Equipment (MAT DDH)	($170)		Forecast based on 3-year average (2017-2019) resulting in forecast lower than 2020 recorded cost.	WP 7-10 Line 1
3		Swing Service, Disconnects/Reconnects (MAT DDJ)	($1,246)		Forecast based on 3-year average (2017-2019) resulting in forecast lower than 2020 recorded cost.	WP 7-10 Line 2
4		Schedule and Dispatch (MAT DD#)	($3,167)		Forecast based on 3-year average (2017-2019) resulting in forecast lower than 2020 recorded cost. Forecast Adjustment of $2.08M is included in DD#.	WP 7-10 Lines 3-4
5		**Net Change**	**($4,584)**			
6	**2021**	**Forecast**	**$18,620**			
7		Outages on Customer Equipment (MAT DDH)	$20		Forecast based on 2021 with escalation	WP 7-10 Line 1
8		Swing Service, Disconnects/Reconnects (MAT DDJ)	$33		Forecast based on 2021 with escalation	WP 7-10 Line 2
9		Schedule and Dispatch (MAT DD#)	$13		Forecast based on 2021 with escalation. Forecast Adjustment of $2.08M is included in DD#.	WP 7-10 Lines 3-4
10		**Net Change**	**$66**			
11	**2022**	**Forecast**	**$18,685**			
12		Outages on Customer Equipment (MAT DDH)	$487		Forecast based on 3-year average (2018-2020) with escalation	WP 7-10 Line 1
13		Swing Service, Disconnects/Reconnects (MAT DDJ)	$1,635		Forecast based on 3-year average (2018-2020) with escalation plus additional forecasted costs included in DDJ.	WP 7-10 Line 2
14		Schedule and Dispatch (MAT DD#)	$2,969		Forecast based on 3-year average (2018-2020) with escalation. Forecast adjustment is not included.	WP 7-10 Lines 3-4
15		**Net Change**	**$5,091**			
16	**2023**	**Forecast**	**$23,776**			

Workpaper Table 7-7
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 7, Distribution System Operations
Expenses by Major Work Category HG - Recorded Walk
MWC HG - Operations Technology
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$338**			
2		FLISR/Cornerstone Maintenance	($19)		No significant change.	WP 7-11, Line No. 5
3		**Net Change**	**($19)**			
4	**2017**	**Recorded Adjusted**	**$319**			
5		Automation and Protection Wildfire Risk Mitigation	$313		Startup of SCADA programming as part of Reclosing Blocking wildfire mitigation. Labor for contractor related to starting up of the program.	WP 7-11, Line No. 2
6		Distribution Management System (DMS) Upgrades	$568		Startup of support for DMS system upgrades to improve current application environment and stability. Prior to the completion of the Distribution Control Center Consolidation (DCCC) project in 2017 these costs were charged to IT (MWC JV).	WP 7-11, Line No. 3
7		SCADA Upgrades and Contract Support	$252		SCADA and DCC applications upgrade and license costs. Prior to the completion of the DCCC project in 2017 these costs were charged to IT (MWC JV).	WP 7-11, Line No. 4
8		FLISR/Cornerstone Maintenance	($98)		Internal employees no longer charging for support in FLISR.	WP 7-11, Line No. 5
9		**Net Change**	**$1,036**			
10	**2018**	**Recorded Adjusted**	**$1,355**			
11		Automation and Protection Wildfire Risk Mitigation	($296)		SCADA programming cost changes as Recloser Blocking wildfire mitigation work stabilizes. Project changed from installation to operational mode. The cost represent on-going maintenance of the system.	WP 7-11, Line No. 2
12		Distribution Management System (DMS) Upgrades	($323)		DMS work postponed due to PSPS events but still deployed a patch upgrade in 2019.	WP 7-11, Line No. 3
13		SCADA Upgrades and Contract Support	$149		Contractors to help test upgrade and PSPS program.	WP 7-11, Line No. 4
14		FLISR/Cornerstone Maintenance	($26)		No significant change.	WP 7-11, Line No. 5
15		**Net Change**	**($496)**			
16	**2019**	**Recorded Adjusted**	**$859**			
17		Automation and Protection Wildfire Risk Mitigation	($17)		No emergency cost recorded.	WP 7-11, Line No. 2
18		Distribution Management System (DMS) Upgrades	($46)		Contractor support for technical writing. Application support including upgrade for ILIS system, EDPI and control center upgrades (VOIP, ROIP, Turrets and Radios).	WP 7-11, Line No. 3
19		SCADA Upgrades and Contract Support	$878		SCADA Consolidation (MWC HX) and increased contractors support for PSPS and ADMS.	WP 7-11, Line No. 4
20		FLISR/Cornerstone Maintenance	$82		Increased use of contractors to support the increased number of new FLISR circuits and field devices programmed and released to distribution control center.	WP 7-11, Line No. 5
21		Operational Business Intelligence (OBI)	$319		Operational Business Intelligence (OBI) team was created to ensure safe, reliable and efficient utility operations through the improvement of existing business processes with the use of innovative business intelligence (i.e., Improve Distribution Operations processes to minimize customer outage and mitigate wildfire risk.). Expense primarily included internal labor and vendor support cost.	WP 7-11, Line No. 6
22		**Net Change**	**$1,215**			
23	**2020**	**Recorded Adjusted**	**$2,074**			

Workpaper Table 7-8
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 7, Distribution System Operations
Expenses by Major Work Category HG - Forecast Walk
MWC HG - Operations Technology
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$2,074**			
2		Automation and Protection Wildfire Risk Mitigation	$100		Additional forecast cost for potential PSPS emergency device replacement support.	WP 7-11, Line No. 2
3		Distribution Management System (DMS) Upgrades	$688		ILIS Upgrades, contractor support for technical writing, and enhancement to control center work management system.	WP 7-11, Line No. 3
4		SCADA Upgrades and Contract Support	$2,471		Continue contractor support to assist with RT SCADA (ADMS participation by existing employees). Former D-SCADA group changed from non-billable to billable.	WP 7-11, Line No. 4
5		FLISR/Cornerstone Maintenance	($82)		Decrease due to reducing the use of contractors.	WP 7-11, Line No. 5
6		Operational Business Intelligence (OBI)	$551		Primary driver for increase is annual vendor maintenance contract taking effect in 2021	WP 7-11, Line No. 6
7		Critical Emergent Technology	$500		Forecast for Emergent Grid Technology modernization efforts	WP 7-11, Line No. 7
8		2021 Forecast Adjustment - HG	($1,916)		Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast.	WP 7-11, Line No. 8
9		**Net Change**	**$2,311**			
10	**2021**	**Forecast**	**$4,385**			
11		Automation and Protection Wildfire Risk Mitigation	$45		No significant change.	WP 7-11, Line No. 2
12		Distribution Management System (DMS) Upgrades	($113)		No significant change.	WP 7-11, Line No. 3
13		SCADA Upgrades and Contract Support	($40)		No significant change.	WP 7-11, Line No. 4
14		FLISR/Cornerstone Maintenance	$11		No significant change.	WP 7-11, Line No. 5
15		Operational Business Intelligence (OBI)	$181		Increase in forecast due to additional contractor support.	WP 7-11, Line No. 6
16		Critical Emergent Technology	$1,252		Forecast increase to respond to technical application development.	WP 7-11, Line No. 7
17		2021 Forecast Adjustment - HG	$1,916		No forecast adjustment in 2022	WP 7-11, Line No. 8
18		**Net Change**	**$3,252**			
19	**2022**	**Forecast**	**$7,638**			
20		Automation and Protection Wildfire Risk Mitigation	($14)		No significant change.	WP 7-11, Line No. 2
21		Distribution Management System (DMS) Upgrades	($773)		Work is still forecasted to be needed for this activity, however due to the authorized targets unidentified efficiencies are needed to offset these costs.	WP 7-11, Line No. 3
22		SCADA Upgrades and Contract Support	$382		Work is still forecasted to be needed for this activity, however due to the authorized targets unidentified efficiencies are needed to offset these costs.	WP 7-11, Line No. 4
23		FLISR/Cornerstone Maintenance	$6		No significant change.	WP 7-11, Line No. 5
24		Operational Business Intelligence (OBI)	($95)		No significant change.	WP 7-11, Line No. 6
25		Critical Emergent Technology	($1,752)		Work is still forecasted to be needed for this activity, however due to authorized targets unidentified efficiencies are needed to offset these costs.	WP 7-11, Line No. 7
26		**Net Change**	**($2,245)**			
27	**2023**	**Forecast**	**$5,392**			

Workpaper Table 7-9
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 7, Distribution System Operations
Expenses by Major Work Category BA - Forecast Details
(Thousands of Nominal Dollars)

Line No.	Description	Recorded 2016	Recorded 2017	Recorded 2018	Recorded 2019	Recorded 2020	Forecast 2021	Forecast 2022	Forecast 2023	Assumptions	Reference
1	**Distribution Operators (BAF)**										
2	Distribution Operators	$ 18,255	$ 13,132	$ 15,006	$ 19,646	$ 26,588	$ 23,117	$ 23,150	$ 25,749	(1)	
3	**Distribution Operators Total**	**$ 18,255**	**$ 13,132**	**$ 15,006**	**$ 19,646**	**$ 26,588**	**$ 23,117**	**$ 23,150**	**$ 25,749**		
4	**Engineers - (BAH)**										
5	Power Quality and Distribution Operations Engineers	$ 2,782	$ 2,543	$ 2,443	$ 2,951	$ 3,429	$ 2,500	$ 2,504	$ 3,728	(2)	
6	**Engineers Total**	**$ 2,782**	**$ 2,543**	**$ 2,443**	**$ 2,951**	**$ 3,429**	**$ 2,500**	**$ 2,504**	**$ 3,728**		
7	**Other Costs - (BA#)**										
8	Forecast Adjustment						$ (2,562)	$ (2,565)		(3)	Chapter 2 Section D
9	**Other Costs Total**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ (2,562)**	**$ (2,565)**	**$ -**		
10	**Total MWC BA**	**$ 21,038**	**$ 15,676**	**$ 17,450**	**$ 22,597**	**$ 30,017**	**$ 23,055**	**$ 23,089**	**$ 29,478**		

Forecast Assumptions and Details

(1) Distribution operators manage and control the electric distribution system. The forecast is based on an analysis of expected operator and apprentice headcount and their related anticipated charging for the operation of the electric system. Due to the high number of major weather and Public Safety Power Shutoff (PSPS) events in 2020, some Distribution Operations work was reprioritized so that the Operators and Technicians could assist with Major Emergency and PSPS response and restoration work, which was charged to MWC IF and AB. PG&E expects the weather to continue to be unpredictable and lead to more PSPS events due to high wind and dry weather. Primary driver of cost increase in 2020 is due to shortage of operators and the need to fill shifts to operate the grid. Some apprentices completed apprenticeship between Q4, 2020 and Q1, 2021. 2021 budget underestimated operator and engineers' cost due to using limited data (without covid impact) in modeling. Forecast in 2022 is an escalation of 2021 forecast. Forecast in 2023 is estimated using expected operator and apprentice headcount based on the training completion schedule and anticipated charging.

(2) Power Quality engineers provide support for customer voltage complaints. Distribution Operations Engineers assess and identify potential overloading and provide guidance to operators regarding load transfers and circuit reconfigurations. 2021 forecast is under-estimated due to modeling using limited data (as a result of covid/sequestration). 2022 forecast is an escalation of 2021 forecast. 2023 forecast is based on an analysis of expected headcount and the related anticipated charging for the support of operations of the electric system, which has remained relatively stable in the recorded years and is expected to continue in the forecast years.

(3) Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast.

Workpaper Table 7-10
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 7, Distribution System Operations
Expenses by Major Work Category DD - Forecast Details
(Thousands of Nominal Dollars)

Line No.	Description	Recorded 2016	Recorded 2017	Recorded 2018	Recorded 2019	Recorded 2020	Forecast 2021	Forecast 2022	Forecast 2023	Assumptions	Reference
1	**Outages on Customer Equipment (DDH)**	$ 5,740	$ 5,227	$ 5,312	$ 5,170	$ 5,741	$ 5,571	$ 5,590	$ 6,078	(1)	
2	**Swing Service, Disconnects/Reconnects (DDJ)**	$ 8,940	$ 7,820	$ 8,871	$ 8,776	$ 10,684	$ 9,438	$ 9,471	$ 11,106	(2)	
3	**Schedule and Dispatch (DD#)**	$ 5,696	$ 5,718	$ 5,145	$ 5,712	$ 6,778	$ 5,750	$ 6,074	$ 6,593	(3)	
4	**Forecast Adjustment**						$ (2,139)	$ (2,450)		(4)	Chapter 2 Section D
5	**Total MWC DD**	**$ 20,377**	**$ 18,764**	**$ 19,328**	**$ 19,658**	**$ 23,204**	**$ 18,620**	**$ 18,685**	**$ 23,776**		

Forecast Assumptions and Details

(1) Outages caused by Customer Equipment cost has remained relatively stable from 2016 through 2020. 2021 and 2022 forecast is based on 3-year average (2017-2020) with escalation. 2023 forecast is based on 3-year average (2018-2020) with escalation. Starting in 2019, DD is not unitized.

(2) Swing Service, Disconnects/Reconnects cost remained relatively stable from 2016 through 2019. 2020 recorded cost went up as 1,400 more units were completed compared to the 3-year average (2017-2019). The cost increase is also due to direct labor and overhead cost increases. 2023 forecast calculation factored in some DDJ costs erroneously recorded in another major work category. The increase due to this change is $0.5 million. This type of cost will be recorded in DD going forward.

(3) Anticipated charging of Schedule and Dispatch remained relatively stable from 2016 through 2019. Primary driver of increase in 2020 cost was staffing up another Dispatch Center for business continuity reasons and as a response to Covid. 2021 and 2022 forecasts are reduced due to recording affordability challenge for all DD programs in DD#.

(4) Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast.

Workpaper Table 7-11
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 7, Distribution System Operations
Expenses by Major Work Category HG - Forecast Details
(Thousands of Nominal Dollars)

Line No.	Description	Recorded 2016	Recorded 2017	Recorded 2018	Recorded 2019	Recorded 2020	Forecast 2021	Forecast 2022	Forecast 2023	Assumptions	Reference
1	**Distribution Operation Technology**										
2	Automation and Protection Wildfire Risk Mitigation			$ 313	$ 17		$ 100	$ 145	$ 131	(1)	
3	Distribution Management System (DMS) Upgrades			$ 568	$ 245	$ 199	$ 886	$ 773		(2)	
4	SCADA Upgrades and Contract Support			$ 252	$ 402	$ 1,279	$ 3,750	$ 3,710	$ 4,092	(3)	
5	FLISR/Cornerstone Maintenance	$ 338	$ 319	$ 221	$ 196	$ 277	$ 195	$ 206	$ 213	(4)	
6	Operational Business Intelligence (OBI)					$ 319	$ 870	$ 1,051	$ 957	(5)	
7	Critical Emergent Technology						$ 500	$ 1,752		(6), (7)	
8	Forecast Adjustment						$ (1,916)			(8)	Chapter 2 Section D
9	**MWC HG (MAT HGD) Total**	**$ 338**	**$ 319**	**$ 1,355**	**$ 859**	**$ 2,074**	**$ 4,385**	**$ 7,638**	**$ 5,392**		

Forecast Assumptions and Details

(1) This program includes ongoing SCADA programming support for the Recloser Blocking and Automation and Protection wildfire risk mitigations. The programming will enable operators to remotely disable reclosing on circuit breakers and reclosers in Tier 2 and Tier 3 of CPUC Fire Threat Map. The forecast is an estimate of emergency costs to provide on-going support for the wildfire risk mitigations. 2018 and 2019 represent the initial build out of the program; beginning in 2020 this activity is used to provide the potential emergency cost. In 2020, no costs were recorded for this activity as all support was charged directly to specific projects.

(2) With the completion of the DMS Upgrade effort, 2022 forecasted cost is to support on-going maintenance of DMS and associated applications which are utilized by Distribution Operators in the control centers to safely operate the grid. There is also forecasted cost in 2023 - see assumption 7 for details.

(3) SCADA Upgrades and contract support are costs for specialists to support the SCADA system including non-billable project time and SCADA contractor support. 2021 increase in cost represents inclusion of non-billable hours for SCADA specialists that were previously charged to general overheads and increase in contractor spend to support legacy SCADA systems while specialists are trained in new ADMS to prepare for upcoming conversion. In 2021 going forward we plan to retain existing contractors and add more to supplement on-going maintenance of both ADMS and RT SCADA systems until RT SCADA system is retired and the ADMS conversion is completed.

(4) On-going annual Eaton license fee for FLISR system.

(5) In 2020, the OBI team was created to support the build and deployment of business intelligence solutions that focused on improving existing business processes (i.e., reducing restoration time for customers) and addressing compliance risk (i.e., CPUC Rule 2). Increase in forecast due to contractor support and license fee.

(6) Forecast for Emergent Grid Technology Modernization efforts. 2022 represents an increase to respond to technical application development.

(7) Additional cost are forecasted for IT O&M (on-going support) such as ADMS, DMS on-going maintenance and Critical Emergent Technology that are not included in the GRC forecast.

(8) Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast.

Workpaper Table 7-12
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 7
Distribution System Operations
Capital Expenditures by Major Work Category
(Thousands of Nominal Dollars)

			Capital Expenditures											
No.	**MWC**	**MWC Description**	**2016 Recorded Adjusted**	**2017 Recorded Adjusted**	**2018 Recorded Adjusted**	**2019 Recorded Adjusted**	**2020 Recorded Adjusted**	**2021 Forecast**	**2022 Forecast**	**2023 Forecast**	**2024 Forecast**	**2025 Forecast**	**2026 Forecast**	**Reference**
1	2F	Build IT Apps & Infra	3,037	866	1,892	-	-	-	-	-	-	-	-	
2	63	Distribution Operational Technology	2,754	3,724	3,712	1,174	1,117	4,129	4,219	4,333	2,225	2,285	2,347	WP 7-16, WP 7-17
3		**Grand Total**	**5,791**	**4,590**	**5,604**	**1,174**	**1,117**	**4,129**	**4,219**	**4,333**	**2,225**	**2,285**	**2,347**	

Workpaper Table 7-13
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 7
Distribution System Operations
Forecast Capital Expenditures Summary
(Thousands of Nominal Dollars)

		Capital Expenditures							
Line No.	Description	2020 CWIP	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference
1	Projects > $3 Million*	-	3,001	4,219	4,333	2,225	2,285	2,347	WP 7-14
2	Other Work	1,117	1,128	-	-	-	-	-	WP 7-15
3	**Total**	**1,117**	**4,129**	**4,219**	**4,333**	**2,225**	**2,285**	**2,347**	

4 * Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.

Workpaper Table 7-14
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 7
Distribution System Operations
Recorded CWIP and Forecast Capital Expenditures Details - Projects Over $3 Million*
(Thousands of Nominal Dollars)

					CWIP	Capital Expenditures							
Line No.	Planning Order	Description	MWC	Operative Date	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Subtotal	Reference
	MWC - 63	**Distribution Operational Technology**											
1	5543574	SYSPLAN ED 63D	63		-	-	4,219	4,333	2,225	2,285	2,347	15,408	
2	5792542	ED PI Data Analytics	63	Oct-2021	-	3,001	-	-	-	-	-	3,001	
3	**Total**				**-**	**3,001**	**4,219**	**4,333**	**2,225**	**2,285**	**2,347**	**18,409**	WP 7-18
4		**Grand Total**			**-**	**3,001**	**4,219**	**4,333**	**2,225**	**2,285**	**2,347**	**18,409**	

5 * Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.

Workpaper Table 7-15
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 7
Distribution System Operations
Recorded and Forecast Capital Expenditures Details - Other Work*
(Thousands of Nominal Dollars)

				Capital Expenditures											
Line No.		MWC	MWC Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference
1		2F	Build IT Apps & Infra	3,037	866	1,892	-	-	-	-	-	-	-	-	
2		63	Distribution Operational Technology	2,754	3,724	3,712	1,174	1,117	1,128	-	-	-	-	-	WP 7-18
3		**Grand Total**		**5,791**	**4,590**	**5,604**	**1,174**	**1,117**	**1,128**	**-**	**-**	**-**	**-**	**-**	
4		* Excludes projects greater than $3M													

Workpaper Table 7-16
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 7, Distribution System Operations
Capital Major Work Category 63 - Recorded Walk
MWC 63 - Distribution Operational Technology
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$2,754**			
2		DCC Consolidation Projects	$330		Costs for building FLISR Dashboard for the DCCs.	WP 7-18, Line No. 2
3		Other Facility Improvements	$640		Minor build out and other work to facilitate moving to the new DCCs.	WP 7-18, Line No. 3
4		**Net Change**	**$970**			
5	**2017**	**Recorded Adjusted**	**$3,724**			
6		DCC Consolidation Projects	($2,795)		Completion of the management system automation upgrades.	WP 7-18, Line No. 2
7		Other Facility Improvements	($626)		Reduction of miscellaneous buildout work for the consolidated Distribution Control Centers.	WP 7-18, Line No. 3
8		Distribution Operational Technology	$3,409		New effort to replace failing DMS system that was no longer being supported by vendor. Costs included IT (internal labor charges) and external vendor charges to replace hardware, software and to build out 160 servers with an accelerated timeline to complete by end of year.	WP 7-18, Line No. 4
9		**Net Change**	**($12)**			
10	**2018**	**Recorded Adjusted**	**$3,712**			
11		Other Facility Improvements	($272)		Completion of miscellaneous buildout work for the consolidated Distribution Control Centers.	WP 7-18, Line No. 3
12		Distribution Operational Technology	($2,266)		Reduction in cost due to only 6 months' worth of project work as the completion date was extended to June 2019. Costs continued to include IT (internal labor support) and vendor support.	WP 7-18, Line No. 4
13		**Net Change**	**($2,538)**			
14	**2019**	**Recorded Adjusted**	**$1,174**			
15		Other Facility Improvements	($31)		No significant change.	WP 7-18, Line No. 3
16		Distribution Operational Technology	($1,143)		DMS Upgrade completion/go live was in 2019. No additional funding needed.	WP 7-18, Line No. 4
17		Operational Business Intelligence (OBI)	$1,117		OBI team was created to ensure safe, reliable and efficient utility operations through the improvement of existing business processes with the use of innovative business intelligence. (i.e., Improve Distribution Operations processes to minimize customer outage and mitigate wildfire risk.) 2020 spend was focused primarily on building a data repository (platform work).	WP 7-18, Line No. 5
18		**Net Change**	**($57)**			
19	**2020**	**Recorded Adjusted**	**$1,117**			

Workpaper Table 7-17
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 7, Distribution System Operations
Capital Major Work Category 63 - Forecast Walk
MWC 63 - Distribution Operational Technology
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$1,117**			
2		Distribution Operational Technology	$828		Forecasted spend for potential ADMS upgrade work.	WP 7-18, Line No. 3
3		Operational Business Intelligence (OBI)	$2,183		2021 work will continue with building a data repository and will also be building solutions to help improve business processes around safety, compliance and wildfire mitigation.	WP 7-18, Line No. 4
4		**Net Change**	**$3,011**			
5	**2021**	**Forecast**	**$4,129**			
6		Distribution Operational Technology	($828)		Work is still forecasted to be needed for this activity, however due to authorized targets, unidentified efficiencies are needed to offset these costs.	WP 7-18, Line No. 3
7		Operational Business Intelligence (OBI)	$918		Increase due to expanded vendor support of safety and wildfire mitigation work (for solutions work).	WP 7-18, Line No. 4
8		**Net Change**	**$90**			
9	**2022**	**Forecast**	**$4,219**			
10		Distribution Operational Technology	$0		Work is still forecasted to be needed for this activity, however due to authorized targets, unidentified efficiencies are needed to offset these costs.	WP 7-18, Line No. 3
11		Operational Business Intelligence (OBI)	$114		No significant change.	WP 7-18, Line No. 4
12		**Net Change**	**$114**			
13	**2023**	**Forecast**	**$4,333**			
14		Operational Business Intelligence (OBI)	($2,108)		Forecast declines as platform work completes. Budget moving forward is predominantly for solutions work.	WP 7-18, Line No. 4
15		**Net Change**	**($2,108)**			
16	**2024**	**Forecast**	**$2,225**			
17		Operational Business Intelligence (OBI)	$60		No significant change.	WP 7-18, Line No. 4
18		**Net Change**	**$60**			
19	**2025**	**Forecast**	**$2,285**			
20		Operational Business Intelligence (OBI)	$62		No significant change.	WP 7-18, Line No. 4
21		**Net Change**	**$62**			
22	**2026**	**Forecast**	**$2,347**			

Workpaper Table 7-18
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 7, Distribution System Operations
Capital Major Work Category 63 - Forecast Details
(Thousands of Nominal Dollars)

Line No.	Description	Recorded 2016	Recorded 2017	Recorded 2018	Recorded 2019	Recorded 2020	Forecast 2021	Forecast 2022	Forecast 2023	Forecast 2024	Forecast 2025	Forecast 2026	Assumptions
1	**Distribution Operational Technology**												
2	DCC Consolidation Projects	$ 2,465	$ 2,795	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
3	Other Facility Improvements	$ 289	$ 929	$ 303	$ 31	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
4	Distribution Operational Technology	$ -	$ -	$ 3,409	$ 1,143	$ -	$ 828	$ -	$ -	$ -	$ -	$ -	(1)
5	Operational Business Intelligence (OBI)	$ -	$ -	$ -	$ -	$ 1,117	$ 3,301	$ 4,219	$ 4,333	$ 2,225	$ 2,285	$ 2,347	(2)
6	**MWC 63 (MAT 63D) Total**	**$ 2,754**	**$ 3,724**	**$ 3,712**	**$ 1,174**	**$ 1,117**	**$ 4,129**	**$ 4,219**	**$ 4,333**	**$ 2,225**	**$ 2,285**	**$ 2,347**	

Forecast Assumptions and Details

(1) Forecast spend for potential Advanced DMS upgrade work.

(2) In 2020, the OBI team was created to support the build and deployment of business intelligence solutions that focused on improving existing business processes (i.e., reducing restoration time for customers) and addressing compliance risk (i.e., CPUC Rule 2). Forecast increase is associated with building a data repository and business solutions.

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE

Testimony: ☐ **Workpapers:** ☒ **SOQ:** ☐

Exhibit Number: 4 **Chapter Number:** 7

Chapter Title: Distribution System Operations

Witness Name: Kari Chester

Page No.	Line No.	Item	As Filed	As Corrected
Errata as of February 25, 2022				
7-2	Line 3	MWC HG – Elec Trans Ops Engr & Tech	2018 Recorded Adjusted $1,388	2018 Recorded Adjusted $1,379
7-2	Line 5	Total	2018 Recorded Adjusted $39,747	2018 Recorded Adjusted $39,738

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
EXHIBIT (PG&E-4) ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING
CHAPTER 8, FIELD METERING

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Workpaper Table 8-1
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 8
Field Metering
Expenses by Major Work Category
(Thousands of Nominal Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	Reference (A)
1	AR	Read & Investigate Meters	11,171	12,418	11,190	10,063	10,096	10,686	10,589	10,425	WP 8-3
2	DD	Provide Field Service	679	589	829	582	400	411	422	480	WP 8-3
3	EY	Change/Maint Used Elec Meter	9,192	6,638	5,975	5,409	6,809	5,079	5,101	7,734	WP 8-3
4	HY	Change/Maint Used Gas Meters	427	640	777	1,157	1,552	590	610	685	WP 8-3
5	IU	Collect Revenue	1,445	1,430	1,295	1,355	1,499	1,500	1,570	2,250	WP 8-3
6	**Total**		**22,913**	**21,715**	**20,065**	**18,566**	**20,355**	**18,266**	**18,292**	**21,574**	

Workpaper Table 8-2
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 8
Field Metering
Expenses by Major Work Category
(Thousands of Base Year Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast
1	AR	Read & Investigate Meters	12,811	13,647	11,908	10,361	10,096	10,375	9,960	9,499
2	DD	Provide Field Service	769	647	883	599	400	399	396	436
3	EY	Change/Maint Used Elec Meter	10,301	7,308	6,379	5,572	6,809	5,055	4,939	7,286
4	HY	Change/Maint Used Gas Meters	484	704	825	1,190	1,552	573	573	621
5	IU	Collect Revenue	1,742	1,634	1,426	1,408	1,499	1,444	1,445	1,996
6	**Total**		**26,106**	**23,941**	**21,421**	**19,131**	**20,355**	**17,847**	**17,313**	**19,838**

Workpaper Table 8-3
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 8, Field Metering
Expense Walk by Major Work Category
(Thousands of Nominal Dollars)

Ln. No.	Year	Amount	MWC AR	MWC DD	MWC EY	MWC HY	MWC IU	Detailed Description/Explanation	Reference
1	**2016**	**22,913**	**11,171**	**679**	**9,192**	**427**	**1,445**		
2			1,247					Increase in manual meter reading costs. Meter Reading balancing account IG was closed, increasing AR	WP 8-4 Line 1
3				(90)				Decrease in start and stop service costs.	WP 8-4 Line 2
4					(2,554)			Decrease in electric meter R-test, corrective maintenance units, and warranty meters installs stop.	WP 8-4 Line 3
5						214		Increase in gas meter preventative and corrective maintenance.	WP 8-4 Line 4
6							(15)	Decrease in miscellaneous revenue assurance investigation costs.	WP 8-4 Line 5
7	**2017**	**21,715**	**12,418**	**589**	**6,638**	**640**	**1,430**		
8			(1,229)					Decrease in manual meter reading costs resulting from more meters being connected and communicating over PG&E's SmartMeter AMI network.	WP 8-4 Line 1
9				240				Increase in start and stop service costs.	WP 8-4 Line 2
10					(663)			Decrease in electric meter R-tests and corrective maintenance	WP 8-4 Line 3
11						136		Increase in gas meter preventative & corrective maintenance.	WP 8-4 Line 4
12							(135)	Decrease in miscellaneous revenue assurance investigation costs.	WP 8-4 Line 5
13	**2018**	**20,065**	**11,190**	**829**	**5,975**	**777**	**1,295**		
14			(1,127)					Decrease in manual meter reading costs resulting from more meters being connected and communicating over PG&E's SmartMeter AMI network.	WP 8-4 Line 1
15				(248)				Decrease in start and stop service costs.	WP 8-4 Line 2
16					(566)			Decrease in electric meter corrective maintenance	WP 8-4 Line 3
17						380		Increase in gas meter maintenance preventative & corrective maintenance.	WP 8-4 Line 4
18							60	Increase in miscellaneous revenue assurance investigation costs.	WP 8-4 Line 5
19	**2019**	**18,566**	**10,063**	**582**	**5,409**	**1,157**	**1,355**		
20			32					Increase in manual meter reading costs resulting from more meters being connected and communicating over PG&E's SmartMeter AMI network, partially offset by escalation	WP 8-4 Line 1
21				(182)				Decrease in start and stop service costs.	WP 8-4 Line 2
22					1,399			Increase in electric meter preventative and corrective maintenance	WP 8-4 Line 3
23						396		Increase in gas meter maintenance preventative & corrective maintenance.	WP 8-4 Line 4
24							144	Increase in miscellaneous revenue assurance investigation costs.	WP 8-4 Line 5
25	**2020**	**20,355**	**10,096**	**400**	**6,809**	**1,552**	**1,499**		
26			590					Increase in manual meter reading costs and escalation	WP 8-4 Line 1
27				11				Escalation	WP 8-4 Line 2
28					(1,729)			Decrease in electric meter maintenance due to operational efficiencies partially offset by escalation	WP 8-4 Line 3
29						(962)		Decrease in gas meter preventative & corrective maintenance partially offset by escalation	WP 8-4 Line 4
30							1	No significant change	WP 8-4 Line 5
31	**2021**	**18,266**	**10,686**	**411**	**5,079**	**590**	**1,500**		
32			(97)					Decrease in manual meter reading costs resulting from reduction in manually read meters	WP 8-4 Line 1
33				11				Labor escalation and increase in start and stop service costs.	WP 8-4 Line 2
34					22			Labor escalation and increase in electric meter R-tests and Time-of-Use meter reprogramming due to TOU rate reform.	WP 8-4 Line 3
35						20		Labor escalation and increase in Smartmeter module maintenance expense cost	WP 8-4 Line 4
36							70	Increase in Revenue Assurance costs due to the expansion of program including employee hiring	WP 8-4 Line 5
37	**2022**	**18,292**	**10,589**	**422**	**5,101**	**610**	**1,570**		
38			(164)					Decrease in manual meter reading costs resulting from more meters being connected and communicating over PG&E's SmartMeter AMI network, partially offset by escalation	WP 8-4 Line 1
39				58				Labor escalation and increase in start and stop service costs.	WP 8-4 Line 2
40					2,632			Labor escalation and increase in electric meter Time-of-Use meter reprogramming due to TOU rate reform.	WP 8-4 Line 3
41						75		Labor escalation and increase in Smartmeter module maintenance expense cost	WP 8-4 Line 4
42							680	Increase in Revenue Assurance costs due to the expansion of program including employee hiring	WP 8-4 Line 5
43	**2023**	**21,574**	**10,425**	**480**	**7,734**	**685**	**2,250**		

Workpaper Table 8-4
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 8, Field Metering
Expense Forecast Summary
(Thousands of Nominal Dollars)

Line No	MWC	Major Work Category Description	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast		Reference
1	AR	Perform Meter Reading	$ 11,171	$ 12,418	$ 11,190	$ 10,063	$ 10,096	$ 10,686	$ 10,589	$ 10,425		WP 8-5
2	DD	Perform Field Services	$ 679	$ 589	$ 829	$ 582	$ 400	$ 411	$ 422	$ 480		WP 8-6
3	EY	Perform Electric Meter Maintenance	$ 9,192	$ 6,638	$ 5,975	$ 5,409	$ 6,809	$ 5,079	$ 5,101	$ 7,734		WP 8-7
4	HY	Perform Gas Meter Maintenance	$ 427	$ 640	$ 777	$ 1,157	$ 1,552	$ 590	$ 610	$ 685		WP 8-8
5	IU	Collect Revenue	$ 1,445	$ 1,430	$ 1,295	$ 1,355	$ 1,499	$ 1,500	$ 1,570	$ 2,250	(1)	
6	All	Total Expense	**$ 22,913**	**$ 21,715**	**$ 20,065**	**$ 18,566**	**$ 20,355**	**$ 18,266**	**$ 18,292**	**$ 21,574**		
7	IG	SmartMeter Opt-out Meter Reading	**$ 6,086**	**$ 72**							(2)	
8	All	Total Expense with Additional Recorded Costs	**$ 28,999**	**$ 21,787**	**$ 20,065**	**$ 18,566**	**$ 20,355**	**$ 18,266**	**$ 18,292**	**$ 21,574**		

Forecast Assumptions and Details

(1) MWC IU is focused on the detection, investigation, and resolution of customer energy theft. This includes the field employees, systems, and staff support necessary to effectively perform these activities. Forecasted costs are based on last recorded year (2020) as the program is anticipated to remain steady through the forecast years.

(2) These recorded costs are shown for trending purposes only. They are from an expired balancing account and not part of the GRC.

Workpaper Table 8-5
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 8 - Field Metering
Unit Cost and Forecast Details: MWC AR

Line No.

1	**MWC**	AR
2	**GRC Ch.**	8 - Field Metering
3	**MWC Definition**	Perform Meter Reading – Includes activities for dedicated meter readers, other field resources performing manual meter reading activities, and the systems, administration, and clerical support necessary to effectively perform these activities. This program relates to safety, reliability, or maintenance because it supports the proper functioning of PG&E's metering infrastructure.

	Risk ID	Type	Name
4	None	N/A	N/A

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	Field orders
8	**Unit Cost (2023)**	$ 12.20
9	**Unit Cost Forecast Basis**	2020 and 2021 1st quarter historic actuals.
10	**Unit Forecast Basis**	Year-over-year historic actuals.

	Unitized Programs	Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 11,104,919	$ 8,787,334	$ 8,552,695	$ 9,963,259	$ 10,063,054	
12	**No. of Units**	2,485,579	1,931,624	1,407,236	1,180,761	1,089,152	
13	**Unit Cost**	$ 4.49	$ 6.43	$ 7.95	$ 8.52	$ 9.27	

	Unitized Programs	Forecast Costs & Units (Escalated) (A)		
	Year	**2021**	**2022**	**2023**
14	**Forecast Costs**	$ 10,685,505	$ 10,588,940	$ 10,425,329
15	**No. of Units**	1,005,222	927,587	854,733
16	**Unit Cost**	$ 10.63	$ 11.42	$ 12.20

	Other Programs	Recorded Costs & Units				
	Year	**2016**	**2017**	**2018**	**2019**	**2020**
17	**Recorded Costs**	$ 66,229	$ 3,630,813	$ 2,636,833	$ 99,767	$ 32,468

	Other Programs	Forecast Costs & Units (Escalated)		
	Year	**2021**	**2022**	**2023**
18	**Forecast Costs**	$ -	$ -	$ -

	Total	Recorded Costs & Units					
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
19	**Recorded Costs**	$ 11,171,148	$ 12,418,146	$ 11,189,529	$ 10,063,027	$ 10,095,522	Calculated - Line 11 + Line 17

	Total	Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
20	**Forecast Costs**	$ 10,685,505	$ 10,588,940	$ 10,425,329	Calculated - Line 14 + Line 18

	Notes	
21	**(A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.
22	**(B)**	Units*Unit Cost equals Total (line 19).

Workpaper Table 8-6
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 8 - Metering
Unit Cost and Forecast Details: MWC DD

Line No.

1	**MWC**	DD
2	**GRC Ch.**	8 - Field Metering
3	**MWC Definition**	Perform Field Services – Includes activities for electric turn-ons and shut-offs initiated by customers, which are mainly performed by electric meter technicians and meter maintenance person resources at commercial and agricultural customer premises. This program relates to safety, reliability, or maintenance because electric service is either established or terminated based on customer request.

	Risk ID	Type	Name
4	None	N/A	N/A

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost, MWC
7	**Unit of Measure**	Commercial turn-ons/offs
8	**Unit Cost (2023)**	$ 133
9	**Unit Cost Forecast Basis**	2020 and 2021 1st quarter historic actuals.
10	**Unit Forecast Basis**	Year-over-year historic actuals.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 678,547	$ 588,710	$ 829,141	$ 581,549	$ 399,824	Calculated - Line 12 * Line 13
12	**No. of Units**	6,285	5,996	8,618	5,747	3,238	
13	**Unit Cost**	$ 108	$ 98	$ 96	$ 101	$ 123	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 411,012	$ 422,000	$ 480,000	Calculated - Line 15 * Line 16
15	**No. of Units**	3,262	3,268	3,604	
16	**Unit Cost**	$ 126	$ 129	$ 133	

17	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 8-7
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 8 - Field Metering
Unit Cost and Forecast Details: MWC EY

Line No.		
1	**MWC**	EY
2	**GRC Ch.**	8 - Field Metering
3	**MWC Definition**	Perform Electric Meter Maintenance – Includes activities such as: electric meter preventive maintenance, electric meter Corrective Maintenance (CM), meter programming, meter network maintenance, electric meter accuracy testing, and the associated staff support necessary to effectively perform these activities. This program relates to safety, reliability, or maintenance because it supports the proper functioning of PG&E's metering infrastructure.

	Risk ID	Type	Name
4	None	N/A	N/A

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	Field orders
8	**Unit Cost (2023)**	$ 210
9	**Unit Cost Forecast Basis**	2020 and 2021 1st quarter historic actuals.
10	**Unit Forecast Basis**	Year-over-year historic actuals.

	Unitized Programs	Recorded Costs & Units (A) (B)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 8,962,601	$ 6,612,528	$ 6,015,781	$ 5,778,106	$ 7,075,235	
12	**No. of Units**	42,775	40,480	38,445	35,217	34,194	
13	**Unit Cost**	$ 215	$ 164	$ 155	$ 154	$ 199	

	Unitized Programs	Forecast Costs & Units (Escalated) (A)		
	Year	**2021**	**2022**	**2023**
14	**Forecast Costs**	$ 5,079,202	$ 5,101,200	$ 7,733,563
15	**No. of Units**	25,582	25,005	36,757
16	**Unit Cost**	$ 199	$ 204	$ 210

	Other Programs	Recorded Costs				
	Year	**2016**	**2017**	**2018**	**2019**	**2020**
17	**Recorded Costs**	$ 229,771	$ 25,605	$ (41,109)	$ (369,057)	$ (266,712)

	Other Programs	Forecast Costs (Escalated)		
	Year	**2021**	**2022**	**2023**
18	**Forecast Costs**	$ -	$ -	$ -

	Total	Recorded Costs					
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
19	**Recorded Costs**	$ 9,192,372	$ 6,638,133	$ 5,974,673	$ 5,409,048	$ 6,808,523	Calculated - Line 11 + Line 17

	Total	Forecast Costs & Units (Escalated)			
	Year	**2021**	**2022**	**2023**	
20	**Forecast Costs**	$ 5,079,202	$ 5,101,200	$ 7,733,563	Calculated - Line 14 + Line 18

	Notes	
21	**(A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.
22	**(B)**	2021 units based on actual recorded units through April 2021
23	**(C)**	Units*Unit Cost equals Total (line 19).

Workpaper Table 8-8
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 8 - Field Metering
Unit Cost and Forecast Details: MWC HY

Line No.

1	**MWC**	HY
2	**GRC Ch.**	8 - Field Metering
3	**MWC Definition**	Perform Gas Meter Maintenance – Covers gas meter maintenance activities that do not result in new meter exchanges, including meter tests, minimal regulator maintenance, meter/module communication trouble-shooting, and meter/module repairs. This program relates to safety, reliability, or maintenance because it supports the proper functioning of PG&E's metering infrastructure.

	Risk ID	Type	Name
4	None	N/A	N/A

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	Field orders
8	**Unit Cost (2023)**	$ 467
9	**Unit Cost Forecast Basis**	2020 and 2021 1st quarter historic actuals.
10	**Unit Forecast Basis**	Year-over-year historical actuals, incorporating working methodology changes.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 426,539	$ 640,161	$ 776,618	$ 1,156,834	$ 1,552,356	Calculated - Line 12 * Line 13
12	**No. of Units**	3,391	3,604	2,824	5,240	6,691	
13	**Unit Cost**	$ 126	$ 178	$ 275	$ 221	$ 232	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021 (B)**	**2022**	**2023**	
14	**Forecast Costs**	$ 590,519	$ 610,000	$ 684,622	Calculated - Line 15 * Line 16
15	**No. of Units**	1,333	1,341	1,466	
16	**Unit Cost**	$ 443	$ 455	$ 467	

	Notes	
17	**(A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.
18	**(B)**	2021 units based on actual recorded units through April 2021

Workpaper Table 8-9
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 8, Field Metering
Remaining Manual Meter Reads

Summary of meters
Forecast for Manually Read a/o Dec, 2023

Line No.	Category	Percent of Total Meters in Service	Number of Meters	Description
1	Automated	99.15%	10,400,000	Total SM Meters (SM-Read/Billed and MV-90)
2	Manual	0.54%	56,499	Opt Out
3	Manual	0.03%	3,600	SmartMeters™ and Legacy Meters with Network Issues
4	Manual	0.28%	28,944	Meter & Site Configuration Issues
5	Manual	0.08%	8,850	Customer issues
6		100.00%	10,489,043	Total

Subtotals		
Automated	99.15%	10,400,000
Manual	0.85%	89,043
	100.00%	**10,489,043**

Workpaper Table 8-10
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 8, Field Metering
Meter Reading by Full Time Equivalent
(Thousands Of Nominal Dollars)

Line No.		2016	2017	2018	2019	2020	2021	2022	2023	Notes
1										
2	Field Employees Performing Regular Reading (FTE)	105	93	76	66	73	72	73	74	
3	Total Number of Meter Readers (Headcount)	100	73	55	44	28	20	13	5	
4	Non Opt Out Regular Read	1,963,954	1,434,292	938,184	737,628	672,186	606,435	551,581	496,728	
5	Opt Out Regular Read	502,906	478,181	451,682	427,669	404,998	382,997	360,996	338,995	
6	Total Regular Reads - Regular Read	2,466,860	1,912,473	1,389,866	1,165,297	1,077,184	989,432	912,577	835,723	(1)
7	Total Reads-Special Read	18,719	19,151	17,370	15,464	11,968	15,790	15,010	19,010	
8	Total Reads	2,485,579	1,931,624	1,407,236	1,180,761	1,089,152	1,005,222	927,587	854,733	(2)
9	Unit Cost-Regular Read	$5.74	$5.71	$7.19	$7.69	$8.45	$9.47	$10.20	$10.48	
10	Unit Cost-Special Read	$89.05	$59.00	$68.86	$71.23	$83.34	$83.04	$85.32	$87.67	
11	Cost Per Read	$6.44	$6.49	$7.95	$8.52	$9.27	$10.63	$11.42	$12.20	(3), (4)

Major Calculation Notes

(1) "Total Regular Reads - Regular Read" = "Non Opt Out Regular Read" + "Opt Out Regular Read"
* Non Opt Out Regular Read includes Smart Meter Deployment (include legacy in green network) and Cities on Hold Deduction
* Opt Out Regular Read has a linear reduction forecasting model with Cities on Hold Opt Out impact (12% parameter and bi-monthly reading)

(2) Total Reads = "Total Regular Reads - Regular Read" + "Total Reads - Special Read"
(3) Unit Cost = Dollar Amount / Units
(4) Differences between recorded costs and cost per read multiplied by number of reads are accounted for in balancing account costs not shown herein.

Workpaper Table 8-11
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 8
Field Metering
Capital Expenditures by Major Work Category
(Thousands of Nominal Dollars)

			Capital Expenditures											
No.	**MWC**	**MWC Description**	**2016 Recorded Adjusted**	**2017 Recorded Adjusted**	**2018 Recorded Adjusted**	**2019 Recorded Adjusted**	**2020 Recorded Adjusted**	**2021 Forecast**	**2022 Forecast**	**2023 Forecast**	**2024 Forecast**	**2025 Forecast**	**2026 Forecast**	**Reference**
1	25	Install New Electric Meters	18,080	21,833	24,638	25,309	24,205	27,535	28,700	30,101	31,378	32,713	34,096	WP 8-15
2	3J	Smart Meter Opt Out	668	3	-	-	-	-	-	-	-	-	-	
3	74	Install New Gas Meters	3,724	5,588	8,122	11,078	18,192	53,573	57,511	74,355	83,911	62,855	42,319	WP 8-15
4		**Grand Total**	**22,472**	**27,424**	**32,760**	**36,387**	**42,397**	**81,108**	**86,211**	**104,455**	**115,290**	**95,568**	**76,414**	

Workpaper Table 8-12
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 8
Field Metering
Forecast Capital Expenditures Summary
(Thousands of Nominal Dollars)

		Capital Expenditures							
Line No.	**Description**	**2020 CWIP**	**2021 Forecast**	**2022 Forecast**	**2023 Forecast**	**2024 Forecast**	**2025 Forecast**	**2026 Forecast**	**Reference**
1	Projects > $3 Million*	-	71,890	86,211	104,455	115,290	95,568	76,414	WP 8-13
2	Other Work	-	9,218	-	-	-	-	-	WP 8-14
3	**Total**	**-**	**81,108**	**86,211**	**104,455**	**115,290**	**95,568**	**76,414**	

4 * Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.

Workpaper Table 8-13
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 8
Field Metering
Recorded CWIP and Forecast Capital Expenditures Details - Projects Over $3 Million*
(Thousands of Nominal Dollars)

Line No.	Planning Order	Description	MWC	Operative Date	CWIP 2020 Recorded Adjusted	Capital Expenditures 2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Subtotal	Reference
	MWC - 25	**Install New Electric Meters**											
1	5510904	1st Install New Bus-RES	25		-	3,140	-	-	-	-	-	3,140	
2	5510907	Mtr Exchg Corr Mntce-RES	25		-	15,176	-	-	-	-	-	15,176	
3	5543488	SYSPLAN ED 25H	25		-	-	6,397	6,842	7,274	7,733	8,207	36,453	
4	5543489	SYSPLAN ED 25K	25		-	-	20,855	21,774	22,594	23,444	24,326	112,994	
5	5543784	SYSPLAN ED 25D	25		-	-	1,449	1,484	1,510	1,536	1,562	7,541	
6	**Total**				**-**	**18,316**	**28,700**	**30,101**	**31,378**	**32,713**	**34,096**	**175,304**	WP 8-16
	MWC - 74	**Install New Gas Meters**											
7	5512840	Gas Module Change <= 1000 CFH	74		-	27,578	-	-	-	-	-	27,578	
8	5539679	FM CBP Balancing (74)	74		-	25,996	-	-	-	-	-	25,996	
9	5543575	SYSPLAN ED 74I	74		-	-	57,511	74,355	83,911	62,855	42,319	320,951	
10	**Total**				**-**	**53,573**	**57,511**	**74,355**	**83,911**	**62,855**	**42,319**	**374,524**	WP 8-16
11		**Grand Total**			**-**	**71,890**	**86,211**	**104,455**	**115,290**	**95,568**	**76,414**	**549,827**	

12 * Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.

Workpaper Table 8-14
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 8
Field Metering
Recorded and Forecast Capital Expenditures Details - Other Work*
(Thousands of Nominal Dollars)

			Capital Expenditures											
Line No.	MWC	MWC Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference
1	25	Install New Electric Meters	7,437	8,656	9,455	8,435	7,511	9,218	-	-	-	-	-	WP 8-16
2	3J	Smart Meter Opt Out	668	3	-	-	-	-	-	-	-	-	-	WP 8-16
3	74	Install New Gas Meters	899	943	1,997	1,511	1,161	-	-	-	-	-	-	WP 8-16
4	**Grand Total**		**9,005**	**9,602**	**11,452**	**9,946**	**8,672**	**9,218**	**-**	**-**	**-**	**-**	**-**	

5 * Excludes projects greater than $3M

Workpaper Table 8-15
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 8, Field Metering
Capital Walk by Major Work Category
(Thousands of Nominal Dollars)

Ln. No.	Year	Amount	MWC 25	MWC 74	Detailed Description/Explanation	References
1	**2016**	**21,804**	**18,080**	**3,724**		
2			3,753		Increase in electric meter maintenance exchanges and elimination of warranty meter installation activity.	WP 8-16 Line 2
3				1,864	Increase in gas meter maintenance exchanges due to failed Smartmeter modules	WP 8-16 Line 3
4	**2017**	**27,421**	**21,833**	**5,588**		
5			2,805		Increase in electric meter maintenance exchanges and associated labor costs	WP 8-16 Line 2
6				2,534	Increase in gas meter maintenance exchanges due to failed Smartmeter modules	WP 8-16 Line 3
7	**2018**	**32,760**	**24,638**	**8,122**		
8			671		Increase in electric meter maintenance exchanges and associated labor costs	WP 8-16 Line 2
9				2,956	Increase in gas meter maintenance exchanges due to failed Smartmeter modules	WP 8-16 Line 3
10	**2019**	**36,387**	**25,309**	**11,078**		
11			(1,104)		Decrease in electric meter maintenance exchanges and associated labor costs	WP 8-16 Line 2
12				7,113	Increase in gas meter maintenance exchanges due to failed Smartmeter modules	WP 8-16 Line 3
13	**2020**	**42,397**	**24,205**	**18,192**		
14			3,330		Labor escalation and incremental corrective maintenance for failed electric Smartmeters	WP 8-16 Line 2
15				35,382	Increase in gas meter maintenance exchanges due to earlier than expected failed Smartmeter modules	WP 8-16 Line 3
16	**2021**	**81,108**	**27,535**	**53,573**		
17			1,165		Labor escalation and incremental corrective maintenance for failed electric Smartmeters	WP 8-16 Line 2
18				3,938	Increase in gas meter maintenance exchanges due to failed Smartmeter modules	WP 8-16 Line 3
19	**2022**	**86,211**	**28,700**	**57,511**		
20			1,400		Labor escalation and incremental corrective maintenance for failed electric Smartmeters	WP 8-16 Line 2
21				16,843	Increase in gas meter maintenance exchanges due to failed Smartmeter modules	WP 8-16 Line 3
22	**2023**	**104,455**	**30,101**	**74,355**		
23			1,278		Labor escalation and incremental corrective maintenance for failed electric Smartmeters	WP 8-16 Line 2
24				9,557	Increase in gas meter module maintenance exchanges due to failed Smartmeter modules	WP 8-16 Line 3
25	**2024**	**115,290**	**31,378**	**83,911**		
26			1,334		Labor escalation and incremental corrective maintenance for failed electric Smartmeters	WP 8-16 Line 2
27				(21,056)	Decrease in failed gas meter module corrective maintenance as proactive exchanges increase	WP 8-16 Line 3
28	**2025**	**95,568**	**32,713**	**62,855**		
29			1,383		Labor escalation and incremental corrective maintenance for failed electric Smartmeters	WP 8-16 Line 2
30				(20,536)	Decrease in failed gas meter module corrective maintenance as proactive exchanges increase	WP 8-16 Line 3
31	**2026**	**76,414**	**34,096**	**42,319**		

Workpaper Table 8-16
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 8, Field Metering
Capital Forecast Summary
(Thousands of Nominal Dollars)

	MWC	Major Work Category Description	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference
1														
2	25	Electric Metering Capital	$ 18,080	$ 21,833	$ 24,638	$ 25,309	$ 24,205	$ 27,535	$ 28,700	$ 30,101	$ 31,378	$ 32,713	$ 34,096	WP 8-17
3	74	Gas Metering Capital	$ 3,724	$ 5,588	$ 8,122	$ 11,078	$ 18,192	$ 53,573	$ 57,511	$ 74,355	$ 83,911	$ 62,855	$ 42,319	WP 8-18
4	3J	Smart Meter Opt Out	$ 668	$ 3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
5	All	Total Capital	**$ 22,472**	**$ 27,424**	**$ 32,760**	**$ 36,387**	**$ 42,397**	**$ 81,108**	**$ 86,211**	**$ 104,455**	**$ 115,290**	**$ 95,568**	**$ 76,414**	

Workpaper Table 8-17
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 8 - Field Metering
Unit Cost and Forecast Details: MWC 25

Line No.		
1	**MWC**	25
2	**GRC Ch.**	8 - Field Metering
3	**MWC Definition**	Electric Metering Capital – Includes labor necessary to perform electric meter installations, exchanges, removals, and retirements. This program relates to safety, reliability, or maintenance because it supports the proper functioning of PG&E's metering infrastructure.

	Risk ID	Type	Name
4	None	N/A	N/A

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	Field orders
8	**Unit Cost (2023)**	$ 232
9	**Unit Cost Forecast Basis**	2020 and 2021 1st quarter historic actuals.
10	**Unit Forecast Basis**	Year-over-year historic actuals.

	Unitized Programs	Recorded Costs & Units (A) (B)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 17,900,974	$ 21,804,517	$ 24,631,242	$ 25,301,197	$ 24,188,193	
12	**No. of Units**	125,025	131,348	122,139	120,196	108,696	
13	**Unit Cost**	$ 145	$ 166	$ 202	$ 211	$ 223	

	Unitized Programs	Forecast Costs & Units (Escalated) (A)					
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
14	**Forecast Costs**	$ 27,534,651	$ 28,700,086	$ 30,100,534	$ 31,378,360	$ 32,712,656	$ 34,095,561
15	**No. of Units**	126,566	127,723	129,890	131,294	132,723	134,135
16	**Unit Cost**	$ 218	$ 225	$ 232	$ 239	$ 246	$ 254

	Other Programs	Recorded Costs					
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
17	**Recorded Costs**	$ 178,609	$ 28,118	$ 6,637	$ 7,633	$ 16,712	

	Other Programs	Forecast Costs (Escalated)					
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
18	**Forecast Costs**	$ -	$ -	$ -	$ -	$ -	$ -

	Total	Recorded Costs					
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
19	**Recorded Costs**	$ 18,079,583	$ 21,832,634	$ 24,637,880	$ 25,308,830	$ 24,204,905	Calculated - Line 11 + Line 17

	Total	Forecast Costs & Units (Escalated)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
20	**Forecast Costs**	$ 27,534,651	$ 28,700,086	$ 30,100,534	$ 31,378,360	$ 32,712,656	$ 34,095,561	Calculated - Line 14 + Line 18

21 **Notes**
(A) Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.
(B) Units*Unit Cost equals Total (line 19).

Workpaper Table 8-18
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 8 - Field Metering
Unit Cost and Forecast Details: MAT 74I

Line No.

1	**MWC**	74
2	**GRC Ch.**	8 - Field Metering
3	**MWC Definition**	Gas Metering Capital – Includes labor necessary to perform gas meter and module installations, exchanges, removals and retirements. This program relates to safety, reliability, or maintenance because customer usage data must be recorded and delivered to the PG&E billing systems on a reliable and timely basis.

	Risk ID	Type	Name
4	None	N/A	N/A

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost, MWC
7	**Unit of Measure**	Field orders
8	**Unit Cost (2023)**	$ 139
9	**Unit Cost Forecast Basis**	2020 and 2021 1st quarter historic actuals.
10	**Unit Forecast Basis**	Year-over-year historical actuals, incorporating working methodology changes.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 3,724,418	$ 5,588,349	$ 8,122,230	$ 11,078,213	$ 18,191,628	Calculated - Line 12 * Line 13
12	**No. of Units**	39,442	59,068	61,239	88,936	161,184	
13	**Unit Cost**	$ 94	$ 95	$ 133	$ 125	$ 113	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 53,573,316	$ 57,511,109	$ 74,354,606	$ 83,911,255	$ 62,854,850	$ 42,318,742	Calculated - Line 15 * Line 16
15	**No. of Units**	396,839	426,008	534,059	584,408	424,473	277,114	
16	**Unit Cost**	$ 135	$ 135	$ 139	$ 144	$ 148	$ 153	

17	**Notes**	
	(A)	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE

Testimony ___ Workpapers _X_ SOQ ___

Exhibit Number: _4_ Chapter Number: _8_

Chapter Title: _Field Metering_

Witness Name: _Craig Kurtz_

Page No.	Line No.	Item	As Filed	As Corrected
Errata as of November 5, 2021				
WP 8-17	3	Remove reference to electric meter purchases	Electric Metering Capital – Includes new electric meter purchases for new customer growth, replacement of failed units, and the associated installation labor necessary to perform electric meter installations, exchanges, removals, and retirements.	Electric Metering Capital – Includes labor necessary to perform electric meter installations, exchanges, removals, and retirements.
WP 8-18	3	Remove reference to gas meter purchases	Includes new gas meter and module purchases for new customer growth, replacement of failed units, and the associated installation labor necessary to perform gas meter and module installations, exchanges, removals and retirements.	Includes labor necessary to perform gas meter and module installations, exchanges, removals and retirements.

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
EXHIBIT (PG&E-4) ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING
CHAPTER 9, VEGETATION MANAGEMENT

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PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
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CHAPTER 9, VEGETATION MANAGEMENT

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Workpaper Table 9-1
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 9
Vegetation Management
Expenses by Major Work Category
(Thousands of Nominal Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	Reference (A)
1	HN	E Dist Tree Trim Bal Acct	198,736	201,456	263,414	375,148	693,149	668,123	711,007	871,220	
2	IG	Manage Var Bal Acct Processes	183,708	195,165	375,268	543,688	544,461	603,930	1,060,600	187,853	(1)
3	**Total**		**382,444**	**396,621**	**638,682**	**918,836**	**1,237,610**	**1,272,053**	**1,771,607**	**1,059,072**	WP 9-3, WP 9-4

(1) Line 2, 2022 forecast value varies from the value listed in the Results of Operations (RO) Model. This amount does not align to the RO Model provided to the Public Advocates Office at the time of filing. The RO will be updated to incorporate these errata with the Joint Comparison Exhibit submittal.

Workpaper Table 9-2
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 9
Vegetation Management
Expenses by Major Work Category
(Thousands of Base Year Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	Reference (A)
1	HN	E Dist Tree Trim Bal Acct	210,942	210,719	265,897	369,564	693,149	670,089	697,510	834,487	
2	IG	Manage Var Bal Acct Processes	194,357	203,858	378,763	534,930	544,461	605,905	1,040,934	180,032	(1)
3	**Total**		**405,298**	**414,577**	**644,660**	**904,494**	**1,237,610**	**1,275,994**	**1,738,444**	**1,014,520**	

(1) Line 2, 2022 forecast value varies from the value listed in the Results of Operations (RO) Model. This amount does not align to the RO Model provided to the Public Advocates Office at the time of filing. The RO will be updated to incorporate these errata with the Joint Comparison Exhibit submittal.

Workpaper Table 9-3
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 9, Vegetation Management
Major Work Category HN/IG – Recorded Walk
MWC HN - E Dist Tree Trim Bal Acct, MWC IG - Manage Var Bal Acct Processes
(Thousands of Nominal Dollars)

Line No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$ 382,444**			
2		Routine Vegetation Management	3,054		Cancellation of uncollected hazard tree reimbursement credits due to non-payment by AT&T. Decrease in LiDAR spending due to delayed implementation.	WP 9-13 Line 2
3		Tree Mortality	11,123		Recorded costs for tree mortality are shown for trending purposes and may differ slightly from previously reported costs. Recorded costs from 2016-2019 are included in the 2018 Catastrophic Event Memorandum Account (CEMA) A 18-03-015.	WP 9-13 Line 22
4		**Net Change**	**$ 14,177**			
5	**2017**	**Recorded Adjusted**	**$ 396,621**			
6		Routine Vegetation Management	61,387		Switched from unit pricing to T&M; all pricing was levelized to T&M for all work resources.	WP 9-13 Line 2
7		Enhanced Vegetation Management	306,412		Onset of AWRR impacted resource mix and work prioritization. AWRR drive pricing changes which impacted all Veg programs (i.e., Routine Tree Work).	WP 9-13 Line 16
8		Tree Mortality	(125,739)		Recorded costs for tree mortality are shown for trending purposes and may differ slightly from previously reported costs. Recorded costs from 2016-2019 are included in the 2018 Catastrophic Event Memorandum Account (CEMA) A 18-03-015.	WP 9-13 Line 22
9		**Net Change**	**$ 242,061**			
10	**2018**	**Recorded Adjusted**	**$ 638,682**			
11		Routine Vegetation Management	111,901		Cash based accounting resulted in 2018 completed units (carryover) being paid in 2019 (no accrual); renegotiatied unit pricing (upwards) effective January 1, 2019. ASP contract was not renewed, impacting ~40% of workforce. Increased ratio of Safety personnel to contracted tree crews Implementation of SB247 – pole clearing workers were included in the collective bargaining increase. In addition, expanded program across entire HFTD.	WP 9-13 Line 2
12		Enhanced Vegetation Management	164,014		More miles completed (2,498). 2019 miles were set based on a desire to complete the entire program in 10 years (25K total miles, 2.5K/yr) without any good insight into the total scope of the program. LiDAR unit data informed 2019 plan.	WP 9-13 Line 16
13		Tree Mortality	4,240		Recorded costs for tree mortality are shown for trending purposes and may differ slightly from previously reported costs. Recorded costs from 2016-2019 are included in the 2018 Catastrophic Event Memorandum Account (CEMA) A 18-03-015.	WP 9-13 Line 19
14		**Net Change**	**$ 280,154**			
15	**2019**	**Recorded Adjusted**	**$ 918,836**			
16		Routine Vegetation Management	318,001		Unit Cost Increases: partially driven by SB 247 timing; significantly higher units completed than year previous (carryover of units from 2019; pause in Routine work to complete EVM mileage) paid at T&M to complete work; Cash basis to accrual transition Bringing ~20k poles into compliance that previously had agreements with customers to maintain compliance. These locations were not being properly maintained and required T&M beyond lump sum contracts. Restructuring of Safety personnel ratio to tree crews	WP 9-13 Line 2
17		Enhanced Vegetation Management	(19,036)		Reduction in mileage completed (1,878 from 2,498), programmatic timeframe 're-set' pending; 2020 targets were created based on the risk model, how many trees we estimated we'd be working in the areas the risk model was pointing us to, the amount of spend it would take,	WP 9-13 Line 16
18		Tree Mortality	19,808		First year recovered in VMBA two-way balancing accoun	WP 9-13 Line 22
19		**Net Change**	**$ 318,773**			
20	**2020**	**Recorded Adjusted**	**$ 1,237,610**			

Workpaper Table 9-4
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 9, Vegetation Management
Major Work Category HN/IG – Forecast Walk
MWC HN - E Dist Tree Trim Bal Acct, MWC IG - Manage Var Bal Acct Processes
(Thousands of Nominal Dollars)

Line No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$ 1,237,610**			
2		Routine Vegetation Management	(25,026)		Fewer units forecasted being completed under Defined Scope lump sum pricing	WP 9-13 Line 2
3		Enhanced Vegetation Management	84,562		Primarily driven by (1) the increase in forecasted tree density, leading to more units being forecasted for completion, (2) at a higher unit cost. (3) Fuel Reduction planned at 2020 GRC funding and (4) In-sourcing of Pre-Inspectors and Work Verifiers. (5) Offset by significant savings related to Wood Management. In-sourcing of Pre-Inspectors and Work Verifers	WP 9-13 Line 16
4		Tree Mortality	(25,093)		Primarily driven by lower unit cost associated with the incorporation of 1st patrol into the Defined Scope lump sum pricing	WP 9-13 Line 22
5		**Net Change**	**$ 34,443**			
6	**2021**	**Forecast**	**$ 1,272,053**			
7		Routine Vegetation Management	42,885		Elimination of Tag Work and Carryover/out, offset by escalation and addition of EVM Maintenance Incremental 6AOI funding	WP 9-13 Line 2
8		Enhanced Vegetation Management	380,648		Incremental 6AOI funding. Addition of costs for transition to One Veg. Escalation	WP 9-13 Line 16
9		Tree Mortality	76,022		No significant change	WP 9-13 Line 22
10		**Net Change**	**$ 499,555**			
11	**2022**	**Forecast**	**$ 1,771,608**			
12		Routine Vegetation Management	160,212		Reduction in EVM Maintenance. Addition of Incremental Routine VM.	WP 9-13 Line 2
13		Enhanced Vegetation Management	(798,578)		Removal of radial clearance. Reduction in wood management and safety oversight forecast costs	WP 9-13 Line 16
14		Tree Mortality	(74,170)		Reduced forecast units of work.	WP 9-13 Line 22
15		**Net Change**	**$ (712,535)**			
16	**2023**	**Forecast**	**$ 1,059,072**			

Workpaper Table 9-5
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 9, Vegetation Management
Expense Summary by Program Element
(Thousands of Nominal Dollars)

Line No.		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026		
1		Recorded	Recorded	Recorded	Recorded	Recorded	Forecast	Forecast	Forecast	Forecast (1)	Forecast (1)	Forecast (1)	Notes	Reference
2	Routine Distribution - Vegetation Management Balancing Account (VMBA)	$ 198,736	$ 201,456	$ 263,414	$ 375,148	$ 693,149	$ 668,123	$ 711,007	$ 871,220	$ 844,736	$ 800,294	$ 727,548	(1)(2)	WP 9-6
3	Enhanced Vegetation Management - Vegetation Management Balancing Account (VMBA)	$ -	$ -	$ 306,412	$ 470,426	$ 451,390	$ 535,952	$ 916,600	$ 118,022	$ 117,555	$ 112,177	$ 102,234	(3)	WP 9-7
4	Tree Mortality - Vegetation Management Balancing Account (VMBA)	$ 183,638	$ 194,761	$ 69,022	$ 73,262	$ 93,070	$ 67,978	$ 144,000	$ 69,830	$ 70,423	$ 71,003	$ 70,396	(4) (5)	WP 9-8
5	Miscellaneous	$ 71	$ 404	$ (167)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	(6)	
6	**Total**	**$ 382,444**	**$ 396,621**	**$ 638,682**	**$ 918,836**	**$ 1,237,610**	**$ 1,272,053**	**$ 1,771,608**	**$ 1,059,072**	**$ 1,032,714**	**$ 983,475**	**$ 900,178**		

Notes

(1) Implementation of SB247 (SB247: All qualified line clearance tree trimmers shall be paid no less than the prevailing wage rate for a first period apprentice electrical utility lineman as determined by the Director of Industrial Relations) beginning in 2020

(2) Routine Distribution recorded include manual adjustments in 2018 and 2019

(3) PG&E will recover Enhanced Vegetation Management Tree Work costs in the Fire Hazard Prevention Memorandum Account (FHPMA) in 2018, Fire Reduction Mitigation Memorandum Account (FRMMA) in 2019 and Vegetation Management Balancing Account (VMBA) beginning 2020. These amounts are shown in testimony and workpapers for trending purposes

(4) PG&E will recover Tree Mortality in the Vegetation Management Balancing Account (VMBA) beginning Feb 16, 2020

(5) Tree Mortality recorded include manual adjustments in 2018 and 2019

(6) Includes miscellaneous recorded costs for Routine Vegetation Management.

Workpaper Table 9-6
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 9, Vegetation Management
Routine Distribution Summary
(Thousands of Nominal Dollars)

Line No.		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026		
1		Recorded	Recorded	Recorded	Recorded	Recorded	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Notes	Reference
2	**Routine Tree Work**	**$ 182,214**	**$ 184,499**	**$ 243,348**	**$ 327,352**	**$ 654,562**	**$ 540,334**	**$ 516,284**	**$ 753,130**	**$ 730,236**	**$ 691,818**	**$ 628,932**		
3	Routine Regulatory Compliance	$ 160,959	$ 157,442	$ 234,373	$ 325,860	$ 653,986	$ 539,788	$ 468,078	$ 471,854	$ 457,510	$ 433,440	$ 394,041	(1)(2)	WP 9-13, line 4
4	Legacy Public Safety and Reliability	$ 21,739	$ 23,538	$ 8,575	$ 1,458	$ 576	$ 530	$ 534	$ 578	$ 560	$ 531	$ 482		WP 9-13, line 5
5	Joint Pole Credits	$ (485)	$ 3,519	$ 400	$ 34	$ -	$ 17	$ -	$ -	$ -	$ -	$ -	(3)	WP 9-13, line 6
6	EVM Maintenance	$ -	$ -	$ -	$ -	$ -	$ -	$ 47,672	$ 20,750	$ 20,120	$ 19,061	$ 17,328		WP 9-13, line 7
7	Incremental Routine VM	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 259,948	$ 252,046	$ 238,786	$ 217,080		
8	**Vegetation Control**	**$ 8,886**	**$ 8,857**	**$ 9,686**	**$ 12,638**	**$ 23,038**	**$ 24,539**	**$ 24,743**	**$ 26,765**	**$ 25,951**	**$ 24,586**	**$ 22,351**		WP 9-13, line 8
9	**Other Programs**	**$ 7,636**	**$ 8,101**	**$ 10,380**	**$ 35,159**	**$ 15,548**	**$ 103,250**	**$ 169,980**	**$ 91,325**	**$ 88,549**	**$ 83,890**	**$ 76,265**		WP 9-13, line 9
10	Contractor Safety	$ 364	$ 993	$ 2,611	$ 25,488	$ 1,482	$ 9,141	$ 9,217	$ 9,970	$ 9,667	$ 9,158	$ 8,326	(4)	WP 9-13, line 10
11	Safety Oversight, Quality Verification, and Quality Assurance	$ 4,011	$ 3,734	$ 4,197	$ 5,660	$ 7,514	$ 87,685	$ 138,254	$ 74,348	$ 72,088	$ 68,296	$ 62,088	(5)	WP 9-13, line 11
12	Public Education	$ 863	$ 718	$ 941	$ 543	$ 600	$ 618	$ 623	$ 674	$ 654	$ 619	$ 563	(6)	WP 9-13, line 12
13	Environmental Compliance	$ 2,399	$ 2,656	$ 2,631	$ 3,468	$ 5,953	$ 5,806	$ 5,854	$ 6,333	$ 6,140	$ 5,817	$ 5,288	(7)	WP 9-13, line 13
14	Wood Management	$ -	$ -	$ -	$ -	$ -	$ -	$ 16,031	$ -	$ -	$ -	$ -		
15														
16	**Total Routine Distribution**	**$ 198,736**	**$ 201,456**	**$ 263,414**	**$ 375,148**	**$ 693,149**	**$ 668,123**	**$ 711,007**	**$ 871,220**	**$ 844,736**	**$ 800,294**	**$ 727,548**		

Notes

(1) Routine Defined Scope was implemented in 2020 with a complete rollout in 2021. LiDAR was previously broken out but now included in Routine Regulatory Compliance.

(2) 2018: $2,953,910 manual adjustment for CEMA/Routine incrementality journal entry performed in 2020.
2019 Routine: $11,881,473 manual adjustment for CEMA/Routine incrementality journal entry performed in 2020.
2020 Routine: -$14,835,383 manual adjustment in 2020 for CEMA/Routine incrementality journal entry performed in 2020.

(3) Joint Pole credits are attained through sharing the cost associated with PG&E's Hazard Tree removal work in locations that share facilities with communication companies. No credits have been forecasted in 2023 due to difficulty reaching agreement with telecommunication companies.

(4) Contractor Safety Program started in 2016 to focus on improving contractor safety practices. The program was fully implemented in 2017. Program continues as tree work volume and complexity have increased.

(5) Quality Assurance verifies that the Vegetation Management program is operating as planned and in compliance with state and federal regulations. In 2014, PG&E enhanced the QA program to more thoroughly audit the vegetation management program and facilitate document governance. The staffing of the QA program, including the split between PG&E employees and contractors, has fluctuated resulting in variations in the annual recorded and forecasted amounts for QA. Beginning Q4 of 2020, PG&E began onboarding ~95 Vegetation Management Inspectors (VMI) and ~350 Work Verifiers (WV) both as internal PG&E employees and contractors across all vegetation management programs. Beginning in 2023 PG&E anticipates a team consisting of approximately 350 VMIs, Work Verifiers, and Safety Observers/SVMIs. The difference in cost is primarily due to changes headcount due to supporting the change in the scope of quality assurance and quality verification work.

(6) Public education includes communication materials, outreach efforts, tree planting events and customer satisfaction activities to inform the public. The forecast is based on last recorded year (2020) plus escalation.

(7) Environmental compliance includes activities performed in order to maintain compliance with environmental laws and regulations. The majority of the forecast costs will be used for screening to look for endangered species or habitats that require protection. The increase in spending, starting in 2019, is due to PG&E modifying its processes to increase environmental review and oversight of vegetation management work.

Workpaper Table 9-7
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 9, Vegetation Management
Enhanced Vegetation Management Summary
(Thousands of Nominal Dollars)

Line No.			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026		
1		MWC	Recorded	Recorded	Recorded	Recorded	Recorded	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Notes	Reference
2	**Enhanced Vegetation Management - VMBA**	**IG**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 451,390**	**$ 535,952**	**$ 916,600**	**$ 118,022**	**$ 117,555**	**$ 112,177**	**$ 102,234**	(1)	WP 9-13, Line 16
3	Overhang Clearing & Radial Clearance	IG	$ -	$ -	$ -	$ -	$ 331,715	$ 408,645	$ 680,495	$ 90,205	$ 89,848	$ 85,737	$ 78,138	(2)(3)(7)	WP 9-13, Line 17
4	Utility Defensible Space	IG	$ -	$ -	$ -	$ -	$ 5,221	$ 28,710	$ 29,500	$ 5,000	$ 4,980	$ 4,752	$ 4,331	(4)	WP 9-13, Line 18
5	Wood Management	IG	$ -	$ -	$ -	$ -	$ 92,733	$ 55,078	$ 71,735	$ 11,496	$ 11,451	$ 10,927	$ 9,959	(5)	WP 9-13, Line 19
6	Safety Oversight, Work Verification, Quality Verification, and Quality Assurance	IG	$ -	$ -	$ -	$ -	$ 21,721	$ 43,518	$ 55,870	$ 11,321	$ 11,276	$ 10,760	$ 9,807	(6)	WP 9-13, Line 20
7	One Veg	IG	$ -	$ -	$ -	$ -	$ -	$ -	$ 79,000	$ -	$ -	$ -	$ -	(8)	WP 9-13, Line 21
8	**Enhanced Vegetation Management - FRMMA**	**IG**	**$ -**	**$ -**	**$ -**	**$ 470,426**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	(1)	WP 9-13, Line 16
9	Overhang Clearing and Radial Clearance	IG	$ -	$ -	$ -	$ 382,838	$ -	$ -	$ -	$ -	$ -	$ -	$ -	(2)(3)	WP 9-13, Line 17
10	Utility Defensible Space	IG	$ -	$ -	$ -	$ 12,064	$ -	$ -	$ -	$ -	$ -	$ -	$ -	(4)	WP 9-13, Line 18
11	Wood Management	IG	$ -	$ -	$ -	$ 65,262	$ -	$ -	$ -	$ -	$ -	$ -	$ -	(5)	WP 9-13, Line 19
12	Safety Oversight, Work Verification, Quality Verification, and Quality Assurance	IG	$ -	$ -	$ -	$ 10,263	$ -	$ -	$ -	$ -	$ -	$ -	$ -	(6)	WP 9-13, Line 20
13	**Enhanced Vegetation Management - Fire Hazard Prevention Memorandum Account (FHPMA)**	**IG**	**$ -**	**$ -**	**$ 306,412**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	(1)	WP 9-13, Line 16
14	Overhang Clearing and Radial Clearance	IG	$ -	$ -	$ 241,623	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	(2)(3)	WP 9-13, Line 17
15	Utility Defensible Space	IG	$ -	$ -	$ 35,931	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	(4)	WP 9-13, Line 18
16	Wood Management	IG	$ -	$ -	$ 28,858	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	(5)	WP 9-13, Line 19
17	Safety Oversight, Work Verification, Quality Verification, and Quality Assurance	IG	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	(6)	WP 9-13, Line 20
18	**Total Enhanced VM**		**$ -**	**$ -**	**$ 306,412**	**$ 470,426**	**$ 451,390**	**$ 535,952**	**$ 916,600**	**$ 118,022**	**$ 117,555**	**$ 112,177**	**$ 102,234**		

Notes

(1) Beginning in 2018, PG&E will perform targeted work including the removal of overhanging vegetation from distribution lines in Tier 2 and Tier 3 HFTD areas to reduce the likelihood of wildfire ignitions and/or downed wires due to vegetation-conductor contact. PG&E will recover Enhanced Vegetation Management Tree Work costs in the Fire Hazard Prevention Memorandum Account (FHPMA) in 2018, Fire Reduction Mitigation Memorandum Account (FRMMA) in 2019 and Vegetation Management Balancing Account (VMBA) beginning 2020. These amounts are shown in testimony and workpapers for trending purposes

(2) Beginning in 2018, PG&E began developing a program to identify and trim or remove trees from ten high risk species where they are tall enough to strike power lines, have a clear path to strike and exhibit other potential risk factors (e.g. leaning or being weighted towards the power lines).

(3) LiDAR data collection will focus on Tier 2 and Tier 3 HFTD areas. Recorded costs and forecast were previously broken out but are now included in Overhang Clearing & Radial Clearance

(4) Beginning in 2018, PG&E began a Fuel Reduction effort, now referred to as Utility Defensible Space, to treat vegetation under and adjacent to distribution power lines located in Tier 2 and Tier 3 HFTD areas.

(5) PG&E anticipates savings related to wood management related to renegotiating contracts with existing vendors, issuing new requests for proposal to competitively bid, and redefining the scope of this work in 2023.

(6) Quality Assurance verifies that the Vegetation Management program is operating as planned and in compliance with state and federal regulations. The staffing of the QA program, including the split between PG&E employees and contractors, has fluctuated resulting in variations in the annual recorded and forecasted amounts for QA. Beginning Q4 of 2020, PG&E began onboarding ~95 Vegetation Management Inspectors (VMI) and ~350 Work Verifiers (WV) both as internal PG&E employees and contractors across all vegetation management programs. Beginning in 2023 only internal VMIs and WVs are included in forecast.

(7) Beginning in 2023, the scope of work in Enhanced VM is Overhang Clearning only. Radial Clearance becomes part of Routine VM.

(8) In 2022 PG&E will transition to the One Veg model

Workpaper Table 9-8
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 9, Vegetation Management
Tree Mortality Summary
(Thousands of Nominal Dollars)

Line No.		MWC	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Notes	Reference
1															
2	**Tree Mortality**	**IG**	**$ 183,638**	**$ 194,761**	**$ 69,022**	**$ 73,262**	**$ 93,070**	**$ 67,978**	**$ 144,000**	**$ 69,830**	**$ 70,423**	**$ 71,003**	**$ 70,396**	(1)	WP 9-13, Line 22
3	Enhanced Vegetation Inspections and Mitigation Initiativ	IG					$ 83,561	$ 58,914	$ 119,517	$ 61,240	$ 61,759	$ 62,268	$ 61,736	(2)	WP 9-13, Line 23
4	Wood Management	IG					$ 2,871	$ 2,842	$ 4,828	$ 2,951	$ 2,976	$ 3,000	$ 2,975		WP 9-13, Line 24
5	Wildland Urban Interface Protectior	IG					$ 4,286	$ 2,189	$ 3,124	$ 2,273	$ 2,292	$ 2,311	$ 2,291		WP 9-13, Line 25
6	Fuel Reduction and Emergency Response Access	IG					$ 2,180	$ 2,000	$ 2,854	$ 2,077	$ 2,094	$ 2,112	$ 2,093		WP 9-13, Line 26
7	Safety Oversight, Work Verification, Quality Verification, and Qualit Assurance	IG					$ 173	$ 2,033	$ 13,677	$ 1,290	$ 1,301	$ 1,312	$ 1,301	(3)	WP 9-13, Line 27
8	**Total Tree Mortality**		**$ 183,638**	**$ 194,761**	**$ 69,022**	**$ 73,262**	**$ 93,070**	**$ 67,978**	**$ 144,000**	**$ 69,830**	**$ 70,423**	**$ 71,003**	**$ 70,396**		
9															
10															

11 **Notes**

12 (1) PG&E will recover Tree Mortality in the Vegetation Management Balancing Account (VMBA) beginning Feb.16, 2020. $9.7 million of Tree Mortality recorded costs (1/1/20-2/15/20) are included in PG&E's 2018 CEMA Application A.18-02-015 and not included herein.

13 (2) 2018: $2,953,910 manual adjustment for CEMA/Routine incrementality journal entry performed in 2020.
2019 Routine: $11,881,473 manual adjustment for CEMA/Routine incrementality journal entry performed in 2020.
2020 Routine: -$14,835,383 manual adjustment in 2020 for CEMA/Routine incrementality journal entry performed in 2020

14 (3) Quality Assurance verifies that the Vegetation Management program is operating as planned and in compliance with state and federal regulations. The staffing of the QA program, including the split between PG&E employees and contractors, has fluctuated resulting in variations in the annual recorded and forecasted amounts for QA. Beginning Q4 of 2020, PG&E began onboarding ~95 Vegetation Management Inspectors (VMI) and ~350 Work Verifiers (WV) both as internal PG&E employees and contractors across all vegetation management programs. Beginning in 2023 only internal VMI's and WV are included in forecast.

15

16 **Adjustments**	2016	2017	2018	2019	2020
17 Routine Tree Work: (Incrementality Journal Entry			$ 2,954	$ 11,881	$ (14,835)
18 Tree Mortality: (Incrementality Journal Entry			$ (2,954)	$ (11,881)	$ 14,835
19 1/1/20-2/15/20 Time period included in CEMA Filing					$ 9,738

20
21

22 1/1/20-2/15/20 Time period included in CEMA Filing	Exclude from 2020 Filing ($k)
23 5244155: Enhanced VEG Inspection & Mitigation	$ 8,729
24 5244156: Urban Wild Land Interface Protection	$ 431
25 5244158: Fuel Reduction & Emergency Resp Access	$ 577
26 5244159: Early Detection Response to Wildfires	$ -
27 5244457: Early Detect Forest Disease or Infestation	$ -
28 5248512: Public Communication	$ -
29 Grand Total	$ 9,738

Workpaper Table 9-9
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 9, Vegetation Management
Routine Regulatory Compliance and Tree Work Forecast Details
(Thousands of Nominal Dollars)

Line No.		Recorded					Forecast							
2		**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**Notes**	**Reference**
3	# of Trees	1,078,049	1,264,300	1,289,259	1,273,796	1,560,055	1,491,625	1,551,625	1,546,783	1,537,100	1,522,576	1,503,209		
4	Total Cost	$ 198,736	$ 201,456	$ 263,414	$ 375,148	$ 693,149	$ 668,123	$ 711,007	$ 871,220	$ 844,736	$ 800,294	$ 727,548	(1)	WP 9-6, line 16
5	Average Cost per Tree	$ 184.35	$ 159.34	$ 204.31	$ 294.51	$ 444.31	$ 447.92	$ 458.23	$ 563.25	$ 549.56	$ 525.62	$ 484.00		
6	**Yearly Increase (million)**		**$ 2,721**	**$ 61,958**	**$ 111,734**	**$ 318,001**	**$ (25,026)**	**$ 42,885**	**$ 160,212**	**$ (26,484)**	**$ (44,442)**	**$ (72,746)**		

(1) In some instances, total costs may differ slightly from previously reported costs.

Number of Trees per Year by Division (excluding incremental hazard trees) (a)

Division	**2021 Forecast Routine Regulatory Compliance**
Central Coast	102,239
De Anza	46,974
Diablo	34,984
East Bay	16,766
Fresno	45,127
Kern	25,179
Los Padres	80,205
Mission	17,977
North Bay	82,656
North Coast	266,046
North Valley	163,912
Peninsula	45,129
Sacramento	102,734
San Francisco	2,168
San Jose	184,807
Sierra	27,458
Stockton	127,428
Yosemite	119,836
System	**1,491,625**

Division	**2022 - 2026 Forecast Routine Regulatory Compliance (b)**
Central Coast	89,506
De Anza	41,847
Diablo	37,087
East Bay	16,807
Fresno	48,101
Kern	20,421
Los Padres	67,638
Mission	17,387
North Bay	66,395
North Coast	246,708
North Valley	157,137
Peninsula	45,279
Sacramento	97,925
San Francisco	2,240
San Jose	23,425
Sierra	176,702
Stockton	114,687
Yosemite	107,333
System	**1,376,625**

(a) Number of hazard trees is shown on Workpaper Table 9-10, line 26
(b) The number of routine regulatory compliance trees decreases each year as shown on Table 9-10.

Workpaper Table 9-10
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 9, Vegetation Management
Routine Vegetation Management Trim and Removal Work
(Nominal Dollars)

Line No.		Recorded					Forecast						Reference
1													
2		**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
3													
4	Trims/Prunes	985,649	1,136,496	1,136,974	1,086,439	1,368,327	1,285,132	1,106,650	1,107,267	1,108,729	1,110,847	1,113,736	
5	Removals	92,400	127,804	187,357	187,357	191,728	206,493	333,078	332,407	331,117	329,119	326,396	
6	Total Tree Units (1)	1,078,049	1,264,300	1,324,331	1,273,796	1,560,055	1,491,625	1,551,625	1,546,883	1,537,100	1,522,576	1,503,209	
7													
8	Nominal-year SAP$ (thousand)	$ 182,214	$ 184,499	$ 243,348	$ 327,352	$ 654,562	$ 540,334	$ 516,284	$ 753,130	$ 730,236	$ 691,818	$ 628,932	WP 9-6, line 2
9	Average Unit Cost (Nominal-year SAP$)	$169.02	$145.93	$183.75	$256.99	$419.58	$362.25	$332.74	$486.87	$475.07	$454.37	$418.39	
10													
11													
12	Trim Units %	91%	90%	86%	85%	88%	86%	88%	88%	88%	89%	90%	
13	Removal Units %	9%	10%	14%	15%	12%	14%	12%	12%	12%	11%	10%	
14													

15 Notes:
16 (1) Starting in 2023 the Routine VM program includes both the trees historically removed as part of Routine VM and the removal of hazard trees as part of the Incremental Routine VM scope of work.
17
18
19

		2022	2023	2024	2025	2026
20	Calculating the forecast number of trees 2022-2026	Routine Regulatory Compliance Trees	1,376,625	1,376,625	1,376,625	1,376,625	1,376,625
21		Reduce Trees Worked as UG Work Occurs (a)	-	(3,442)	(10,325)	(20,649)	(34,416)
22		Subtotal	1,376,625	1,373,183	1,366,300	1,355,976	1,342,209
23							
24		Incremental Hazard Tree Removal	175,000	175,000	175,000	175,000	175,000
25		Reduce Trees Worked as UG Work Occurs (a)	-	(1,400)	(4,200)	(8,400)	(14,000)
26		Subtotal	175,000	173,600	170,800	166,600	161,000
27							
28		**Total**	**1,551,625**	**1,546,783**	**1,537,100**	**1,522,576**	**1,503,209**
29							
30							
31		Routine Regulatory Compliance Removal	1,358,898	1,358,898	1,358,898	1,358,898	1,358,898
32		Trim/Prune	192,728	187,886	178,203	163,679	144,312
33							
34		Trim Units %	88%	88%	88%	89%	90%
35		Removal Units %	12%	12%	12%	11%	10%
36							

(a) PG&E's forecast assumes that it will work fewer trees and remove fewer hazard trees as system hardening underground work progresses

Workpaper Table 9-11
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 9, Vegetation Management
Enhanced Vegetation Management Tree Work Forecast Details
(Nominal Dollars)

Line No.	Item	Forecast						Assumptions	Reference
		2021	2022	2023	2024	2025	2026		
1	**Overhang Clearing & Radial Clearance Miles to be Worked**	1,890	1,890	1,800	1,800	1,800	1,800	(1)	
2	**Trees Removals Per Mile**	70.4	70.4	70.4	70.4	70.4	70.4	(2)	
3	**Trees Trims Per Mile**	30.2	30.2	30.2	30.2	30.2	30.2	(3)	
4	**Equivalent Tree Removals per Mile**	80.4	80.4	80.4	80.4	80.4	80.4	(4)	
5	**Cost Per Tree Removal**	$5,081	$8,461	$1,122	$1,117	$1,066	$972	(5)	
6	**Cost Per Mile**	$216	$360	$50	$50	$48	$43		
7	**Overhang Clearing & Radial Clearance Total Program Costs with Escalation (Overhang Clearing only starting in 2023)**	$408,645	$680,495	$90,205	$89,848	$85,737	$78,138		WP 9-7, line 3
8	**Utility Defensible Space**	$28,710	$29,500	$5,000	$4,980	$4,752	$4,331		WP 9-7, line 4
9	**Wood Management**	$55,078	$71,735	$11,496	$11,451	$10,927	$9,959		WP 9-7, line 5
10	**Safety Oversight, Work Verification, Quality Verification, and Quality Assurance**	$43,518	$55,870	$11,321	$11,276	$10,760	$9,807		WP 9-7, line 6
11	**One Veg**		$79,000						WP 9-7, line 7
12	**Enhanced Vegetation Management Total**	**$535,952**	**$916,600**	**$118,022**	**$117,555**	**$112,177**	**$102,234**		
13									
14									

15 **Forecast Assumptions and Detail**

16 (1) The Enhanced VM program is a 12-year program starting in 2021. The initial clearing of overhangs is forecast to include at least 1,890 miles in 2021 and 2022 1,800 miles per year thereafter per the plan approved by PG&E's WGSC. The final annual planned number of miles may be more than planned and will be based on the outputs from the Wildfire Distribution Risk model and Wildfire Distribution Risk Model with EVM Tree Weighted Prioritization.

17 (2) Estimated tree density is informed by the 2019 and 2020 LiDAR point survey conducted by PG&E and assumes approximately 100 trees per mile. Inspection data identified that approximately 70% of trees that reach within 4' of conductors will require removal.

18 (3) Estimated tree density is informed by the 2019 and 2020 LiDAR point survey conducted by PG&E and assumes approximately 100 trees per mile. Inspection data identified that approximately 30% of trees that reach within 4' of conductors will require trim.

19 (4) PG&E estimates equivalent removal units based on the assumptions that a tree trim costs one third as much as a tree removal.

20 (5) PG&E does not track Enhanced Vegetation Management costs on a "per tree removed" basis, and the overall cost for this work cannot be divided by the number of trees removed (or trimmed) to determine a reasonably accurate per-removed tree (or trimmed tree) cost because of the various types of work that comprises PG&E's Enhanced Vegetation Management program. PG&E has imputed costs for trimming and removing trees for the GRC 2023 filing, but does not track actual costs on this basis.

Workpaper Table 9-12
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 9, Vegetation Management
Tree Mortality Tree Removal Work Forecast Details
(Nominal Dollars)

Line No.		Recorded					Forecast						Notes
1													
2		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	
3													
4	Removals	281,000	94,100	62,500	45,600	65,402	65,000	95,000	65,000	65,000	65,000	65,000	
5	Total Cost	$ 183,638	$ 194,761	$ 69,022	$ 73,262	$ 93,070	$ 67,978	$ 144,000	$ 69,830	$ 70,423	$ 71,003	$ 70,396	(1)(2)
6	Average Cost per Tree	$ 654	$ 2,070	$ 1,104	$ 1,607	$ 1,423	$ 1,046	$ 1,516	$ 1,074	$ 1,083	$ 1,092	$ 1,083	

Notes
(1) PG&E will recover Tree Mortality in the Vegetation Management Balancing Account (VMBA) beginning Feb 16, 2020
(2) Tree Mortality recorded include manual adjustments in 2018 and 2019

Workpaper Table 9-13
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 9, Vegetation Management
Vegetation Management Balancing Account Cost Summary
(Thousands of Nominal Dollars)

Line No.		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Difference	Total	Notes
1		Recorded	Recorded	Recorded	Recorded	Recorded	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	2023 Forecast - 2020 Recorded	2023 through 2026	
2	**Routine Distribution Vegetation Management**	**$ 198,736**	**$ 201,456**	**$ 263,414**	**$ 375,148**	**$ 693,149**	**$ 668,123**	**$ 711,007**	**$ 871,220**	**$ 844,736**	**$ 800,294**	**$ 727,548**	**$ 178,071**	**$ 3,243,798**	
3	**Routine Tree Work**	**$ 182,214**	**$ 184,499**	**$ 243,348**	**$ 327,352**	**$ 654,562**	**$ 540,334**	**$ 516,284**	**$ 753,130**	**$ 730,236**	**$ 691,818**	**$ 628,932**	**$ 98,567**		
4	Routine Regulatory Compliance	$ 160,959	$ 157,442	$ 234,373	$ 325,860	$ 653,986	$ 539,788	$ 468,078	$ 471,854	$ 457,510	$ 433,440	$ 394,041	$ (182,133)		
5	Legacy Public Safety and Reliability	$ 21,739	$ 23,538	$ 8,575	$ 1,458	$ 576	$ 530	$ 534	$ 578	$ 560	$ 531	$ 482	$ 2		
6	Joint Pole Credits	$ (485)	$ 3,519	$ 400	$ 34	$ -	$ 17	$ -	$ -	$ -	$ -	$ -	$ -		
7	EVM Maintenance	$ -	$ -	$ -	$ -	$ -	$ -	$ 47,672	$ 20,750	$ 20,120	$ 19,061	$ 17,328	$ 20,750		
8	Incremental Routine VM							$ -	$ 259,948	$ 252,046	$ 238,786	$ 217,080	$ 259,948		
9	**Vegetation Control**	**$ 8,886**	**$ 8,857**	**$ 9,686**	**$ 12,638**	**$ 23,038**	**$ 24,539**	**$ 24,743**	**$ 26,765**	**$ 25,951**	**$ 24,586**	**$ 22,351**	**$ 3,727**		
10	**Other Programs**	**$ 7,636**	**$ 8,101**	**$ 10,380**	**$ 35,159**	**$ 15,548**	**$ 103,250**	**$ 169,980**	**$ 91,325**	**$ 88,549**	**$ 83,890**	**$ 76,265**	**$ 75,777**		
11	Contractor Safety	$ 364	$ 993	$ 2,611	$ 25,488	$ 1,482	$ 9,141	$ 9,217	$ 9,970	$ 9,667	$ 9,158	$ 8,326	$ 8,488		
12	Safety Oversight, Quality Verification, and Quality Assurance	$ 4,011	$ 3,734	$ 4,197	$ 5,660	$ 7,514	$ 87,685	$ 138,254	$ 74,348	$ 72,088	$ 68,296	$ 62,088	$ 66,834		
13	Public Education	$ 863	$ 718	$ 941	$ 543	$ 600	$ 618	$ 623	$ 674	$ 654	$ 619	$ 563	$ 74		
14	Environmental Compliance	$ 2,399	$ 2,656	$ 2,631	$ 3,468	$ 5,953	$ 5,806	$ 5,854	$ 6,333	$ 6,140	$ 5,817	$ 5,288	$ 380		
15	Wood Management							$ 16,031	$ -	$ -	$ -	$ -	$ -		
16	**Enhanced Vegetation Management**	**$ -**	**$ -**	**$ 306,412**	**$ 470,426**	**$ 451,390**	**$ 535,952**	**$ 916,600**	**$ 118,022**	**$ 117,555**	**$ 112,177**	**$ 102,234**	**$ (333,368)**	**$ 449,989**	(1)
17	Overhang Clearing and Radial Clearance	$ -	$ -	$ 241,623	$ 382,838	$ 331,715	$ 408,645	$ 680,495	$ 90,205	$ 89,848	$ 85,737	$ 78,138	$ (241,510)		
18	Utility Defensible Space	$ -	$ -	$ 35,931	$ 12,064	$ 5,221	$ 28,710	$ 29,500	$ 5,000	$ 4,980	$ 4,752	$ 4,331	$ (221)		
19	Wood Management	$ -	$ -	$ 28,858	$ 65,262	$ 92,733	$ 55,078	$ 71,735	$ 11,496	$ 11,451	$ 10,927	$ 9,959	$ (81,237)		
20	Safety Oversight, Work Verification, Quality Verification, and Quality Assurance	$ -	$ -	$ -	$ 10,263	$ 21,721	$ 43,518	$ 55,870	$ 11,321	$ 11,276	$ 10,760	$ 9,807	$ (10,400)		
21	One Veg							$ 79,000							
22	**Tree Mortality**	**$ 183,638**	**$ 194,761**	**$ 69,022**	**$ 73,262**	**$ 93,070**	**$ 67,978**	**$ 144,000**	**$ 69,830**	**$ 70,423**	**$ 71,003**	**$ 70,396**	**$ (23,240)**	**$ 281,653**	(2)
23	Enhanced Vegetation Inspections and Mitigation Initiative	$ -	$ -	$ -	$ -	$ 83,561	$ 58,914	$ 119,517	$ 61,240	$ 61,759	$ 62,268	$ 61,736	$ (22,322)		(3)
24	Wood Management	$ -	$ -	$ -	$ -	$ 2,871	$ 2,842	$ 4,828	$ 2,951	$ 2,976	$ 3,000	$ 2,975	$ 80		
25	Wildland Urban Interface Protection	$ -	$ -	$ -	$ -	$ 4,286	$ 2,189	$ 3,124	$ 2,273	$ 2,292	$ 2,311	$ 2,291	$ (2,013)		
26	Fuel Reduction and Emergency Response Access	$ -	$ -	$ -	$ -	$ 2,180	$ 2,000	$ 2,854	$ 2,077	$ 2,094	$ 2,112	$ 2,093	$ (103)		
27	Safety Oversight, Work Verification, Quality Verification, and Quality Assurance	$ -	$ -	$ -	$ -	$ 173	$ 2,033	$ 13,677	$ 1,290	$ 1,301	$ 1,312	$ 1,301	$ 1,117		
28	**Miscellaneous**	**$ 71**	**$ 404**	**$ (167)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**		
29	**Total**	**$ 382,444**	**$ 396,621**	**$ 638,682**	**$ 918,836**	**$ 1,237,610**	**$ 1,272,053**	**$ 1,771,608**	**$ 1,059,072**	**$ 1,032,714**	**$ 983,475**	**$ 900,178**	**$ (178,537)**	**$ 3,975,440**	

	Funding Source										
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Routine Tree Work	VMBA	VMBA	VMBA	VMBA	VMBA	VMBA	VMBA	VMBA	VMBA	VMBA	VMBA
Enhanced Vegetation Management Tree Work			FHPMA	FHPMA/ FRMMA	VMBA	VMBA	VMBA	VMBA	VMBA	VMBA	VMBA
Tree Mortality	CEMA	CEMA	CEMA	CEMA	VMBA	VMBA	VMBA	VMBA	VMBA	VMBA	VMBA

Routine distribution	$ 198,736	$ 201,456	$ 263,414	$ 375,148	$ 693,149	$ 668,123	$ 711,007	$ 871,220	$ 844,736	$ 800,294	$ 727,548
Enhanced Vegetation Management	$ -	$ -	$ 306,412	$ 470,426	$ 451,390	$ 535,952	$ 916,600	$ 118,022	$ 117,555	$ 112,177	$ 102,234
Tree Mortality	$ 183,638	$ 194,761	$ 69,022	$ 73,262	$ 93,070	$ 67,978	$ 144,000	$ 69,830	$ 70,423	$ 71,003	$ 70,396
Total	**$ 382,374**	**$ 396,217**	**$ 638,848**	**$ 918,836**	**$ 1,237,610**	**$ 1,272,053**	**$ 1,771,608**	**$ 1,059,072**	**$ 1,032,714**	**$ 983,475**	**$ 900,178**

Notes:

(1) Starting in 2023 the scope of work in Enhanced VM transitions to Overhang Clearing. Radial Clearance becomes part of Routine VM.

(2) Recorded costs for tree mortality are shown here for trending purposes and may differ slightly from previously reported costs. Recorded costs from 2016-2019 are included in the 2018 Catastrophic Event Memorandum Account (CEMA) A. 18-03-015.

(3) PG&E will recover Tree Mortality in the Vegetation Management Balancing Account (VMBA) beginning Feb.16, 2020. $9.7 million of Tree Mortality recorded costs (1/1/20-2/15/20) are included in PG&E's 2018 CEMA Application A.18-02-015 and not included herein.

Workpaper Table 9-14
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 9 - Vegetation Management
Unit Cost and Forecast Details: MWC HN

Line No.

1	**MWC**	HN
2	**GRC Ch.**	9 - Vegetation Management
3	**MWC Definition**	Vegetation Management Balancing Account – Includes costs necessary to support and execute patrolling, inspecting and maintaining clearances of vegetation along PG&E's OH high voltage electric distribution lines. The program covers routine tree trimming and removal, vegetation control, contractor quality control, environmental compliance and public education, and fire risk reduction work. This program relates to safety and reliability by managing the vegetation adjacent to powerlines to reduce the risk of vegetation contact with the electric distribution equipment.

	Risk ID	Type	Name
4	DOVHD-M001	Control	Vegetation Management
5	WLDFR-C004	Control	Vegetation Management - Distribution Overhead

6	**Program Area**	Maintenance and Compliance
7	**Forecast Method**	Unit cost
8	**Unit of Measure**	# of Veg. Mgmt Trees
9	**Unit Cost (2023)**	$ 539
10	**Unit Cost Forecast Basis**	Defined scope contract that PG&E entered into with vendors in late 2020, plus additional costs for EV Maintenance and Safety Oversight and Quality Work Verification. Incremental Routine VM costs are based on the costs for Level 1 and Level 2 strike tree assessments in the HFTD and the costs for removing hazard trees that may be identified as part of these inspections.
11	**Unit Forecast Basis**	2021 work plan incorporating the work in Defined Scope Vegetation Management Contracts. The number of trees that may be removed in the Incremental Routine VM program is based on ar estimate of the number of hazard trees removed historically under the Routine VM program and adjusted to account for trees that may be identified as part of the Level 1 and Level 2 inspections.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
12	**Recorded Costs**	$ 198,735,574	$ 201,456,190	$ 260,460,059	$ 363,266,641	$ 693,148,966	Calculated - Line 13 * Line 14
13	**No. of Units**	1,078,049	1,264,300	1,289,259	1,273,796	1,560,055	
14	**Unit Cost**	$ 184	$ 159	$ 202	$ 285	$ 444	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
15	**Forecast Costs**	$ 668,122,962	$ 711,007,474	$ 871,219,828	$ 844,736,102	$ 800,294,252	$ 727,547,910	Calculated - Line 16 * Line 17
16	**No. of Units**	1,491,625	1,551,625	1,546,783	1,537,100	1,522,576	1,503,209	
17	**Unit Cost**	$ 448	$ 458	563	$ 550	$ 526	$ 484	

18	**Notes**	
	(A)	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding

Workpaper Table 9-15
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 9 - Vegetation Management
Unit Cost and Forecast Details: MAT IGJ

Line No.

1	**MAT Code**	IGJ
2	**GRC Ch.**	9 - Vegetation Management
3	**MAT Code Definition**	Work in this MAT is targeted work, primarily in Tier 2 and Tier 3 HFTD areas, to further mitigate the possibility of wildfire ignitions and/or downed wires due to vegetation-conductor contact. This work includes establishing greater conductor to vegetation clearances and clearing overhanging vegetation from distribution lines, This multi-year effort continues during this GRC period. Overhang clearing and radial clearance includes removing all branches that directly overhang or reach within four horizontal feet of electric distribution lines

	Risk ID	Type	Name
4	DOVHD-M001	Mitigation	Enhanced Vegetation Management
5	WLDFR-M001	Mitigation	Enhanced Vegetation Management

6	**Program Area**	Risk Reduction
7	**Forecast Method**	Unit cost
8	**Unit of Measure**	Miles
9	**Unit Cost (2023)**	$ 65,568
10	**Unit Cost Forecast Basis**	Implied based on forecast and planned number of miles.
11	**Unit Forecast Basis**	Completing at least 1,890 miles per year, based on outputs from the Wildfire Distribution Risk Model.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
12	**Recorded Costs**	$ -	$ -	$ 306,412,302	$ 470,426,089	$ 451,390,239	Calculated - Line 13 * Line 14
13	**No. of Units**	-	-	621	2,498	1,878	
14	**Unit Cost**	$ -	$ -	$ 493,418	$ 188,321	$ 240,357	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
15	**Forecast Costs**	$ 535,951,926	$ 916,600,000	$ 118,022,400	$ 117,555,234	$ 112,176,917	$ 102,234,120	Calculated - Line 16 * Line 17
16	**No. of Units**	1,890	1,890	1,800	1,800	1,800	1,800	
17	**Unit Cost**	$ 283,572	$ 484,974	$ 65,568	$ 65,308	$ 62,321	$ 56,797	

Notes

18 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

19 **(B)** In 2018, the recorded costs and units were associated with the Accelerated Wildfire Risk Reduction (AWRR) program, which was replaced by this program

Workpaper Table 9-16
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 9 - Vegetation Management
Unit Cost and Forecast Details: MAT IGI

Line No.

1	**MAT Code**	IGI
2	**GRC Ch.**	9 - Vegetation Management
3	**MAT Code Definition**	Work in this MAT includes tree mortality work, which targets dead, dying or diseased trees that, once mitigated, will no longer pose a threat to overhead electric facilities.

	Risk ID	Type	Name
4	DOVHD-C002	Control	Vegetation Management - CEMA/Tree Mortality
5	WLDFR-C007	Control	Vegetation Management - CEMA/Tree Mortality

6	**Program Area**	Risk Reduction
7	**Forecast Method**	Unit cost
8	**Unit of Measure**	# of Veg. Mgmt Trees
9	**Unit Cost (2023)**	$ 1,074
10	**Unit Cost Forecast Basis**	Tree Mortality tree units and costs for 2023 – 2026 are planned at a level consistent with PG&E's 2020 recorded units and 2021 planed units.
11	**Unit Forecast Basis**	Tree Mortality tree units and costs for 2023 – 2026 are planned at a level consistent with PG&E's 2020 recorded units and 2021 planed units.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
12	**Recorded Costs**	$ 183,637,546	$ 194,761,013	$ 71,976,150	$ 85,143,735	$ 93,070,401	Calculated - Line 13 * Line 14
13	**No. of Units**	281,000	94,100	62,500	45,600	66,215	
14	**Unit Cost**	$ 654	$ 2,070	$ 1,152	$ 1,867	$ 1,406	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
15	**Forecast Costs**	$ 67,977,674	$ 144,000,050	$ 69,830,227	$ 70,422,901	$ 71,003,348	$ 70,396,338	Calculated - Line 16 * Line 17
16	**No. of Units**	65,000	95,000	65,000	65,000	65,000	65,000	
17	**Unit Cost**	$ 1,046	$ 1,516	$ 1,074	$ 1,083	$ 1,092	$ 1,083	

18 **Notes (A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 9-17
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 9, Vegetation Management
Vegetation Management Balancing Account Cost Summary - Comparing PG&E's June 30, 2021 Forecast to its Updated February 25, 2022 Forecast
(Thousands of Nominal Dollars)

Line No.		February 25, 2022 Updated Forecast					June 30, 2021 Forecast					Difference: February 25, 2022 Forecast - June 30, 2021 Forecast						June 31, 2021 Forecast
		2022	2023	2024	2025	2026	2022	2023	2024	2025	2026	2022	2023	2024	2025	2026	Total	Total
1		Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	2023 to 2026	2023 to 2026
2	**Routine Distribution Vegetation Management**	**$ 711,007**	**$ 871,220**	**$ 844,736**	**$ 800,294**	**$ 727,548**	**$ 585,224**	**$ 575,225**	**$ 590,565**	**$ 607,882**	**$ 624,441**	**$ 125,783**	**$ 295,995**	**$ 254,171**	**$ 192,412**	**$ 103,107**	**$ 845,685**	**$ 2,398,113**
3	**Routine Tree Work**	**$ 516,284**	**$ 753,130**	**$ 730,236**	**$ 691,818**	**$ 628,932**	**$ 446,917**	**$ 461,666**	**$ 474,224**	**$ 488,690**	**$ 502,329**	**$ 69,367**	**$ 291,463**	**$ 256,011**	**$ 203,127**	**$ 126,603**		
4	Routine Regulatory Compliance	$ 468,078	$ 471,854	$ 457,510	$ 433,440	$ 394,041	$ 429,955	$ 455,258	$ 468,490	$ 482,333	$ 496,402	$ 38,123	$ 16,596	$ (10,980)	$ (48,893)	$ (102,361)		
5	Legacy Public Safety and Reliability	$ 534	$ 578	$ 560	$ 531	$ 482	$ 526	$ 555	$ 568	$ 582	$ 597	$ 8	$ 23	$ (8)	$ (52)	$ (114)		
6	Joint Pole Credits	$ -	$ -	$ -	$ -	$ -	$ 3	$ 3	$ 3	$ 3	$ 3	$ (3)	$ (3)	$ (3)	$ (3)	$ (3)		
7	EVM Maintenance	$ 47,672	$ 20,750	$ 20,120	$ 19,061	$ 17,328	$ 16,433	$ 5,851	$ 5,162	$ 5,771	$ 5,328	$ 31,239	$ 14,900	$ 14,957	$ 13,290	$ 12,001		
8	Incremental Routine VM	$ -	$ 259,948	$ 252,046	$ 238,786	$ 217,080	$ -	$ -	$ -	$ -	$ -	$ -	$ 259,948	$ 252,046	$ 238,786	$ 217,080		
9	**Vegetation Control**	**$ 24,743**	**$ 26,765**	**$ 25,951**	**$ 24,586**	**$ 22,351**	**$ 24,389**	**$ 25,708**	**$ 26,338**	**$ 26,983**	**$ 27,644**	$ 355	$ 1,057	$ (386)	$ (2,397)	$ (5,293)		
10	**Other Programs**	**$ 169,980**	**$ 91,325**	**$ 88,549**	**$ 83,890**	**$ 76,265**	**$ 113,918**	**$ 87,851**	**$ 90,003**	**$ 92,208**	**$ 94,467**	**$ 56,062**	**$ 3,474**	**$ (1,454)**	**$ (8,318)**	**$ (18,203)**		
11	Contractor Safety	$ 9,217	$ 9,970	$ 9,667	$ 9,158	$ 8,326	$ 9,085	$ 9,576	$ 9,811	$ 10,051	$ 10,297	$ 132	$ 394	$ (144)	$ (893)	$ (1,972)		
12	Safety Oversight, Quality Verification, and Quality Assurance	$ 138,254	$ 74,348	$ 72,088	$ 68,296	$ 62,088	$ 98,449	$ 71,545	$ 73,297	$ 75,093	$ 76,933	$ 39,805	$ 2,804	$ (1,209)	$ (6,798)	$ (14,845)		
13	Public Education	$ 623	$ 674	$ 654	$ 619	$ 563	$ 614	$ 647	$ 663	$ 680	$ 696	$ 9	$ 27	$ (10)	$ (60)	$ (133)		
14	Environmental Compliance	$ 5,854	$ 6,333	$ 6,140	$ 5,817	$ 5,288	$ 5,770	$ 6,083	$ 6,232	$ 6,384	$ 6,541	$ 84	$ 250	$ (91)	$ (567)	$ (1,252)		
15	Wood Management	$ 16,031	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 16,031	$ -	$ -	$ -	$ -		
16	**Enhanced Vegetation Management**	**$ 916,600**	**$ 118,022**	**$ 117,555**	**$ 112,177**	**$ 102,234**	**$ 553,916**	**$ 550,686**	**$ 564,085**	**$ 577,809**	**$ 589,078**	**$ 283,684**	**$ (432,664)**	**$ (446,529)**	**$ (465,632)**	**$ (486,844)**	**$ (1,831,669)**	**$ 2,281,658**
17	Overhang Clearing and Radial Clearance	$ 680,495	$ 90,205	$ 89,848	$ 85,737	$ 78,138	$ 418,070	$ 428,906	$ 439,414	$ 450,179	$ 458,959	$ 262,425	$ (338,701)	$ (349,566)	$ (364,442)	$ (380,821)		
18	Utility Defensible Space	$ 29,500	$ 5,000	$ 4,980	$ 4,752	$ 4,331	$ 29,319	$ 30,079	$ 30,816	$ 31,571	$ 32,186	$ 181	$ (25,079)	$ (25,835)	$ (26,818)	$ (27,855)		
19	Wood Management	$ 71,735	$ 11,496	$ 11,451	$ 10,927	$ 9,959	$ 56,245	$ 57,703	$ 59,116	$ 60,565	$ 61,746	$ 15,490	$ (46,206)	$ (47,665)	$ (49,638)	$ (51,787)		
20	Safety Oversight, Work Verification, Quality Verification, and Quality Assurance	$ 55,870	$ 11,321	$ 11,276	$ 10,760	$ 9,807	$ 50,283	$ 34,000	$ 34,739	$ 35,495	$ 36,187	$ 5,587	$ (22,679)	$ (23,463)	$ (24,734)	$ (26,380)		
21	One Veg	$ 79,000																
22	**Tree Mortality**	**$ 144,000**	**$ 69,830**	**$ 70,423**	**$ 71,003**	**$ 70,396**	**$ 68,951**	**$ 70,771**	**$ 73,182**	**$ 75,634**	**$ 78,169**	**$ 75,050**	**$ (941)**	**$ (2,759)**	**$ (4,631)**	**$ (7,772)**	**$ (16,103)**	**$ 297,756**
23	Enhanced Vegetation Inspections and Mitigation Initiative	$ 119,517	$ 61,240	$ 61,759	$ 62,268	$ 61,736	$ 59,982	$ 62,165	$ 64,364	$ 66,601	$ 68,914	$ 59,535	$ (925)	$ (2,605)	$ (4,333)	$ (7,178)		
24	Wood Management	$ 4,828	$ 2,951	$ 2,976	$ 3,000	$ 2,975	$ 2,906	$ 2,977	$ 3,050	$ 3,125	$ 3,201	$ 1,922	$ (27)	$ (74)	$ (125)	$ (227)		
25	Wildland Urban Interface Protection	$ 3,124	$ 2,273	$ 2,292	$ 2,311	$ 2,291	$ 2,239	$ 2,293	$ 2,350	$ 2,407	$ 2,466	$ 885	$ (20)	$ (57)	$ (96)	$ (175)		
26	Fuel Reduction and Emergency Response Access	$ 2,854	$ 2,077	$ 2,094	$ 2,112	$ 2,093	$ 2,045	$ 2,095	$ 2,147	$ 2,199	$ 2,253	$ 809	$ (19)	$ (52)	$ (88)	$ (160)		
27	Safety Oversight, Work Verification, Quality Verification, and Quality Assurance	$ 13,677	$ 1,290	$ 1,301	$ 1,312	$ 1,301	$ 1,779	$ 1,240	$ 1,271	$ 1,302	$ 1,334	$ 11,898	$ 50	$ 30	$ 10	$ (33)		
28	**Miscellaneous**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**						$ -	$ -	$ -	$ -	$ -		
29	**Total**	**$ 1,771,608**	**$ 1,059,072**	**$ 1,032,714**	**$ 983,475**	**$ 900,178**	**$ 1,208,091**	**$ 1,196,683**	**$ 1,227,831**	**$ 1,261,325**	**$ 1,291,687**	**$ 484,517**	**$ (137,610)**	**$ (195,117)**	**$ (277,851)**	**$ (391,509)**	**$ (1,002,087)**	**$ 4,977,527**

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 9, VEGETATION MANAGEMENT
PROJECT SUMMARY – SAFETY OVERSIGHT, WORK VERIFICATION, QUALITY VERIFICATION AND ASSURANCE

Project Title: Safety Oversight, Work Verification, Quality Verification and Assurance
Major Work Categories: MWC HN, IGI
Planning Order Numbers:
Project Start Date: 2020
Project Completion Date: Ongoing
Operative Date (only applies to Capital): N/A

This project summary section has been modified to describe program changes related to PG&E's updated Vegetation Management program and forecast as of February 25, 2022.

Project Description

As part of the new, integrated wildfire mitigation strategy, PG&E is changing the scope of its VM programs. Starting in 2023, the Enhanced VM program will only include on overhang clearing (and associated activities) while radial clearance and identification and removal of hazard trees will become part of Routine VM. Because of the change in program scope, the people needed to perform safety oversight, quality verification and work verification will change, resulting in a decrease in PG&E's forecast for this work. PG&E is also removing QA audits from its forecast. They are unnecessary in addition to 100 percent work verification.

Safety Oversight (HN and IGI)
The VM Safety team supports field observations for all Vegetation Management (VM) vendors to encourage safe practices. They also trend data and report findings to operations for awareness. PG&E's Safety Oversight and Work Verification is performed by PG&E employees. More than 200 work verification inspectors have been hired since 2021 to perform sight safety inspections.
SafetyNet App
The SafetyNet App is available to all employees conducting in-field safety observations on tree crews, pre-inspectors, and Vegetation Control contractors. SafetyNet is the Vegetation Management system of record for recording safety observations. SafetyNet captures both Safe Findings as well as At-Risk Findings. SafetyNet is used by all VPMs, SVPMs, VMIs, Contract Foresters and VM Safety team members starting as of April 19, 202. The system and data collected allows for system and regional performance reporting related to OSHA, ANSI, and PG&E standards

Work Verification, Quality Verification and Assurance - Routine (HN)
PG&E performs Quality Assurance and Quality Verification audits of VM Defined Scope work.
Quality Assurance confirms through statistical random sampling that the work complies with standards and regulations; GO 95 Rule 35, PRC 4292 and PRC 4293. Quality Assurance (QA) also focuses on work procedure and guidance provided to pre-inspection and tree trimming contractors. QA audits are independent of specific pre-inspection and tree work projects performed through an annual plan that is created to identify areas of higher potential risk and to ensure that each Vegetation Management Region is audited at least once per year. The auditors also perform root cause analyses when non-compliance issues are identified. If a reoccurring or systemic issue is identified, Regional Managers are required to develop action plans for personnel and contractors to prevent recurrence.
Quality Verification focus is on contractor work quality through auditing sampled populations of recently completed work from Distribution Routine, Tree Mortality, Vegetation Control, Enhanced Vegetation

Management as well as, Routine Transmission and special projects. Quality Verification focuses on work quality of pre-inspection and tree trimming contractors.

Work Verification, Quality Verification and Assurance - Enhanced Vegetation Management (IGI)

Work Verification (WV) and Quality Verification are independent reviews of all Enhanced Vegetation Management (EVM) work to verify that:

(1) the Pre-Inspector prescribed tree work that is needed, per compliance requirements,
(2) tree work is completed as prescribed;
(3) the Pre-Inspector has listed out all strike trees; and
(4) all hazard trees are mitigated or removed

All (100 percent) of EVM pre-inspection work is reviewed by the WV team. WV employees are required to have extensive experience in forestry and/or utility line clearance work and/or ISA Arborist certification(s).

EVM Quality Assurance (QA)

The purpose of QA is to determine whether the EVM WV field personnel complied with the WV field process. QA audits use a sampling equation to determine the number of miles needed for a statistically valid audit.

Justifications

Safety

Compliance and conformance with safety requirements in OSHA, ANSI, PRC Health and Safety Code and PG&E standards.

Quality

Compliance verification with PRC 4293, PRC 4293, GO 95, Rule 35 and the systematic evaluation of vegetation standards and guidance.

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PROJECT SUMMARY – SAFETY OVERSIGHT, WORK VERIFICATION, QUALITY VERIFICATION AND ASSURANCE

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

								Updated February 25, 2022 Forecast			
Expense	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Routine	**Recorded**	**Recorded**	**Recorded**	**Recorded**	**Recorded**	**Forecast**	**Forecast**	**Forecast**	**Forecast**	**Forecast**	**Forecast**
Contractor Safety (HN, IG, IGI)	$ 364	$ 993	$2,611	$ 25,488	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Routine VM Safety Oversight, Work Verification, Quality Verification and Quality Assurance	$ 4,011	$ 3,734	$4,197	$5,660	$ 7,514	$87,685	$138,254	$74,348	$72,088	$ 68,296	$62,088
Enhanced VM Safety Oversight, Work Verification, Quality Verification and Quality Assurance			$ -	$10,263	$21,721	$ 43,518	$55,870	$11,321	$11,276	$10,760	$9,807
Tree Mortality Safety Oversight, Work Verification, Quality Verification and Quality Assurance					$173	$2,033	$13,677	$1,290	$1,301	$1,312	$1,301
Total	**$ 4,374**	**$ 4,727**	**$ 6,808**	**$ 51,673**	**$29,408**	**$133,236**	**$207,801**	**$86,959**	**$84,665**	**$80,368**	**$73,196**

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PROJECT SUMMARY – SAFETY OVERSIGHT, WORK VERIFICATION, QUALITY VERIFICATION AND ASSURANCE

Additional Cost Information:
None

Benefits

Safety

Employee, Contractor and Public Safety in alignment with company vision and culture expectations to maintain safety as the first and foremost priority.

Quality

Consistent and documented evaluation of compliance and conformance with regulation and company and contractual standards

Alternatives Considered

1 – Do not support Safety and Quality programs

- Loss of life and injuries
- Decreased public safety
- Decreased compliance
- Increased wildfire risk
- Decreased system reliability

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 9, VEGETATION MANAGEMENT
PROJECT SUMMARY – ENHANCED VEGETATION MANAGEMENT

Project Title: Enhanced Vegetation Management (VM)
Major Work Categories: MWC IG
Planning Order Numbers: 5273140 (Recorded costs in various planning orders)
Project Start Date: Jan 1, 2018
Project Completion Date: 2031
Operative Date (only applies to Capital): N/A

This project summary section has been modified to describe program changes related to PG&E's updated Vegetation Management program and forecast as of February 25, 2022.

Project Description

California has experienced dramatic, unpredictable climactic and environmental changes in recent years, resulting in record drought, massive tree mortality, periods of record rainfall, record heat waves, and extremely strong wind events. In support of public safety, PG&E routinely evolves its plans and programs in response to new standards and regulations – but the "new normal" of climate and environmental change, evident in the 2017 and 2018 wildfires statewide, means we must partner to do even more to strengthen the resiliency and safety of our state's energy infrastructure and communities. Therefore, as a precautionary measure to further reduce the threat of wildfires, PG&E is expanding vegetation management work in Tier 2 (elevated risk) and Tier 3 (extreme risk) areas of the California Public Utilities Commission's High Fire-Threat District (HFTD) map.

Enhanced Vegetation Management is a risk mitigation for both the Wildfire risk (WLDFR-M001) and the Failure of Distribution Overhead Assets risk (DOVHD-M001).

This Enhanced Vegetation Management program includes the following activities:

- Overhang Clearing and Radial Clearance—removing branches overhanging electric power lines or branches that reach within four horizontal feet of electric distribution lines to reduce the possibility of wildfire ignitions and/or downed wires due to vegetation-conductor contact.
- Evaluating the condition of trees— using the PG&E tree assessment tool (TAT) to determine if a strike tree (a tree tall enough to strike electrical facilities should it fall) should be abated (because it is a hazard tree) or just inventoried (healthy strike tree).
- Utility Defensible Space— creating "Fire Defense Zones".
- Wood management— The Wood Management program disposes of woody material in an environmentally safe and cost-effective manner.
- Work Verification (WV) —100 percent of EVM pre-inspection work is reviewed by the WV team.

PG&E revised the Enhanced VM Program in the February 25, 2022 GRC update. Starting in 2023, radial clearance and evaluating the condition of trees moves to the Routine VM program.

Overhang Clearing and Radial Clearance: Beginning in 2018, PG&E performed targeted work including the clearing of overhanging vegetation from above distribution lines in Tier 2 and Tier 3 HFTD areas to prevent the possibility of wildfire ignitions and/or downed wires due to vegetation-conductor contact. This will be a multi-year effort. In 2018, the Enhanced Vegetation Management program began executing different approaches to completing this work within Tier 3 HFTD areas with the goal of obtaining field information that can be used to

determine the most effective program plan going forward. For 2019 and beyond, the forecast for this program is based on removing all branches that directly overhang or reach within 4 horizontal feet of electric distribution lines. Removing overhanging branches and keeping the area above and immediately adjacent to distribution lines clear of limbs is intended to reduce the wildfire, public safety, and reliability impact of limbs failing into powerlines. This work will also support compliance with GO 95 Rule 35, California Public Utilities Code Section 8386, and PRC 4293, which require that no vegetation approach within 4 feet of electric distribution wires at any time (including when a branch or tree fails).

PG&E's June 30, 2011 forecast for 2023 Overhang Clearing was $428.9 million. PG&E's updated February 25, 2022 forecast for 2023 Overhang Clearing is $90.2 million.

In addition to the initial Overhang Clearing work, PG&E will need to perform annual, follow-up vegetation maintenance work on the sections of line previously cleared of overhangs to keep all branches above power line height from growing back into an overhanging position. As the number of miles initially cleared of overhangs grows, the annual maintenance costs will grow as well.

These maintenance costs are included under the Routine Vegetation Management program (MWC HN) and in the June 30, 2021 submittal were $16.4 million, $5.8 million, $5.1 million, $5.7 million, and $5.3 million, for 2022, 2023, 2024, 2025, and 2026, respectively.

These maintenance costs updated in February 2022 are $47.7 million, $20.8 million, $20.1 million, $19.1 million, and $17.3 million, for 2022, 2023, 2024, 2025, and 2026, respectively.

Evaluating the condition of trees: PG&E Pre-Inspectors use the PG&E tree assessment tool (TAT) to determine if a strike tree (a tree tall enough to strike electrical facilities should it fall) should be abated (because it is a hazard tree) or just inventoried (healthy strike tree). The TAT tool has various data inputs that inform the assessment, including but not limited to historical data and statistics on tree failures, tree species, lean, health, terrain, slope, and local wind gust data. In this way, the TAT tool serves as a risk prioritization tool that recognizes high-risk areas and tree species. The TAT is used by inspectors in the field on a per-tree basis to inform Pre-Inspectors on abatement decisions.

PG&E's EVM scope published in March of 2019 identified the top 10 species that should be removed if they qualify as strike trees. Pursuant to CPUC Rulemaking 18-10-007, which provided new direction and limitations associated with the removal of healthy trees in June 2019, we revised EVM scope to assess all strike trees regardless of species, but only remove those that are hazard trees. Hazard trees are trees that are dead or show signs of disease, decay or ground or root disturbance, which could fall into or otherwise impact PG&E's equipment. When the pre-inspector identifies a tree to be abated, it is assigned to a tree crew to be mitigated.

PG&E's 2023 forecast for evaluating the condition of trees is included in the Overhang Clearing and Radial Clearance forecast above.

Utility Defensible Space: In 2018, PG&E began a Fuel Reduction program to reduce vegetative fuels under and adjacent to power lines located within Tier 2 and Tier 3 HFTD areas. Work in this program includes the use of herbicides and tree growth regulators to minimize regrowth of combustible vegetation around PG&E facilities and to create "Fire Defense Zones".

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PROJECT SUMMARY – ENHANCED VEGETATION MANAGEMENT

"Fire Defense Zones" help to:

- Create safe space between power lines and trees and brush that can act as fuel for wildfires;
- Slow the spread of fires and improve access for first responders in the event of a wildfire; and
- Enhance defensible space around homes, businesses and properties, improving safety.

PG&E will work with property owners to perform this work selectively in Tier 2 and Tier 3 HFTD areas.

PG&E's June 30, 2021 forecast for the 2023 Utility Defensible Space Program was $30 million. PG&E's February 25, 2022 forecast for the 2023 Utility Defensible Space Program is $5 million.

Wood Management: The Wood Management program disposes of woody material in an environmentally safe and cost effective manner. Woody material is either worked on-site or removed at the property owner's request. If worked on-site it is either relocated, chipped or cut to specified length. If removed it is typically taken to a wood processing yard where it is ground into chips and transported to the final destination (i.e. BioMass facility, landfill, particle board processing, etc.).

PG&E's June 30, 2021 forecast for the 2023 Wood Management Program was $57.7 million. PG&E's updated February 25, 2022 forecast for the 2023 Wood Management Program is $11.5 million.

Safety Oversight, Work Verification, Quality Verification and Assurance: The VM Safety team supports field observations for all Vegetation Management (VM) vendors to encourage safe practices. They also trend data and report findings to operations for awareness. PG&E's Safety Oversight and Work Verification is performed by PG&E employees. More than 200 work verification inspectors have been hired since 2021 to perform sight safety inspections.

SafetyNet App: The SafetyNet App is available to all employees conducting in-field safety observations on tree crews, pre-inspectors, and Vegetation Control contractors. SafetyNet is the Vegetation Management system of record for recording safety observations. SafetyNet captures both Safe Findings as well as At-Risk Findings. SafetyNet is used by all VPMs, SVPMs, VMIs, Contract Foresters and VM Safety team members starting as of April 19, 2021. The system and data collected allows for system and regional performance reporting related to OSHA, ANSI, and PG&E standards

Quality Verification focus is on contractor work quality through auditing sampled populations of recently completed work from Distribution Routine, Tree Mortality, Vegetation Control, Enhanced Vegetation Management as well as, Routine Transmission and special projects. Quality Verification focuses on work quality of pre-inspection and tree trimming contractors.

100 percent of EVM pre-inspection work is reviewed by the Work Verification (WV) team.

Work Verification is an independent review of all EVM work to verify: (1) the Pre-Inspector prescribed tree work that is needed, per compliance requirements, (2) Tree work is completed as prescribed; (3) Pre-Inspector has listed out all strike trees (applicable to PG&E's EVM only), and (4) all hazard trees are mitigated or removed.

Additionally, there is a distinct EVM audit that occurs annually on the program. The purpose of the audit is to determine whether the EVM field personnel were working in conformance with EVM processes. PG&E hires an

external contractor to perform this EVM Audit. PG&E eliminated the EVM audit with the February 2022 GRC update.

PG&E's June 2021 forecast for the 2023 Safety Oversight, Work Verification, Quality Verification and Assurance Program(s) was $34.0 million. PG&E's updated February 25, 2022 forecast for the 2023 Program Safety Oversight, Work Verification, and Quality Verification is $11.3 million.

Justification

The Enhanced Vegetation Management work described above is part of PG&E's overall plan to reduce fire risk, the Community Wildfire Safety Program (CWSP). PG&E's Vegetation Management program has been enhanced in response to a climate change driven 'new normal' which includes the October 2017 wildfires, multiple years of drought, more severe winter storms, and extended summer heat waves. This work is needed as an additional precautionary measure to further reduce the likelihood, risk and impact of future wildfire ignitions. A variation of this enhanced tree work was initially proposed in PG&E's November 2017 Risk Assessment Mitigation Phase (RAMP) report and has since been expanded in scope to include the overhang clearing and evaluation of the condition of trees described above.

Risk – Overhang clearing and evaluating the condition of trees will help mitigate future wildfire ignitions by removing trees and branches that could fail during fire season and result in downed lines.

Compliance – The clearance requirements in General Order 95, Rule 35, and Public Resource Code 4293 (namely the requirement for a 4 foot clearance between distribution powerlines and vegetation in HFTD areas) are results-driven requirements. This means that if vegetation enters the clearance zone at any time, it can be interpreted as a non-compliant situation regardless of antecedents, cause or extenuating circumstances. For example, even if a branch or tree was 50 or more feet away at the time that vegetation management work was performed, if it fails (e.g. during a severe wind storm) and contacts the powerline the utility theoretically can be cited for non-compliance. Given these results-driven clearance requirements, the Enhanced Vegetation Management program, as well as any vegetation management effort intended to prevent vegetation from entering the clearance zone at any time supports PG&E's efforts to meet compliance requirements.

Safety and Reliability – Beyond the significant public safety and reliability benefits which are primarily driving this work, overhang clearing and the evaluation of the condition of trees has safety and reliability benefits throughout the year by reducing the number of vegetation related wires downs and vegetation caused outages.

PG&E revised the scope of its Enhanced VM program as part of its updated, integrated wildfire mitigation strategy. The updated strategy consists of 10,000 miles of system hardening undergrounding, implementing the Enhanced Powerline Safety Settings (EPSS) program and the revised Enhanced VM program. Together, the integrated mitigation strategy will provide significant wildfire risk reduction.

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PROJECT SUMMARY – ENHANCED VEGETATION MANAGEMENT

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

		2018	2019	2020	2021	2022	2023	2024	2025	2026
EXPENSE MWC IG	**POs**	**Recorded**			**Updated February 25, 2022 Forecast**					
Enhanced Vegetation Management - VMBA		**$306,412**	**$470,426**	**$451,390**	**$535,952**	**$916,600**	**$118,022**	**$117,555**	**$112,177**	**$102,234**
Overhang Clearing & Radial Clearance[(a)]	5262012 5264336 5264337 5264338 5264339 5264340 5264341 5264342 5264350 5265358 5266754	241,623	382,838	331,715	408,645	680,495	90,205	89,848	85,737	78,138
Utility Defensible Space	5262012 5264343 5264344 5264345 5264346 5264347 5264348 5266754	35,931	12,064	5,221	28,710	29,500	5,000	4,980	4,752	4,331
Wood Management	5262012 5264336 5264337 5264338 5264339 5264340 5264341	8,858	65,262	92,733	55,078	71,735	11,496	11,451	10,927	9,959
Safety Oversight, Work Verification, Quality Verification and Assurance	5264342 5272494	-	10,263	21,721	43,518	55,870	11,321	11,276	10,760	9,807
One Veg						79,000				
Total Enhanced VM		**$306,412**	**$470,426**	**$451,390**	**$535,952**	**$916,600**	**$118,022**	**$117,555**	**112,177**	**$102,234**

(a) Becomes Overhang Clearing only in 2023. Radial Clearance transitions to Routine VM.

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Additional Cost Information:

- See Workpaper 9-13 for additional detail on cost forecast.
- 2018 Enhanced Vegetation Management Tree Work was recorded to the Fire Hazard Prevention Memorandum Account (FHPMA).
- 2019 Enhanced Vegetation Management Tree Work was recorded to the Fire Risk Mitigation Memorandum Account (FRMMA) and the Wildfire 2Mitigation Plan Memorandum Account (WMPMA). Because the wildfire mitigation programs implemented in 2019 were approved in the 2019 Wildfire Mitigation Plan (WMP), we use the term "WMPMA" and "FRMMA" synonymously.

Benefits

As discussed earlier the primary purpose of this project is to improve safety and reliability for the benefit of PG&E's customers and communities served, through:

- Reducing the likelihood of a wildfire ignition due to vegetation and powerline interaction
- Mitigating the severity of a wildfire, were one to start
- Improving the ability of first responders to respond to fires adjacent to or under powerlines
- Reducing wire down events
- Improving electric reliability through reducing vegetation-caused power outages

Alternatives Considered

1 – Do not pursue Enhanced Vegetation Management Tree Work

- Discontinuing Overhang Clearing and Radial Clearance, Evaluating the condition of trees, Utility Defensible Space, Wood Management, and Work Verification would limit PG&E's progress on improving public safety, preventing and mitigating wildfires, and addressing the system impacts brought on by the 'new normal'.
- PG&E would not be in compliance with commitments made in the Wildfire Mitigation Plan.
- Customers would not be able to take full advantage of the safety and reliability benefits associated with this work.

2 – Implement Enhanced Vegetation Management Tree Work over a longer period of time

- Delaying Overhang Clearing and Radial Clearance, Evaluating the condition of trees, Utility Defensible Space, Wood Management, and Work Verification would limit PG&E's progress on improving public safety, preventing and mitigating wildfires, and addressing the system impacts brought on by the 'new normal'.
- Customers would not be able to take full advantage of the safety and reliability benefits associated with this work.

3 – Accelerate Enhanced Vegetation Management Tree Work

- Accelerating Overhang Clearing and Radial Clearance, Evaluating the condition of trees, Utility Defensible Space, Wood Management, and Work Verification may burden rate payers due to the large expense associated with tree work. Although customers may be able to take advantage of the safety and reliability benefits associated with this work, it would come at higher costs.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 9, VEGETATION MANAGEMENT
PROJECT SUMMARY – TREE MORTALITY PROGRAM

Project Title: Tree Mortality (CEMA CPUC issued Resolution ESRB-4)
Major Work Categories: MWC IG
Planning Order Numbers: 5273141 (recorded costs in various planning orders)
Project Start Date: October 30, 2014
Project Completion Date: N/A - Ongoing Annual Program
Operative Date (only applies to Capital): N/A

This project summary section has been modified to describe program changes related to PG&E's updated Vegetation Management program and forecast as of February 25, 2022.

Project Description

This work was implemented in response to the 2014 Drought Emergency proclamation issuance of Commission Resolution (Res.) ESRB-4 the Governor's October 30, 2015 Bark Beetle Tree Mortality Emergency Proclamation, and the February 18, 2014 letter from the CPUC Safety and Enforcement Division , which all relate to the mitigating the effects of the drought on tree mortality and fire risk reduction. ESRB-4 directs investor-owned utilities (IOU) to take remedial measures to reduce the likelihood of fires started by or threatening utility facilities. Specifically, these remedial measures include but are not limited to: "increasing vegetation inspections and removing hazardous, dead and sick trees and other vegetation near the IOUs' electric power lines and poles; sharing resources with the California Department of Forestry and Fire Protection (CAL FIRE) to sponsor lookouts adjacent to the IOUs property; and clearing access roads under power lines for fire truck access." These proactive measures serve the important purposes of reducing fire risk in California, improving the safety of PG&E's system, and protecting customers.

CEMA CPUC issued Resolution ESRB-4 includes the following activities:

- Enhanced vegetation inspections and mitigation
- Wood management
- Wildland Urban Interface Protection
- Fuel Reduction and Emergency Response Access

Enhanced Vegetation Inspection and Mitigation Initiative: The purpose of the Enhanced Vegetation Inspection and Mitigation initiative is to implement a series of redundant enhanced vegetation patrols and associated tree work in State Responsibility Areas (SRA). This allows PG&E to address the rapidly changing forest conditions resulting from the drought and bark beetle infestations to prevent dead or dying vegetation from contacting power lines.

In State Responsibility Area (SRA), CAL FIRE is the primary responder to fires or has delegated that responsibility to a "co-operator," such as a countywide fire district (e.g., Santa Barbara and Marin counties) that acts on behalf of, and in concert with, CAL FIRE. SRA is generally in proximity to wildland areas and comprise about 60 percent of PG&E's service territory. Because SRA is usually in rural lands, CAL FIRE or the co-operator may not be located nearby and response times may be significantly longer. As a result, there is an increased risk that a fire started in SRA can lack immediate detection and spread quickly prior to appropriate response.
All portions of overhead conductor within the SRA and HFTD areas (including an HFTD in the LRA area designated as an Increased Clearance Area [ICA]) are patrolled a second time each year, approximately 6

months before/after routine patrol inspection of the circuit to identify and mitigate subsequent, undetected tree mortality.
During the patrols, PG&E VM identifies trees requiring abatement work, issues the work to its tree contracting work force, and conducts the abatement work. These incremental inspections and tree work along numerous circuits also require that PG&E VM interact with customers and gain their support.
Also, beginning in 2018, as a sub-set of the ground and helicopter-based inspections, PG&E VM started conducting third patrols in HFTD Tier 3 areas and ad-hoc patrols of areas that were subject to “Red Flag” wind warnings.

Red-flag patrols can occur on lands designated LRA, SRA, or HFTD Tier 2 or Tier 3 depending on when or where the warnings were issued. Because the red flag patrols were determined by weather, the segments of line may have been patrolled several times during the year.

The HFTD Tier 3 patrols are conducted to specifically identify and abate dead trees; the red flag patrols are conducted to identify dead trees and/or specific trees at risk of failure due to extraordinary wind conditions that could significantly compromise tree stability

PG&E’s June 30, 2021 forecast for Enhanced Vegetation Inspection and Mitigation Initiative in 2023 was $62.1 million. PG&E’ updated February 25, 2022 forecast for Enhanced Vegetation Inspection and Mitigation Initiative in 2023 is $61.2 million.

Safety Oversight, Quality Verification and Assurance: The VM Safety team supports field observations for all Vegetation Management (VM) vendors to encourage safe practices. They also trend data and report findings to operations for awareness. PG&E’s Safety Oversight and Work Verification is performed by PG&E employees. More than 200 work verification inspectors have been hired in 2021 to perform sight safety inspections.

SafetyNet App is the Vegetation Management system of record for recording safety observations. The SafetyNet App is used by employees conducting in-field safety observations on tree crews, pre-inspectors, and Vegetation Control contractors. In Q2 2021, all VPMs, SVPMs, VMIs, Contract Foresters and VM Safety team members began to use the SafetyNet App. SafetyNet captures both Safe Findings as well as At-Risk Findings. The system and data collected allows for system and regional performance reporting related to OSHA, ANSI, and PG&E standards.

Quality Assurance confirms through statistical random sampling that the work complies with standards and regulations; GO 95 Rule 35, PRC 4292 and PRC 4293. Quality Assurance also focuses on work procedure and guidance provided to pre-inspection and tree trimming contractors. The QA auditors also perform root cause analyses when non-compliance issues are identified. If a reoccurring or systemic issue is identified, Regional Managers are required to develop action plans for personnel and contractors to prevent recurrence. These QA audits are in addition to the specific pre-inspection and tree work projects performed through an annual plan that is created to identify areas of higher potential risk and to ensure that each Vegetation Management Region is audited at least once per year.

Quality Verification focus is on contractor work quality through auditing sampled populations of recently completed work from Distribution Routine, Tree Mortality, Vegetation Control, Enhanced Vegetation Management as well as, Routine Transmission and special projects. Quality Verification focuses on work quality of pre-inspection and tree trimming contractors. PG&E performs Quality Assurance (QA) and Quality

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 9, VEGETATION MANAGEMENT
PROJECT SUMMARY – TREE MORTALITY PROGRAM

Verification audits of VM Defined Scope work which includes work completed as part of the Tree Mortality program

PG&E's June 30, 2021 forecast for Safety Oversight, Work Verification, Quality Verification and Assurance in 2023 for Tree Mortality Programs was $1.24 million. PG&E's February 25, 2022 forecast for Safety Oversight, Work Verification, Quality Verification and Assurance in 2023 for Tree Mortality Programs is $1.3 million.

Wood Management : Wood management became necessary because the number and size of drought-killed or beetle-killed trees has been so large that logs left behind on properties precluded the safe conduct of work on other trees and the safe use of the properties by the owners. In addition, the dead wood constitutes fuel on the ground that not only can catch fire, but also compromises firefighter safety. This wood removal activity applies to logs remaining after PG&E has severed the dead and dying hazardous trees near the affected property. To address these safety issues, PG&E began its Wood Management program in July 2016.

PG&E disposes of the wood in various ways. In compliance with the Governor's proclamation requiring a biomass energy solution to the mortality crisis, PG&E entered into an agreement with Sierra Pacific Industries (SPI), a forest products company with biomass generation capacity at its facilities. The agreement allows for PG&E to deliver biomass fuels to SPI facilities in exchange for a reduced price for the electricity sold back to PG&E. PG&E immediately set up processing facilities close to SPI facilities in Tuolumne County and began delivering biomass fuel. PG&E also delivers biomass materials to other facilities, including IHI Rio Bravo facilities in Fresno, Tuolumne, and Placer Counties; and delivers logs to sawmills, pressboard facilities, and export facilities. Lastly, and on a very limited scale, PG&E has also provided wood to local artisans on a case-by-case basis.

PG&E's June 30, 2021 forecast for the Wood Management Program in 2023 was $3.0 million. PG&E's forecast for this program has not changed.

Wildland Urban Interface Protection: The WUI represents areas around the urban environment where conditions in the field, like slopes and vegetation, closely resemble rural areas. However, these areas are usually moderately to densely developed and local agencies are responsible for fire suppression, unlike SRA. The areas are also labeled Local Responsibility Areas (LRA) and CAL FIRE is not primarily responsible for fire suppression.

The initiative to increase safety in these areas consists of two main risk reduction efforts in LRAs:

- Redundant inspection and tree work where segments of overhead conductor in LRA areas were patrolled and dead trees were abated up to four times per year; and
- Clearing vegetation from around poles with equipment that may issue molten material when the equipment operates.

In LRAs, the local fire district, county, or municipal fire services are the primary responders to fire. Generally, faster fire response times occur in LRAs than in SRAs, allowing for quicker suppression by the local fire agency because the local fire agency is generally closer to the ignition.

Since these LRA/WUI areas tend to be near urban and suburban centers with high human populations, PG&E determined that the risk to human life and property due to ignition and spread of fire warranted additional inspections, pole clearing, and tree work. As part of the 2016 through 2020 drought and tree mortality work,

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 9, VEGETATION MANAGEMENT
PROJECT SUMMARY – TREE MORTALITY PROGRAM

PG&E patrolled and conducted tree work in these areas up to four times per year, in contrast to the usual once per year.

Where poles are outfitted with equipment that can start a fire when it operates, California PRC 4292 requires certain fire preventative measures around those poles in SRAs. PG&E VM concluded that reducing ignition risk was critical in LRAs where field conditions closely resembled wildlands in SRAs, because even with fast response times, conditions were too extreme in these areas and could otherwise jeopardize public safety. PG&E VM acted by clearing poles that occur in LRA's to PRC 4292 standards.

Performing the additional, interim inspection and tree work and inspecting and clearing poles to PRC 4292 standards in the LRAs increased public safety and reduced the risk of fire ignitions associated with vegetation-equipment interactions.

PG&E's June 30, 2021 forecast for the Wildland Urban Interface Protection program in 2023 was $2.3 million. PG&E's forecast for this program has not changed.

Fuel Reduction and Emergency Response Access: PG&E VM supports local grassroots Fire Safe Councils (FSCs). Local FSCs, largely found in SRAs, are community-based, self-governed groups of people that focus on fire safety. FSCs:

- Distribute fire safety materials;
- Teach fire-safe home construction techniques;
- Coordinate fire safety workshops with insurance companies and home builders;
- Conduct fuel reduction projects;
- Fund defensible space projects around homes required by PRC 4291 and escape routes;
- Sponsor lookout towers; and
- Form community safety networks.

PG&E assists local FSCs to implement these safety efforts to reduce fire dangers to PG&E facilities. PG&E reaches out to FSCs or their fiscal sponsors and asks for "shovel-ready" project proposals. "Shovel-ready projects," consist of fuel reduction work, chipper programs, and escape route improvement projects that has been planned, prepared in the field, and permitted (if necessary), and that simply needs funding to implement. Eligible entities needed to be 501(c)(3) non-profit or other non-governmental organizations.

Physical work in the field is conducted by private contractors employed by the FSC, private party volunteers, homeowners, FSC members and the like.

PG&E's June 31, 2021 forecast for the Fuel Reduction and Emergency Response Access Program in 2023 was $2.1 million. PG&E's forecast for this program has not changed.

<u>Justification</u>

The Tree Mortality (CEMA CPUC issued Resolution ESRB-4) program is was implemented pursuant to CPUC Res. ESRB-4 OP 2, whereby the CPUC ordered that:

> …Investor Owned Electric Utilities must take practicable measures necessary to reduce the likelihood of fires associated with their facilities. These measures include: increasing vegetation inspections and removing

10 hazardous, dead and sick trees and other vegetation near the IOUs electric power lines and poles; sharing resources with the California Department of Forestry and Fire Protection (CalFire) to staff lookouts adjacent to IOUs' property; and clearing access roads under power lines for fire truck access.

On October 30, 2015, Governor Brown issued a Tree Mortality Emergency Proclamation, stating that the vast scale of tree mortality "worsens wild fire risks across large regions of the State." In this proclamation, Governor Brown directed utilities to:

> undertake efforts to remove dead or dying trees…that threaten powerlines, roads or other evacuation corridors, critical community infrastructure, and other existing structures. Due to the record drought conditions, and the resulting bark beetle infestations, California is experiencing vast tree mortality and worsened fire risk.

The CPUC has confirmed that, although the Governor issued an Executive Order in April 2017 ending the Drought State of Emergency, the CPUC has not rescinded Res.ESRB-4, and work by the utilities to comply with it and the Tree Mortality Emergency continues.

Risk – Tree Mortality (CEMA CPUC issued Resolution ESRB-4) program will help mitigate future wildfire ignitions by removing dead, rotten or diseased trees.

Compliance – The clearance requirements in General Order 95, Rule 35, requires that PG&E remove hazard trees. Rule 35 (paragraph 2) describes the utility's obligation:

> …When a supply or communication company has actual knowledge, obtained either through normal operating practices or notification to the company, that dead, rotten or diseased trees or dead, rotten or diseased portions of otherwise healthy trees overhang or lean toward and may fall into a span of supply or communication lines, said trees or portions thereof should be removed.

Public Resources Code Section 4293 (which applies in areas where fire protection services are provided by CAL FIRE) includes similar language regarding hazard trees:

> Dead trees, old decadent or rotten trees, trees weakened by decay or disease and trees or portions thereof that are leaning toward the line which may contact the line from the side or may fall on the line shall be felled, cut, or trimmed so as to remove such hazard.

Safety and Reliability – Beyond the CPUC order aforementioned, public safety and reliability benefits drive this work as well. Removing dead, rotten or diseased trees has safety and reliability benefits by reducing the number of vegetation related wires downs and vegetation caused outages along with creating fire breaks, defensible space that can utilized by fire personnel to protect life and property.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 9, VEGETATION MANAGEMENT
PROJECT SUMMARY – TREE MORTALITY PROGRAM

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
EXPENSE		**Recorded**					**February 25, 2022 Updated Forecast**					
Tree Mortality	**PO**	**$183,638**	**$194,761**	**$69,022**	**$73,262**	**$ 93,070**	**$ 67,978**	**$144,000**	**$69,830**	**$70,423**	**$71,003**	**$70,396**
Enhanced Vegetation Inspections and Mitigations	5244155 5244159 5244457 5248512 5255833					$ 83,561	$ 58,914	$119,517	$61,240	$61,759	$62,268	$61,736
Wood Management	5244155					$ 2,871	$ 2,842	$4,828	$2,951	$2,976	$3,000	$2,975
Wildland Urban Interface Protection	5244156					$ 4,286	$ 2,189	$3,124	$2,273	$2,292	$2,311	$2,291
Fuel Reduction and Emergency Response Access	5244158					$ 2,180	$ 2,000	$2,854	$2,077	$2,094	$2,112	$2,093
Safety Oversight, Work Verification, and Quality Verification and Assurance	5272495					$ 173	$ 2,033	$13,677	$1,290	$1,301	$1,312	$1,301
Total Tree Mortality		**$183,638**	**$194,761**	**$69,022**	**$73,262**	**$ 93,070**	**$ 67,978**	**$144,000**	**$69,830**	**$70,423**	**$71,003**	**$70,396**

Additional Cost Information:

- 2019 and prior expense was recorded to the Catastrophic Event Memorandum Account (CEMA) pursuant to CPUC Res.ESRB-4 OP 4, whereby the CPUC ordered that:
  …to the extent that additional funding is reasonable, and not already included or recoverable in the Investor Owned Electric Utilities [IOU] accounts, incremental cost recovery through the CEMAs may be sought by the IOUs
- See Exhibit (PG&E-4), WP 9-8 for 2016 through 2019 Tree Mortality recorded costs.

Benefits

As discussed earlier the primary purpose of this project is to comply with California Public Utilities Commission (CPUC or Commission) Resolution (Res.) ESRB-4 that directs investor-owned utilities (IOU) to take remedial measures to reduce the likelihood of fires started by or threatening utility facilities.

Alternatives Considered

1 – Do not pursue Tree Mortality (CEMA CPUC issued Resolution ESRB-4) program

- PG&E would not be in compliance with CPUC Res. ESRB-4 OP 2

- Customers would not be able to take full advantage of the safety and reliability benefits associated with this work.

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE

Testimony: ☐ **Workpapers:** ☒ **SOQ:** ☐

Exhibit Number: 4 **Chapter Number:** 9

Chapter Title: Vegetation Management

Witness Name: Kamran Rasheed

Page No.	Line No.	Item	As Filed	As Corrected
Errata as of February 25, 2022				
Various (see for example Table 9-5, Line 4)	Various	2020 recorded adjusted costs for Tree Mortality were incorrect. Errata includes all cascading changes.	$91,927	$93,070
WP 9-15	15	No. of Units 2021	1,870	1,890
WP 9-15	16	Unit Costs 2021	$286,605	$283,572

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
EXHIBIT (PG&E-4) ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING
CHAPTER 10, OVERHEAD AND UNDERGROUND ELECTRIC ASSET INSPECTIONS

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Table 10-1
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 10
Inspections
Expenses by Major Work Category
(Thousands of Nominal Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	Reference (A)
1	BF	E T&D Patrol/Insp	30,104	26,243	26,863	199,137	160,684	119,647	89,625	89,464	WP 10-3, WP 10-4
2	**Total**		**30,104**	**26,243**	**26,863**	**199,137**	**160,684**	**119,647**	**89,625**	**89,464**	

Table 10-2
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 10
Inspections
Expenses by Major Work Category
(Thousands of Base Year Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast
1	BF	E T&D Patrol/Insp	33,090	28,410	28,227	197,195	160,684	119,211	87,132	84,742
2	**Total**		**33,090**	**28,410**	**28,227**	**197,195**	**160,684**	**119,211**	**87,132**	**84,742**

Workpaper Table 10-3
Pacific Gas and Electric Company
2020 General Rate Case
Exhibit 4, Chapter #10, Overhead and Underground Electric Asset Inspections
Major Work Category BF – Recorded Walk
MWC BF - Patrols and Inspections
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$ 30,104**			WP 10-6 Line 19
2		UG BART Cable Test/Insp (MAT BF3)	$ (6)		No significant change.	WP 10-6 Line 10
3		UG Auto Xfer Swch Test/Insp (MAT BF4)	$ 5		No significant change.	WP 10-6 Line 11
4		Overhead Patrols (MAT BFA)	$ (531)		Cost reduction due to a decrease in unit cost per pole patrolled compared to 2016.	WP 10-6 Line 2
5		Overhead Inspections (MAT BFB)	$ (410)		Cost reduction due to a decrease in unit cost per pole inspected compared to 2016.	WP 10-6 Line 3
6		Overhead Infrared Inspections (MAT BFC)	$ (1,851)		Cost decrease due to a decrease in the amount of infrared miles funded compared to 2016.	WP 10-6 Line 13
7		Underground Patrols (MAT BFD)	$ (378)		Cost reduction due to a decrease in unit cost per patrol compared to 2016.	WP 10-6 Line 4
8		Underground Inspections (MAT BFE)	$ (885)		Cost reduction due to a decrease in unit cost per enclosure inspected compared to 2016.	WP 10-6 Line 5
9		Underground Line Equipment Inspected and Tested (MAT BFF)	$ 69		Minor variation in work costs.	WP 10-6 Line 7
10		Overhead Line Equipment Inspected and Tested (MAT BFG)	$ (60)		Minor variation in work costs.	WP 10-6 Line 6
11		Inspection Support Costs (MAT BFH)	$ 362		Cost increase due to streetlight inspection pilot program	WP 10-6 Line 12
12		OH Patrol ORT Post Outage (MAT BFJ)	$ (8)		No significant change.	WP 10-6 Line 14
13		Santa Barbara Wildfire Poles Patrolled (MAT BFL)	$ (4)		No significant change.	WP 10-6 Line 15
14		Urban and Other Wildfire Poles Inspected (MAT BFM)	$ (127)		Minor variation in work costs.	WP 10-6 Line 16
15		Santa Barbara Wildfire Poles Inspected (MAT BFO)	$ (37)		Minor variation in work costs.	WP 10-6 Line 17
16	**2017**	**Recorded Adjusted**	**$ 26,243**			WP 10-6 Line 19
17		UG BART Cable Test/Insp (MAT BF3)	$ 12		No significant change	WP 10-6 Line 10
18		UG Auto Xfer Swch Test/Insp (MAT BF4)	$ (6)		No significant change	WP 10-6 Line 11
19		Overhead Patrols (MAT BFA)	$ 1,857		Increase due to implementing additional patrols in the HFTD areas and shifting patrols of padmount facilities (BFD to BFA)	WP 10-6 Line 2
20		Overhead Inspections (MAT BFB)	$ 2,242		Increased based on additional inspections from the padmount cycle change (BFE to BFB), incorporation of wildfire inspections into Overhead Inspection program (BFM and BFO to BFB) and increased unit cost	WP 10-6 Line 3
21		Overhead Infrared Inspections (MAT	$ 74		No significant change	WP 10-6 Line 13
22		Underground Patrols (MAT BFD)	$ (50)		No significant change	WP 10-6 Line 4
23		Underground Inspections (MAT BFE)	$ (3,259)		Decrease due to units decrease from shifting padmount equipment to overhead inspection program (BFE to BFB)	WP 10-6 Line 5
24		Underground Line Equipment Inspected and Tested (MAT BFF)	$ (110)		Minor variation in work cost	WP 10-6 Line 7
25		Overhead Line Equipment Inspected and Tested (MAT BFG)	$ (197)		Minor variation in work cost	WP 10-6 Line 6
26		Inspection Support Costs (MAT BFH)	$ 728		Increase related to the ramp-up of the non-wood pole streetlight program	WP 10-6 Line 12
27		OH Patrol ORT Post Outage (MAT BFJ)	$ 33		No significant change	WP 10-6 Line 14
28		Santa Barbara Wildfire Poles Patrolled (MAT BFL)	$ (20)	20	No significant change	WP 10-6 Line 15
29		Urban and Other Wildfire Poles Inspected (MAT BFM)	$ (682)		Units decreased as UWF/OWF inspection requirements changed due to HFTD/Non-HFTD boundaries established in 2018 and shift to overhead inspection program (BFM to BFB)	WP 10-6 Line 16
30		Santa Barbara Wildfire Poles Inspected (MAT BFO)	$ -		No change	WP 10-6 Line 17
31	**2018**	**Recorded Adjusted**	**$ 26,863**			WP 10-6 Line 19
32		UG BART Cable Test/Insp (MAT BF3)	$ (0)		No significant change	WP 10-6 Line 10
33		UG Auto Xfer Swch Test/Insp (MAT BF4)	$ 11		No significant change	WP 10-6 Line 11
34		Overhead Patrols (MAT BFA)	$ 1,602		Increase associated with increase in unit const compared to 2018	WP 10-6 Line 2
35		Overhead Inspections (MAT BFB)	$ 136,331		Increase due to increase volume and unit costs associated with the WSIP program that inspected the entire HFTD and introduced enhanced inspection protocols.	WP 10-6 Line 3
36		Assumes change in inspection cycle	$ 58		No significant change	WP 10-6 Line 13
37		Underground Patrols (MAT BFD)	$ 92		No significant change	WP 10-6 Line 4
38		Underground Inspections (MAT BFE)	$ 104		No significant change	WP 10-6 Line 5
39		Underground Line Equipment Inspected and Tested (MAT BFF)	$ 91		No significant change	WP 10-6 Line 7
40		Overhead Line Equipment Inspected and Tested (MAT BFG)	$ 19		No significant change	WP 10-6 Line 6

Workpaper Table 10-3
Pacific Gas and Electric Company
2020 General Rate Case
Exhibit 4, Chapter #10, Overhead and Underground Electric Asset Inspections
Major Work Category BF – Recorded Walk
MWC BF - Patrols and Inspections
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
41		Inspection Support Costs (MAT BFH)	$ 33,910		Increase associated with the WSIP and pole loading programs.	WP 10-6 Line 12
42		OH Patrol ORT Post Outage (MAT BFJ)	$ 56		No significant change	WP 10-6 Line 14
43		Santa Barbara Wildfire Poles Patrolled (MAT BFL)	$ (0)		Program discontinued	WP 10-6 Line 15
44		Urban and Other Wildfire Poles Inspected (MAT BFM)	$ -		Program discontinued	WP 10-6 Line 16
45		Santa Barbara Wildfire Poles Inspected (MAT BFO)	$ 1		Program discontinued	WP 10-6 Line 17
46	**2019**	**Recorded Adjusted**	**$ 199,137**			WP 10-6 Line 19
47		UG BART Cable Test/Insp (MAT BF3)	$ (14)		No significant change	WP 10-6 Line 10
48		UG Auto Xfer Swch Test/Insp (MAT BF4)	$ 22		No significant change	WP 10-6 Line 11
49		Overhead Patrols (MAT BFA)	$ 332		No significant change	WP 10-6 Line 2
50		Overhead Inspections (MAT BFB)	$ (52,086)		Decrease reflects the transition from WSIP to steady state	WP 10-6 Line 3
51		Overhead Infrared Inspections (MAT BFC)	$ (357)		Decrease due to lack of resources to implement during timeframe needed	WP 10-6 Line 13
52		Underground Patrols (MAT BFD)	$ 1,048		Increase due to increase in units (padmount equipment shifting back from Overhead Patrol program, BFA to BFD) and an increase in unit cost compared to 2019	WP 10-6 Line 4
53		Underground Inspections (MAT BFE)	$ 6,498		Increase due to increase in units (padmount equipment shifting back from Overhead Inspection program, BFB to BFE)	WP 10-6 Line 5
54		Underground Line Equipment Inspected and Tested (MAT BFF)	$ 153		Minor variation in work cost	WP 10-6 Line 7
55		Overhead Line Equipment Inspected and Tested (MAT BFG)	$ 466		Cost increase due to a increase in units and unit cost compared to 2019.	WP 10-6 Line 6
56		Inspection Support Costs (MAT BFH)	$ 5,509		Increase reflects additional cost related to inspection program, idle facility field check program and WSIP support.	WP 10-6 Line 12
57		OH Patrol ORT Post Outage (MAT BFJ)	$ (23)		No significant change	WP 10-6 Line 14
58		Santa Barbara Wildfire Poles Patrolled (MAT BFL)	$ 0		Program discontinued	WP 10-6 Line 15
59		Urban and Other Wildfire Poles Inspected (MAT BFM)	$ -		Program discontinued	WP 10-6 Line 16
60		Santa Barbara Wildfire Poles Inspected (MAT BFO)	$ (1)		Program discontinued	WP 10-6 Line 17
61	**2020**	**Recorded Adjusted**	**$ 160,684**			WP 10-6 Line 19

Workpaper Table 10-4
Pacific Gas and Electric Company
2020 General Rate Case
Exhibit 4, Chapter #10, Overhead and Underground Electric Asset Inspections
Major Work Category BF – Forecast Walk
MWC BF - Patrols and Inspections
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$ 160,684**			WP 10-6 Line 19
2		UG BART Cable Test/Insp (MAT BF3)	$ 45		No significant change	WP 10-6 Line 10
3		UG Auto Xfer Swch Test/Insp (MAT BF4)	$ 26		No significant change	WP 10-6 Line 11
4		Overhead Patrols (MAT BFA)	$ (2,592)		Cost reduction based on transitioning from impact of 2019 WSIP	WP 10-6 Line 2
5		Overhead Inspections (MAT BFB)	$ (1,682)		Decrease due to decrease in unit inspected	WP 10-6 Line 3
6		Overhead Infrared Inspections (MAT BFC)	$ 759		Contractor availability impacted implementation of the 2020 plan, 2021 forecast covers address resourcing challenges to accomplish full annual plan	WP 10-6 Line 13
7		Underground Patrols (MAT BFD)	$ 42		No significant change	WP 10-6 Line 4
8		Underground Inspections (MAT BFE)	$ 1,386		Decrease due to fluctuation in number of units that need inspection to meet compliance minimums per maintenance plans	WP 10-6 Line 5
9		Underground Line Equipment Inspected and Tested (MAT BFF)	$ (147)		Minor variation in work costs	WP 10-6 Line 7
10		Overhead Line Equipment Inspected and Tested (MAT BFG)	$ (155)		Minor variation in work costs	WP 10-6 Line 6
11		Inspection Support Costs (MAT BFH)	$ (38,731)		Reduction based on completion of WSIP related program work	WP 10-6 Line 12
12		OH Patrol ORT Post Outage (MAT BFJ)	$ 13		No significant change	WP 10-6 Line 14
13	**2021**	**Forecast**	**$ 119,647**			WP 10-6 Line 19
14		UG BART Cable Test/Insp (MAT BF3)	$ 0		No significant change	WP 10-6 Line 10
15		UG Auto Xfer Swch Test/Insp (MAT BF4)	$ 0		No significant change	WP 10-6 Line 11
16		Overhead Patrols (MAT BFA)	$ 6		No significant change	WP 10-6 Line 2
17		Overhead Inspections (MAT BFB)	$ (32,816)		Due to an error in the total cost forecast for 2022, the unit costs in this year is lower than is expected to accomplish the work. PG&E intends to do all required inspection units for compliance with GO 165 and PG&E utility standards as well as units determined necessary for risk mitigation and will manage budget internally to meet these requirements.	WP 10-6 Line 3
18		Overhead Infrared Inspections (MAT BFC)	$ 3		No significant change	WP 10-6 Line 13
19		Underground Patrols (MAT BFD)	$ 162		Minor variation in work costs	WP 10-6 Line 4
20		Underground Inspections (MAT BFE)	$ 320		Minor variation in work costs	WP 10-6 Line 5
21		Underground Line Equipment Inspected and Tested (MAT BFF)	$ (0)		No significant change	WP 10-6 Line 7
22		Overhead Line Equipment Inspected and Tested (MAT BFG)	$ 230		Increase in units due to variation in inspection cycle of SCADA units	WP 10-6 Line 6
23		Inspection Support Costs (MAT BFH)	$ 2,090		Increase due to Non-Wood Streetlight-Only Inspection Program	WP 10-6 Line 12
24		OH Patrol ORT Post Outage (MAT BFJ)	$ (16)		No significant change	WP 10-6 Line 14
25	**2022**	**Forecast**	**$ 89,626**			WP 10-6 Line 19
26		UG BART Cable Test/Insp (MAT BF3)	$ 8		No significant change	WP 10-6 Line 10
27		UG Auto Xfer Swch Test/Insp (MAT BF4)	$ 22		No significant change	WP 10-6 Line 11
28		Overhead Patrols (MAT BFA)	$ 733		Increase due to increase in units needing patrols in HFTDs (as number of inspections decrease)	WP 10-6 Line 2
29		Overhead Inspections (MAT BFB)	$ (1,728)		Reduction based on program efficiency gains	WP 10-6 Line 3
30		Overhead Infrared Inspections (MAT BFC)	$ 271		Cost increase due to planned program scope	WP 10-6 Line 13
31		Underground Patrols (MAT BFD)	$ 24		No significant change	WP 10-6 Line 4
32		Underground Inspections (MAT BFE)	$ 268		Unit cost planned to increase as underground inspections transition to an enhanced inspection protocol	WP 10-6 Line 5
33		Underground Line Equipment Inspected and Tested (MAT BFF)	$ -		No significant change	WP 10-6 Line 7
34		Overhead Line Equipment Inspected and Tested (MAT BFG)	$ (219)		Decrease in units due to variation in unit inspection cycles	WP 10-6 Line 6
35		Inspection Support Costs (MAT BFH)	$ 459		Increase due to increase volume and unit costs associated with the WSIP program that inspected the entire HFTD and introduced enhanced inspection protocols.	WP 10-6 Line 12
36	**2023**	**Forecast**	**$ 89,464**			WP 10-6 Line 19

Workpaper Table 10-5
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 10, Overhead and Underground Electric Asset Inspections
Expenses by Major Work Category BF – Forecast Details
(Thousands of Nominal Dollars)

Line No.		MAT CODE	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	Assumptions	Reference
1	**Total Cost by Activity Type**											
2	Total Cost Overhead Patrols	BFA	$ 3,224	$ 2,693	$ 4,550	$ 6,152	$ 6,483	$ 3,891	$ 3,897	$ 4,630		WP 10-7
3	Total Cost Overhead Inspections	BFB	$ 8,955	$ 8,546	$ 10,787	$ 147,118	$ 95,032	$ 93,351	$ 60,535	$ 58,807		WP 10-8
4	Total Cost Underground Patrols	BFD	$ 1,514	$ 1,136	$ 1,086	$ 1,178	$ 2,226	$ 2,268	$ 2,430	$ 2,455		WP 10-9
5	Total Cost Underground Inspections	BFE	$ 8,886	$ 8,001	$ 4,743	$ 4,847	$ 11,345	$ 12,731	$ 13,051	$ 13,319		WP 10-10
6	Total Cost Overhead Line Equipment Inspected and Tested	BFG	$ 2,347	$ 2,286	$ 2,089	$ 2,108	$ 2,574	$ 2,419	$ 2,649	$ 2,430		WP 10-11
7	Total Cost Underground Line Equipment Inspected and Tested	BFF	$ 408	$ 477	$ 367	$ 458	$ 612	$ 464	$ 464	$ 464		WP 10-12
8	**Subtotal Cost by Activity Type**		$ 25,334	$ 23,139	$ 23,622	$ 161,862	$ 118,273	$ 115,125	$ 83,026	$ 82,105		
9	**Additional Program Costs**											
10	UG BART Cable Test/Insp	BF3	$ 8	$ 2	$ 14	$ 14	$ -	$ 45	$ 45	$ 54	(1)	
11	UG Auto Xfer Swch Test/Insp	BF4	$ 55	$ 60	$ 53	$ 64	$ 85	$ 111	$ 112	$ 133	(2)	
12	Inspection Support Costs	BFH	$ 100	$ 462	$ 1,190	$ 35,099	$ 40,608	$ 1,876	$ 3,966	$ 4,425	(3)	WP 10-17
13	Overhead Infrared Inspections	BFC	$ 3,638	$ 1,788	$ 1,861	$ 1,919	$ 1,561	$ 2,320	$ 2,323	$ 2,595		WP 10-15
14	OH Patrol ORT Post Outage	BFJ	$ 98	$ 89	$ 123	$ 179	$ 156	$ 169	$ 152	$ 152	(4)	
15	Total Cost Santa Barbara Wildfire Poles Patrolled	BFL	$ 24	$ 20	$ 0	$ -	$ 0	$ -	$ -	$ -	(5)	
16	Total Cost Urban and Other Wildfire Poles Inspected	BFM	$ 809	$ 682	$ -	$ -	$ -	$ -	$ -	$ -	(6)	
17	Total Cost Santa Barbara Wildfire Poles Inspected	BFO	$ 37	$ -	$ -	$ 1	$ -	$ -	$ -	$ -	(7)	
18	**Subtotal Additional Project Costs**		$ 4,770	$ 3,103	$ 3,241	$ 37,275	$ 42,411	$ 4,522	$ 6,599	$ 7,359		
19	**Total MWC BF**		**$ 30,104**	**$ 26,243**	**$ 26,863**	**$ 199,137**	**$ 160,684**	**$ 119,647**	**$ 89,625**	**$ 89,464**		

Forecast Assumptions and Details

(1) Annual inspection/tests of Bay Area Rapid Transit (BART) cable per PG&E Standard TD-2302S. Annual volume is based on maintenance plans.

(2) Annual inspection testing of individual auto-transfer switches that support large commercial customers and deliver service to Bay Area transportation, sporting events, or Silicon Valley. Annual volume is based on maintenance plans

(3) Category is for costs associated with asset strategy projects, MobileConnect rollout, and special quality control efforts. Increase spend in 2019-2020 primarily driven by support of inspections in HFTDs and through the Wildfire Safety Inspection Program (WSIP) as well as Pole Loading assessment. The Streetlight-only Inspection program is primary driver of costs in 2021 and beyond. The year over year forecast fluctuations are a result of changes in the mix of projects

(4) Special patrols performed following outages at the request of local management to investigate the cause of an outage

(5) Prior to 2018, Santa Barbara wildfire patrols were conducted in two divisions in PG&E territory in Santa Barbara county. Since 2019, zero inspections are forecast as all work was moved to MAT BFA and has expanded to include patrols of all poles in Tier 2 and Tier 3 HFTD's per the new requirement.

(6) Prior to 2018, annual overhead inspections were performed in nine divisions in locations designated as Urban and Other wildfire areas. Beginning in 2018 this program was discontinued, PG&E has adopted all patrol requirements specified in HFTD Fire Safety Decision and increased inspection frequency in all HFTD areas

(7) Prior to 2018, Santa Barbara wildfire inspections were conducted in two divisions that have facilities within Santa Barbara County. Beginning in 2018 this program was discontinued, PG&E has adopted all patrol requirements specified in HFTD Fire Safety Decision and increased inspection frequency in all HFTD areas.

Workpaper Table 10-6
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 10 - Overhead and Underground Electric Asset Inspections
Unit Cost and Forecast Details: MAT BFA

Line No.		
1	**MAT Code**	BFA
2	**GRC Ch.**	10 - Overhead and Underground Electric Asset Inspections
3	**MAT Code Definition**	Overhead Patrols – Visual patrol of OH electric distribution facilities to identify obvious structural problems or hazards for compliance with GO 165 and the EDPM Manual. Patrolled facilities include primary, secondary, and service, and other associated electric distribution facilities outside the substation fence to the end of the line. Towers supporting only electric distribution facilities are included in the overhead patrol. Patrols can be performed from a vehicle, on foot, or by helicopter. Units measured: Number of poles patrolled. This program relates to safety, reliability, or maintenance because it proactively identifies overhead assets needing repair or replacement and generates corrective work orders for future work planning.

	Risk ID	Type	Name
4	DOVHD-C013	Control	Patrols
5	WLDFR-C001	Control	Patrols and Inspections - Overhead Patrols

6	**Program Area**	Maintenance and Compliance
7	**Forecast Method**	Unit cost
8	**Unit of Measure**	# of Poles Patrolled
9	**Unit Cost (2023)**	$ 3.39

10	**Unit Cost Forecast Basis**	Forecast unit costs are in line with historic actuals. Recorded unit cost fluctuations due to change in annual population of assets patrolled; 2019 and 2020 unit cost impacted by volume and timing of High Fire Threat District (HFTD) work.
11	**Unit Forecast Basis**	Required number of units to meet maxiumum length of patrol cycles on distribution facilities outlined in GO165 plus additional patrols in HFTD areas that PG&E has identified for reducing wildfire risk.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
12	**Recorded Costs**	$ 3,223,901	$ 2,692,899	$ 4,549,735	$ 6,151,576	$ 6,483,378	Calculated - Line 13 * Line 14
13	**No. of Units**	1,136,785	1,143,750	1,601,777	1,601,338	1,650,872	
14	**Unit Cost**	$ 2.84	$ 2.35	$ 2.84	$ 3.84	$ 3.93	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023 (E)**	
15	**Forecast Costs**	$ 3,891,139	$ 3,896,810	$ 4,630,081	Calculated - Line 16 * Line 17
16	**No. of Units**	1,181,485	1,186,481	1,366,233	
17	**Unit Cost**	$ 3.29	$ 3.28	$ 3.39	

	Notes	
18	**(A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 10-7
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 10 - Overhead and Underground Electric Asset Inspections
Unit Cost and Forecast Details: MAT BFB

Line No.		
1	**MAT Code**	BFB
2	**GRC Ch.**	10 - Overhead and Underground Electric Asset Inspections
3	**MAT Code Definition**	Overhead Inspections – Detailed inspection of OH electric distribution facilities to examine and record any compelling, abnormal conditions that will adversely impact safety or reliability for compliance with GO 165 and the EDPM Manual. Inspected facilities include PG&E solely and jointly owned poles, including all equipment and facilities on the pole; primary and secondary risers and services; primary and secondary conductor; transmission poles with electric distribution under build; electric distribution towers and lattices; streetlights on PG&E solely owned or joint poles; and primary metering. Units measured: Number of poles inspected. This program relates to safety, reliability, or maintenance because it proactively identifies overhead assets needing repair or replacement and generates corrective work orders for future work planning.

	Risk ID	Type	Name
4	DOVHD-C005	Control	Inspections
6	WLDFR-C01A	Control	Patrols and Inspections - Overhead Inspections

7	**Program Area**	Maintenance and Compliance
8	**Forecast Method**	Unit cost
9	**Unit of Measure**	# of Poles Inspected
10	**Unit Cost (2023)**	$ 97
11	**Unit Cost Forecast Basis**	2020 to 2023 unit cost decreases driven by insourcing contracted inspectors and implementing data and process improvements.
12	**Unit Forecast Basis**	For non-HFTD areas, required number of units to meet maxiumum length of inspection cycles on distribution facilities outlined in GO165. Plus accellerated inspections in HFTD areas that PG&E has determined are needed to reduce wildfire risk, details in testimony Exhibit 4 Chapter 10 Section B.1.a.1.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019 (B)**	**2020 (C)**	
13	**Recorded Costs**	$ 8,955,399	$ 8,545,550	$ 10,787,074	$ 147,118,083	$ 95,032,433	Calculated - Line 14 * Line 15
14	**No. of Units**	448,840	453,974	456,071	1,180,999	759,484	
15	**Unit Cost**	$ 20	$ 19	$ 24	$ 125	$ 125	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022 (D)**	**2023 (E)**	
16	**Forecast Costs**	$ 93,350,805	$ 60,534,875	$ 58,807,363	Calculated - Line 17 * Line 18
17	**No. of Units**	847,370	882,202	608,807	
18	**Unit Cost**	$ 110	$ 69	$ 97	

	Notes	
19	**(A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.
20	**(B)**	Starting in 2019, PG&E implemented an enhanced process for its detailed overhead inspections, resulting in higher unit costs
21	**(C)**	The number of 2020 recorded units for MAT BFB in the 2020 Risk Spending Accountability Report (RSAR) is 679,096. The 2020 recorded units in this workpaper include an additional 80,388 field safety reviews not included in the RSAR.
22	**(D)**	Due to an error in the total cost forecast for 2022, the unit costs in this year is lower than is expected to accomplish the work. PG&E intends to do all required inspection units for compliance with GO 165 and PG&E utility standards as well as units determined necessary for risk mitigation and will manage budget internally to meet these
23	**(E)**	Assumes change in inspection cycle frequency: HFTD Tier 3 and Zone 1 assets inspected every three years, HFTD Tier 2 assets inspected every four years, and non-HFTD assets inspected every 5 years.

Workpaper Table 10-8
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 10 - Overhead and Underground Electric Asset Inspections
Unit Cost and Forecast Details: MAT BFD

Line No.		
1	**MAT Code**	BFD
2	**GRC Ch.**	10 - Overhead and Underground Electric Asset Inspections
3	**MAT Code Definition**	Underground Patrols – Visual patrol of UG electric distribution facilities to identify obvious structural problems or hazards for compliance with GO 165 and the EDPM Manual. Patrolled facilities include pad-mounted equipment, primary enclosures, and visible secondary enclosures outside the substation fence to the end of the line. An UG patrol may be performed by walking or driving. Units measured: Number of enclosures patrolled. This program relates to safety, reliability, or maintenance because it proactively identifies underground assets needing repair or replacement and generates corrective work orders for future work planning.

	Risk ID	Type	Name
4	DUNGD-C001	Control	Patrols

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Enclosures Patrolled
8	**Unit Cost (2023)**	$ 9.09
9	**Unit Cost Forecast Basis**	2020 recorded costs.
10	**Unit Forecast Basis**	Required number of units to meet maxiumum length of patrol cycles on distribution facilities outlined in GO165.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 1,513,816	$ 1,136,219	$ 1,086,131	$ 1,178,491	$ 2,226,225	Calculated - Line 12 * Line 13
12	**No. of Units**	247,565	245,896	186,385	169,509	259,023	
13	**Unit Cost**	$ 6.11	$ 4.62	$ 5.83	$ 6.95	$ 8.59	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 2,268,243	$ 2,430,208	$ 2,454,510	Calculated - Line 15 * Line 16
15	**No. of Units**	252,027	270,158	270,158	
16	**Unit Cost**	$ 9.00	$ 9.00	$ 9.09	

Notes

17 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 10-9
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 10 - Overhead and Underground Electric Asset Inspections
Unit Cost and Forecast Details: MAT BFE

Line No.		
1	**MAT Code**	BFE
2	**GRC Ch.**	10 - Overhead and Underground Electric Asset Inspections
3	**MAT Code Definition**	Underground Inspections – Detailed inspection of UG electric distribution facilities to examine and record any compelling, abnormal conditions that will adversely impact safety or reliability for compliance with GO 165 and the EDPM Manual. Inspected facilities include pad-mounted facilities; all underground equipment, conductors, splices, and elbows within primary enclosures; primary metering that includes all visible, primary cable up to termination point plus the primary metering facilities. An infrared inspection must be performed in conjunction with underground inspections. Units measured: Number of enclosures inspected. This program relates to safety, reliability, or maintenance because it proactively identifies underground assets needing repair or replacement and generates corrective work orders for future work planning.

	Risk ID	Type	Name
4	DUNGD-C001	Control	Patrols

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Enclosures Inspected
8	**Unit Cost (2023)**	$ 99
9	**Unit Cost Forecast Basis**	2020 to 2023 increase is due to transitioning underground inspections to PG&E's digital, enhanced approach for detailed inspections.
10	**Unit Forecast Basis**	Required number of units to meet maxiumum length of patrol cycles on distribution facilities outlined in GO165.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 8,886,200	$ 8,001,191	$ 4,742,529	$ 4,846,947	$ 11,345,172	Calculated - Line 12 * Line 13
12	**No. of Units**	143,466	142,176	75,716	63,536	170,262	
13	**Unit Cost**	$ 62	$ 56	$ 63	$ 76	$ 67	

		Forecast Costs & Units (Escalated) (A) (B)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 12,730,991	$ 13,051,003	$ 13,318,664	Calculated - Line 15 * Line 16
15	**No. of Units**	136,278	134,979	134,979	
16	**Unit Cost**	$ 93	$ 97	$ 99	

	Notes	
17	**(A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.
18	**(B)**	Unit Cost is anticipated to increase in 2023 and beyond as PG&E implements an enhanced protocol for underground detailed inspections, see Testimony Exhibit 4, Chapter 10, Section C.1.e for details.

Workpaper Table 10-10
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 10 - Overhead and Underground Electric Asset Inspections
Unit Cost and Forecast Details: MAT BFG

Line No.		
1	**MAT Code**	BFG
2	**GRC Ch.**	10 - Overhead and Underground Electric Asset Inspections
3	**MAT Code Definition**	OH Line Equipment Inspected and Tested – Annual inspections/testing of OH, pad-mounted, and UG electric distribution line equipment for compliance with Utility Standard TD-2302S. Facilities include: capacitors, regulators, reclosers, and SCADA operated switches, interrupters, and sectionalizers. Units measured: Number of OH line equipment inspected and tested. This program relates to safety, reliability, or maintenance because it proactively identifies assets needing repair or replacement and generates corrective work orders for future work planning.

	Risk ID	Type	Name
4	None	N/A	N/A

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Equip Inspections
8	**Unit Cost (2023)**	$ 95
9	**Unit Cost Forecast Basis**	Forecast unit costs are in line with historic actuals.
10	**Unit Forecast Basis**	Number of pieces of equipment that have an inspection requirement in PG&E utility standard TD-2302S for the forecasted year.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 2,346,619	$ 2,286,404	$ 2,089,277	$ 2,108,397	$ 2,574,246	Calculated - Line 12 * Line 13
12	**No. of Units**	24,079	24,332	23,929	22,422	24,577	
13	**Unit Cost**	$ 97	$ 94	$ 87	$ 94	$ 105	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 2,419,175	$ 2,648,980	$ 2,429,743	Calculated - Line 15 * Line 16
15	**No. of Units**	25,465	27,884	25,576	
16	**Unit Cost**	$ 95	$ 95	$ 95	

Notes

17 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 10-11
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 10 - Overhead and Underground Electric Asset Inspections
Unit Cost and Forecast Details: MAT BFF

Line No.		
1	**MAT Code**	BFF
2	**GRC Ch.**	10 - Overhead and Underground Electric Asset Inspections
3	**MAT Code Definition**	UG Line Equipment Inspected and Tested – Annual inspections of UG electric distribution line equipment for compliance with Utility Standard TD-2302S. Facility inspections only include manholes with special equipment (i.e., oil -filled equipment). 34.5 kV BART Cable Inspections and ATS Inspections are performed and tracked in MATs BF3 and BF4, respectively. Units measured: Number of UG line equipment inspected and tested. This program relates to safety, reliability, or maintenance because it proactively identifies assets needing repair or replacement and generates corrective work orders for future work planning.

	Risk ID	Type	Name
4	DUNGD-C001	Control	Patrols

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Manholes/Vaults Inspected
8	**Unit Cost (2023)**	$ 300
9	**Unit Cost Forecast Basis**	Unit cost can fluctuate year-to-year due to low unit volume. Forecasted unit cost in line with 2016-2020 average recorded costs.
10	**Unit Forecast Basis**	Number of manholes with equipment that have an annual inspection requirement in PG&E utility standard TD-2302S.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 407,798	$ 477,138	$ 367,441	$ 458,106	$ 611,573	Calculated - Line 12 * Line 13
12	**No. of Units**	1,951	1,580	1,377	1,540	1,272	
13	**Unit Cost**	$ 209	$ 302	$ 267	$ 297	$ 481	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 464,411	$ 464,411	$ 464,411	Calculated - Line 15 * Line 16
15	**No. of Units**	1,546	1,546	1,546	
16	**Unit Cost**	$ 300	$ 300	$ 300	

	Notes	
17	**(A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 10-12
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 10 - Overhead and Underground Electric Asset Inspections
Number of Overhead Inspections by Division (MAT BFB) – 2019 Recorded Details

Line No.	Division	Number of Inspections (HFTD - Tier 2 and Tier 3)	Number of Inspections (Non-HFTD)	Total
1	Sierra	135,362	36,257	171,619
2	North Valley	109,995	42,951	152,946
3	Yosemite	74,173	55,527	129,700
4	Humboldt	72,505	26,508	99,013
5	Stockton	52,671	32,174	84,845
6	Central Coast	42,755	28,910	71,665
7	Los Padres	39,255	23,458	62,713
8	Sonoma	38,561	11,930	50,491
9	North Bay	30,468	17,395	47,863
10	Fresno	22,250	51,488	73,738
11	Peninsula	13,455	12,194	25,649
12	Sacramento	13,316	36,268	49,584
13	Diablo	10,949	13,000	23,949
14	De Anza	10,902	13,082	23,984
15	East Bay	10,018	11,495	21,513
16	Mission	7,516	18,165	25,681
17	San Jose	6,728	17,082	23,810
18	Kern	2,824	33,036	35,860
19	San Francisco	547	8,772	9,319
20	**Subtotals**	**694,250**	**489,692**	**1,183,942**

Workpaper Table 10-13
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 10 - Overhead and Underground Electric Asset Inspections
Number of Overhead Inspections by Division (MAT BFB) – 2020 Recorded Details

Line No.	Division	Number of Inspections (HFTD - Tier 2 and Tier 3)	Number of Inspections (Non-HFTD)	Total
1	Sierra	84,329	13,925	98,254
2	North Valley	44,450	33,302	77,752
3	Yosemite	37,266	34,210	71,476
4	Fresno	5,185	43,959	49,144
5	Stockton	28,307	18,411	46,718
6	Central Coast	20,321	24,367	44,688
7	Humboldt	32,828	11,472	44,300
8	Sonoma	24,763	15,718	40,481
9	Sacramento	4,608	30,566	35,174
10	Kern	5	30,673	30,678
11	North Bay	19,171	10,913	30,084
12	De Anza	7,399	10,578	17,977
13	Los Padres	9,102	7,627	16,729
14	Peninsula	6,849	9,181	16,030
15	San Jose	2,260	12,648	14,908
16	East Bay	3,918	9,927	13,845
17	Diablo	4,751	8,730	13,481
18	Mission	3,633	9,304	12,937
19	San Francisco	0	4,440	4,440
20	**Subtotals**	**339,145**	**339,951**	**679,096**

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 10, ELECTRIC DISTRIBUTION MAINTENANCE
PROJECT SUMMARY- OVERHEAD INFRARED INSPECTIONS

Project Title: Overhead Infrared Inspections
Major Work Categories: BF
Planning Order Numbers: 5002210, 5002215, 5002220, 5022233, 5058289, 5233092
Project Start Date: May 1, 2021
Project Completion Date: Ongoing
Operative Date (only applies to Capital): N/A

Program Description

In 2019, PG&E completed a multi-year program of infrared inspections and splice inventory of all PG&E circuits. The program consisted of the following work:

- Infrared Inspection: Overhead electric distribution facilities are inspected using infrared technology and all abnormal conditions are assessed and corrected through the electric distribution maintenance process.

- Splice Inventory: When three or more splices are found in a single overhead span the GPS location and total splices per phase are documented. Splice location and splice count data are leveraged to inform decision making on proactive conductor replacement projects.

Beginning in 2020, PG&E has refocused the program to perform infrared inspections on approximately 14,000 miles of overhead electric distribution facilities per year. Each year, the revised program will target one-third of the overhead electric distribution circuitry located in the Tier 2 and Tier 3 High Fire Threat District (HFTD) areas and up to approximately 10 percent of the remaining overhead electric distribution circuitry in non-HFTD areas. These inspections are a control (C6) for the Failure of Distribution Overhead Assets risk as shown in the 2020 Risk Assessment Mitigation Phase (RAMP).

The 2020 HFTD infrared distribution circuit plan utilized the 2019 REAX scoring component to rank each circuit and was used to the select the 2020 HFTD infrared circuit list. The program targeted 10 percent of work to non-HFTD area to allow for more focus on HFTD area. For 2021, PG&E's HFTD infrared plan will evaluate which circuits to inspect using the 2021 Wildfire Consequence Model instead of REAX based modeling. Unlike the circuit scoring model used in 2020, the 2021 Wildfire Consequence Model for overhead conductor is being used to rank and prioritize circuits based on potential consequence circuit level.

Justification

Infrared technology produces an image that can identify electrical equipment operating at high temperatures that would not be identified during a visual inspection. Identification of electrical equipment operating at high temperatures allows PG&E to replace or repair the equipment before it fails through PG&E's electric distribution maintenance program. This work improves public safety and increases reliability through elimination of potential outages and reducing the number of wires-down events where falls to the ground due to equipment failure. It is a proactive and non-contact inspection.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 10, ELECTRIC DISTRIBUTION MAINTENANCE
PROJECT SUMMARY- OVERHEAD INFRARED INSPECTIONS

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast			
	2016	2017	2018	2019	2020	2021	2022	2023	Forecast Total
EXPENSE									
OH Infrared Inspections-EB (PO# 5002210)	3	-	-	-	-	-	-	-	-
OH Infrared Inspections-NB (PO# 5002215)	0	3	-	-	-	-	-	-	-
OH Infrared Inspections-SF (PO# 5002220)	8	-	-	-	-	-	-	-	-
Infrared Inspections (PO# 5022233)	3,340	1,662	1,861	1,919	1,561	2,320	-	-	2,320
SYSPLAN ED BFC WLDFR-C01B DOVHD-C006 (PO# 5058289)	0	-	-	-	-	-	2,323	2,595	4,918
UWF/OWF Wildfire IR Inspections (PO# 5233092)	287	123	-	-	-	-	-	-	-
Expense Total	**3,638**	**1,788**	**1,861**	**1,919**	**1,561**	**2,320**	**2,323**	**2,595**	**7,238**

Benefits

Benefits of the revised infrared program that began in 2020 include:

1. Continued proactive infrared inspections of electric overhead distribution facilities with an emphasis on HFTD areas.
2. Identification of abnormal conditions on the overhead distribution system that can be mitigated prior to equipment failure.
3. A reduction in equipment failure events improves public safety, improves system reliability and reduces fire risk.

Alternatives Considered (In Addition to the Selected Alternative)

1. Conduct infrared inspections on overhead circuit portions in Tier 3 HFTD areas only.
   - This alternative would not provide the benefits associated with proactive infrared inspections in Tier 2 HFTD or non-HFTD areas.

2. Discontinue the infrared inspection program at the completion of the current program ending in 2022
   - This alternative would eliminate all benefits associated with proactive infrared inspections on the entire PG&E system.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 10, ELECTRIC DISTRIBUTION MAINTENANCE
PROJECT SUMMARY - NON-WOOD STREETLIGHT-ONLY POLE INSPECTIONS PROGRAM

Project Title: Non-Wood Streelight-Only Pole Inspections Program
Major Work Categories: MWC BF, MAT BFH
Planning Order Numbers: 5057007
Project Start Date: 2017
Project Completion Date: Ongoing
Operative Date (only applies to Capital): N/A

Program Description

In 2023 the primary costs in MAT BFH will be the Non-Wood Streetlight-Only Pole Inspection Program.

In 2017, PG&E ran a pilot program to inspect non-wood streetlight-only poles owned by PG&E. 5 percent of the sample population failed the inspection criteria. Due to that failure rate PG&E has developed the on-going inspection program to maintain public safety. The initial focus has been on metallic poles due to risk of corrosion, but PG&E is expanding the program scope to include concrete and fiberglass streetlight-only poles.

The costs charged to BFH for the Streetlight Inspection Program include:

- Non-wood streetlight-only pole inspections which also includes the historical Golden Triangle and Chinatown Dragon Lights in the City and County of San Francisco.
- Developing a streetlight data management system to store and manage streetlight-only pole inspection data.

The cost forecast estimates include first inspections of metallic poles initially installed 20 years ago, first inspections of concrete and fiberglass streetlight-only poles, and re-inspections of poles based on data from earlier inspections. The results of the Non-Wood Streetlight Inspection Program will feed into other programs including streetlight maintenance (MWC KAP, Chapter 11), streetlight pole replacements (MWC 2AP, Chapter 11), and refurbishment of historical streetlights in the City and County of San Francisco (MWC 2AI, Chapter 11).

Justification

Streetlight-only poles have not been systematically inspected in recent times, and condition data for this asset needed to be gathered to assess public safety risk. Proactive detailed inspections provide visibility into asset condition and alert us of any maintenance or replacement work needed to mitigate risk.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast			
	2016	2017	2018	2019	2020	2021	2022	2023	Forecast Total
EXPENSE									
Non-Wood SL Insp Program (PO# 5057007)	-	102	891	2,314	989	1,272	1,275	3,783	6,330
Expense Total	**-**	**102**	**891**	**2,314**	**989**	**1,272**	**1,275**	**3,783**	**6,330**

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 10, ELECTRIC DISTRIBUTION MAINTENANCE
PROJECT SUMMARY - NON-WOOD STREETLIGHT-ONLY POLE INSPECTIONS PROGRAM

Benefits

- As of 2017 when detailed inspections were first performed, PG&E has identified and replaced over 350 heavily corroded streetlight-only poles.
- Inspection results (pole wall thickness, stray voltage, foreign attachments) are documented, and proactive re-inspections are planned based on these results.

Alternatives Considered (In Addition to the Selected Alternative)

- Do Nothing: Status quo is not acceptable due to the public safety risk.
- Inspect All Streetlight-only Poles including Concrete and Fiberglass: The decision was made to inspect *metallic* streetlight-only poles first because they presented the highest risk due to their potentially corrosive nature. Additionally, the *oldest* metallic light poles were prioritized first because older (pre-1975) steel light poles were not protected with a galvanized coating that minimizes the corrosion potential.

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE

Testimony: ☐ **Workpapers:** ☒ **SOQ:** ☐

Exhibit Number: 4 **Chapter Number:** 10

Chapter Title: Overhead and Underground Electric Asset Inspections

Witness Name: Maria Delgado

Page No.	Line No.	Item	As Filed	As Corrected
Errata as of February 25, 2022				
10-2	Line 1	BF – E T&D Patrol/Insp	2021 Forecast $119,195	2021 Forecast $119,211
10-2	Line 2	Total	2021 Forecast $119,195	2021 Forecast $119,211

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
EXHIBIT (PG&E-4) ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING
CHAPTER 11, OVERHEAD AND UNDERGROUND ELECTRIC DISTRIBUTION MAINTENANCE

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Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11
Overhead and Underground Electric Distribution Maintenance
Expenses by Major Work Category
(Thousands of Nominal Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	Reference
1	BK	Maint Other Equip	1,548	1,455	1,414	1,927	1,851	1,619	1,621	1,912	WP 11-7, WP 11-8
2	IG	Manage Var Bal Acct Processes			605						
3	KA	E Dist Maint OH General	32,175	27,436	33,130	102,518	117,745	62,508	60,713	74,135	WP 11-3. WP 11-4
4	KB	E Dist Maint UG	16,133	13,643	17,077	16,442	13,147	15,079	15,101	18,938	WP 11-5, WP 11-6
5	**Total**		**49,856**	**42,534**	**52,227**	**120,887**	**132,744**	**79,206**	**77,436**	**94,985**	

Workpaper Table 11-2
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11
Overhead and Underground Electric Distribution Maintenance
Expenses by Major Work Category
(Thousands of Base Year Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast
1	BK	Maint Other Equip	1,732	1,576	1,480	1,964	1,851	1,587	1,540	1,760
2	IG	Manage Var Bal Acct Processes			616					
3	KA	E Dist Maint OH General	35,313	29,541	34,342	101,812	117,745	62,239	58,971	70,143
4	KB	E Dist Maint UG	17,594	14,600	17,594	16,410	13,147	14,945	14,574	17,778
5	**Total**		**54,639**	**45,717**	**54,032**	**120,186**	**132,744**	**78,771**	**75,085**	**89,681**

Workpaper Table 11-3
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #11, Overhead and Underground Electric Distribution Maintenance
Major Work Category KA – Recorded Walk
MWC KA - Overhead Maintenance
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount	Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$ 32,175**		WP 11-9, line 23
2		Transformer Labor Expense (MAT KA#)	$ 59	Minor variation in work costs.	WP 11-9, line 18
3		Overhead Notifications (MAT KAA)	$ 2,574	Increase in cost due to increased volume of F tags completed compared to	WP 11-9, line 2
4		Regs/Recls CM Tag (MAT KAB)	$ (7)	No significant change.	WP 11-9, line 15
5		Bird Safe (MAT KAC)	$ (70)	Minor variation in work costs.	WP 11-9, line 3
6		Bird Retrofits (MAT KAD)	$ (3)	No significant change.	WP 11-9, line 4
7		Overhead COE (MAT KAF)	$ (1,341)	Decrease in volume due to higher priority work (i.e. wildfire emergency	WP 11-9, line 5
8		Streetlight Group Replacements (MAT KAG)	$ (4)	No significant change.	WP 11-9, line 14
9		Streetlight Burnouts (MAT KAH)	$ (751)	Cost decrease due to fewer burnouts compared to 2016.	WP 11-9, line 6
10		Radio and Television Interference (RTVI) Investigations (MAT	$ (47)	Minor variation in work costs.	WP 11-9, line 11
11		Capacitor Controllers Replacements (MAT KAL)	$ (5)	No significant change.	WP 11-9, line 21
12		Insulator Washing (MAT KAM)	$ 51	Minor variation in work costs.	WP 11-9, line 13
13		Notifications Validate (MAT KAN)	$ (1)	No significant change.	WP 11-9, line 16
14		Idle facilities Investigations (MAT KAO)	$ (594)	Decrease in cost due to the completion of fewer idle facility investigations compared to 2016.	WP 11-9, line 20
15		OH Projects (MAT KAP)	$ (54)	Minor variation in work costs.	WP 11-9, line 17
16		Wood Pole Bonding (MAT KAQ)	$ (39)	No significant change.	WP 11-9, line 7
17		Surge Arrestor Grounding (MAT KAR)	$ (4,295)	Cost decrease due to stopping the Surge Arrester Grounding work as a stand alone project. Incorporated into Non-Exempt Surge Arrester Replacement Program (2AR) starting in 2017.	WP 11-9, line 12
18		FAS Overhead expense (MAT KAS)	$ (211)	Slight decrease due to higher priority work.	WP 11-9, line 8
19	**2017**	**Recorded Adjusted**	**$ 27,436**		WP 11-9, line 23
20		Transformer Labor Expense (MAT KA#)	$ 251	Minor variation in work costs.	WP 11-9, line 18
21		Overhead Notifications (MAT KAA)	$ 4,994	Increase in cost due to increase in volume of tags completed.	WP 11-9, line 2
22		Regs/Recls CM Tag (MAT KAB)	$ 3	No significant change.	WP 11-9, line 15
23		Bird Safe (MAT KAC)	$ 208	Minor variation in work costs.	WP 11-9, line 3
24		Bird Retrofits (MAT KAD)	$ 821	Increase due to higher unit costs.	WP 11-9, line 4
25		Overhead COE (MAT KAF)	$ (401)	Decrease due to lower unit costs.	WP 11-9, line 5
26		Streetlight Group Replacements (MAT KAG)	$ 0	No significant change.	WP 11-9, line 14
27		Streetlight Burnouts (MAT KAH)	$ (319)	Decrease due to fewer burnouts compared to 2017.	WP 11-9, line 6
28		Radio and Television Interference (RTVI) Investigations (MAT	$ (10)	No significant change.	WP 11-9, line 11
29		Capacitor Controllers Replacements (MAT KAL)	$ (0)	No significant change.	WP 11-9, line 21
30		Insulator Washing (MAT KAM)	$ (86)	Minor variation in work costs.	WP 11-9, line 13
31		Idle facilities Investigations (MAT KAO)	$ 341	Increase in cost due to the completion of more idle facility investigations.	WP 11-9, line 20
32		OH Projects (MAT KAP)	$ 135	Minor variation in work costs.	WP 11-9, line 17
33		Wood Pole Bonding (MAT KAQ)	$ (7)	No significant change.	WP 11-9, line 7
34		Surge Arrestor Grounding (MAT KAR)	$ (355)	Cost decrease due to stopping the Surge Arrester Grounding work as a stand alone project. Incorporated into Non-Exempt Surge Arrester Replacement Program (2AR) starting in 2017.	WP 11-9, line 12
35		FAS Overhead expense (MAT KAS)	$ 119	Minor variation in work costs.	WP 11-9, line 8
36	**2018**	**Recorded Adjusted**	**$ 33,130**		WP 11-9, line 23
37		Transformer Labor Expense (MAT KA#)	$ (1,292)	Decrease due to re-class of costs.	WP 11-9, line 18
38		Overhead Notifications (MAT KAA)	$ 65,914	Increase due to increase of notifications completed and higher unit costs.	WP 11-9, line 2
39		Regs/Recls CM Tag (MAT KAB)	$ 0	No significant change.	WP 11-9, line 15
40		Bird Safe (MAT KAC)	$ 114	Increase in cost due to higher units costs.	WP 11-9, line 3
41		Bird Retrofits (MAT KAD)	$ (999)	Decrease due to fewer units completed, qualifying work completed under other MATs.	WP 11-9, line 4
42		Overhead COE (MAT KAF)	$ 635	Increase due to increase in unit cost.	WP 11-9, line 5
43		Streetlight Group Replacements (MAT KAG)	$ (0)	No significant change.	WP 11-9, line 14
44		Streetlight Burnouts (MAT KAH)	$ (194)	Decrease in cost due to fewer streetlight burnouts compared to 2018.	WP 11-9, line 6
45		Radio and Television Interference (RTVI) Investigations (MAT KAK)	$ (18)	No significant change.	WP 11-9, line 11
46		Capacitor Controllers Replacements (MAT KAL)	$ 0	No longer used.	WP 11-9, line 21
47		Insulator Washing (MAT KAM)	$ (19)	No significant change.	WP 11-9, line 13
48		Idle facilities Investigations (MAT KAO)	$ (142)	Decrease in cost due to the completion of fewer idle facility investigations.	WP 11-9, line 20
49		OH Projects (MAT KAP)	$ 5,526	Increase in cost due to Nova Board replacement project.	WP 11-9, line 17
50		Surge Arrestor Grounding (MAT KAR)	$ (174)	Cost decrease due to stopping the Surge Arrester Grounding work as a stand alone project. Incorporated into Non-Exempt Surge Arrester Replacement Program (2AR) starting in 2017.	WP 11-9, line 12
51		FAS Overhead expense (MAT KAS)	$ 38	No significant change.	WP 11-9, line 8
52	**2019**	**Recorded Adjusted**	**$ 102,518**		WP 11-9, line 23
53		Transformer Labor Expense (MAT KA#)	$ 1,262	Increase in cost due to higher labor expense.	WP 11-9, line 18
54		Overhead Notifications (MAT KAA)	$ 11,520	Higher spend due to more units completed at higher unit costs.	WP 11-9, line 2
55		Regs/Recls CM Tag (MAT KAB)	$ (0)	No significant change.	WP 11-9, line 15
56		Bird Safe (MAT KAC)	$ (57)	Minor variation in work costs	WP 11-9, line 3
57		Bird Retrofits (MAT KAD)	$ 84	Minor variation in work costs	WP 11-9, line 4
58		Overhead COE (MAT KAF)	$ 882	Increase in unit cost due to increased labor costs	WP 11-9, line 5
59		Streetlight Group Replacements (MAT KAG)	$ -	No significant change.	WP 11-9, line 14
60		Streetlight Burnouts (MAT KAH)	$ 59	Minor variation in work costs	WP 11-9, line 6
61		Radio and Television Interference (RTVI) Investigations (MAT KAK)	$ 10	No significant change.	WP 11-9, line 11
62		Capacitor Controllers Replacements (MAT KAL)	$ (0)	No significant change.	WP 11-9, line 21
63		Insulator Washing (MAT KAM)	$ 45	No significant change.	WP 11-9, line 13
64		Idle facilities Investigations (MAT KAO)	$ 344	Increase due to increase in number of investigations.	WP 11-9, line 20
65		OH Projects (MAT KAP)	$ 938	Increase due to Nova Board Replacement project.	WP 11-9, line 17
66		Wood Pole Bonding (MAT KAQ)	$ 20	No significant change.	WP 11-9, line 7
67		Surge Arrestor Grounding (MAT KAR)	$ 0	No significant change.	WP 11-9, line 12
68		FAS Overhead expense (MAT KAS)	$ 119	Minor variation in work costs	WP 11-9, line 8
69	**2020**	**Recorded Adjusted**	**$ 117,745**		WP 11-9, line 23

Workpaper Table 11-4
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #11, Overhead and Underground Electric Distribution Maintenance
Major Work Category KA – Forecast Walk
MWC KA - Overhead Maintenance
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$117,745**			WP 11-9, line 23
2		Transformer Labor Expense (MAT KA#)	$ (885)		Decrease due to reclass of costs	WP 11-9, line 18
3		Forecast Adjustment (MAT KA#)	$ (3,613)		Decrease due to forecast adjustment in 2021	WP 11-9, line 19
4		Overhead Notifications (MAT KAA)	$ (49,098)		Decrease due to fewer units forecasted to be completed due to funding changes.	WP 11-9, line 2
5		Regs/Recls CM Tag (MAT KAB)	$ -		No significant change	WP 11-9, line 15
6		Bird Safe (MAT KAC)	$ 277		Minor variation in work costs	WP 11-9, line 3
7		Bird Retrofits (MAT KAD)	$ 801		Increase due to forecasting more units to be completed to support reliability.	WP 11-9, line 4
8		Overhead COE (MAT KAF)	$ (32)		No significant change	WP 11-9, line 5
9		Streetlight Group Replacements (MAT KAG)	$ -		No significant change	WP 11-9, line 14
10		Streetlight Burnouts (MAT KAH)	$ 272		Minor variation in work costs	WP 11-9, line 6
11		Radio and Television Interference (RTVI) Investigations (MAT KAK)	$ 64		Minor variation in work costs	WP 11-9, line 11
12		Capacitor Controllers Replacements (MAT KAL)	$ -		No significant change	WP 11-9, line 21
13		Insulator Washing (MAT KAM)	$ 166		Minor variation in work costs	WP 11-9, line 13
14		Notifications Validate (MAT KAN)	$ -		No significant change	WP 11-9, line 16
15		Idle facilities Investigations (MAT KAO)	$ 19		No significant change	WP 11-9, line 20
16		OH Projects (MAT KAP)	$ (3,060)		Decrease in costs due to completion of Nova Board project.	WP 11-9, line 17
17		Wood Pole Bonding (MAT KAQ)	$ (19)		No significant change	WP 11-9, line 7
18		FAS Overhead expense (MAT KAS)	$ (130)		Minor variation in work costs	WP 11-9, line 8
19	**2021**	**Forecast**	**$ 62,508**			WP 11-9, line 23
20						
21		Transformer Labor Expense (MAT KA#)	$ -		No significant change	WP 11-9, line 18
22		Forecast Adjustment (MAT KA#)	$ (5)		No significant change	WP 11-9, line 19
23		Overhead Notifications (MAT KAA)	$ (990)		Minor variation in forecasted units to be completed to align with prioritization of funding	WP 11-9, line 2
24		Bird Safe (MAT KAC)	$ (204)		Minor variation in work costs	WP 11-9, line 3
25		Bird Retrofits (MAT KAD)	$ 2		No significant change	WP 11-9, line 4
26		Overhead COE (MAT KAF)	$ 9		No significant change	WP 11-9, line 5
27		Streetlight Burnouts (MAT KAH)	$ 3		No significant change	WP 11-9, line 6
28		Radio and Television Interference (RTVI) Investigations (MAT KAK)	$ 0		No significant change	WP 11-9, line 11
29		Insulator Washing (MAT KAM)	$ 0		No significant change	WP 11-9, line 13
30		Idle facilities Investigations (MAT KAO)	$ 1		No significant change	WP 11-9, line 20
31		OH Projects (MAT KAP)	$ (612)		No significant change	WP 11-9, line 17
32		Wood Pole Bonding (MAT KAQ)	$ (0)		No significant change	WP 11-9, line 7
33		FAS Overhead expense (MAT KAS)	$ 2		No significant change	WP 11-9, line 8
34	**2022**	**Forecast**	**$ 60,713**			WP 11-9, line 23
35						
36		Transformer Labor Expense (MAT KA#)	$ 815		Forecasted adjustments to transformer labor expense.	WP 11-9, line 18
37		Forecast Adjustment (MAT KA#)	$ 3,618		Increase due to end of forecast adjustment in 2022	WP 11-9, line 19
38		Overhead Notifications (MAT KAA)	$ 9,803		Increase due to funding allocation.	WP 11-9, line 2
39		Bird Safe (MAT KAC)	$ 301		Forecast minor increase in units.	WP 11-9, line 3
40		Bird Retrofits (MAT KAD)	$ 76		Minor variation in work costs	WP 11-9, line 4
41		Overhead COE (MAT KAF)	$ 382		Increase due to forecast higher units to be completed.	WP 11-9, line 5
42		Streetlight Burnouts (MAT KAH)	$ 115		Minor variation in work costs	WP 11-9, line 6
43		Radio and Television Interference (RTVI) Investigations (MAT KAK)	$ 7		No significant change	WP 11-9, line 11
44		Insulator Washing (MAT KAM)	$ 13		No significant change	WP 11-9, line 13
45		Idle facilities Investigations (MAT KAO)	$ (504)		Forecast decrease in investigations due to funding prioritization.	WP 11-9, line 20
46		OH Projects (MAT KAP)	$ (1,301)		Forecast decrease in spend due to Nova Board project completion in prior year. Current forecast is for remote grid project ramping up.	WP 11-9, line 17
47		Wood Pole Bonding (MAT KAQ)	$ 0		No significant change	WP 11-9, line 7
48		FAS Overhead expense (MAT KAS)	$ 95		Minor variation in work costs	WP 11-9, line 8
49	**2023**	**Forecast**	**$ 74,135**			WP 11-9, line 23

Workpaper Table 11-5
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #11, Overhead and Underground Electric Distribution Maintenance
Major Work Category KB – Recorded Walk
MWC KB - Underground Maintenance
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$ 16,133**			WP 11-17, line 13
2		Transformer Labor and Reclassification and Sand/Gravel and Spoil (MAT KB#)	$ (940)		Decreased use of sand, gravel, and spoil removals.	WP 11-17, line 9
3		Underground Notifications (MAT KBA)	$ 432		Increase due to slightly higher number of units worked and higher unit cost.	WP 11-17, line 2
4		Underground COE (MAT KBC)	$ (1,113)		Decrease in volume due to higher priority work (i.e. wildfire emergency	WP 11-17, line 3
5		Nitrogen Cylinders (MAT KBD)	$ (3)		No significant change.	WP 11-17, line 7
6		BART Cable Repair (MAT KBE)	$ (104)		Minor variation in work costs.	WP 11-17, line 8
7		UG Projects (MAT KBP)	$ (545)		Decrease in cost due to completing less work on the Wye Transformer Grounding project compared to 2016.	WP 11-17, line 4
8		Elbows/Splices Repl (MAT KBQ)	$ (218)		Decrease in cost due to completion of project to improve reliability by replacing elbows and splices in Foster City (Bay Meadows 21kv system).	WP 11-17, line 11
9	**2017**	**Recorded Adjusted**	**$ 13,643**			WP 11-17, line 13
10						
11		Transformer Labor and Reclassification and Sand/Gravel and Spoil (MAT KB#)	$ (444)		Decreased use of sand, gravel, and spoil removals.	WP 11-17, line 9
12		Underground Notifications (MAT KBA)	$ 3,638		Increase in cost due to higher contract spend.	WP 11-17, line 2
13		Underground COE (MAT KBC)	$ 19		No significant change.	WP 11-17, line 3
14		Nitrogen Cylinders (MAT KBD)	$ 33		No significant change.	WP 11-17, line 7
15		BART Cable Repair (MAT KBE)	$ (16)		No significant change.	WP 11-17, line 8
16		UG Projects (MAT KBP)	$ 27		No significant change.	WP 11-17, line 4
17		Elbows/Splices Repl (MAT KBQ)	$ 178		Minor variation in work costs.	WP 11-17, line 11
18	**2018**	**Recorded Adjusted**	**$ 17,077**			WP 11-17, line 13
19						
20		Transformer Labor and Reclassification and Sand/Gravel and Spoil (MAT KB#)	$ (98)		Minor variation in work costs.	WP 11-17, line 9
21		Underground Notifications (MAT KBA)	$ (334)		Minor variance due to less units completed.	WP 11-17, line 2
22		Underground COE (MAT KBC)	$ 363		Increase due to increase in unit cost.	WP 11-17, line 3
23		Nitrogen Cylinders (MAT KBD)	$ (29)		No significant change.	WP 11-17, line 7
24		BART Cable Repair (MAT KBE)	$ (44)		No significant change.	WP 11-17, line 8
25		UG Projects (MAT KBP)	$ (310)		Minor variance due to less units completed.	WP 11-17, line 4
26		Elbows/Splices Repl (MAT KBQ)	$ (183)		Minor variation in work costs	WP 11-17, line 11
27	**2019**	**Recorded Adjusted**	**$ 16,442**			WP 11-17, line 13
28						
29		Transformer Labor and Reclassification and Sand/Gravel and Spoil (MAT KB#)	$ 241		Minor variation in work costs.	WP 11-17, line 9
30		Underground Notifications (MAT KBA)	$ (3,287)		Decrease in costs due to less notifications completed than forecast.	WP 11-17, line 2
31		Underground COE (MAT KBC)	$ (87)		Minor variation in work costs.	WP 11-17, line 3
32		Nitrogen Cylinders (MAT KBD)	$ 15		No significant change.	WP 11-17, line 7
33		BART Cable Repair (MAT KBE)	$ 4		No significant change.	WP 11-17, line 8
34		UG Projects (MAT KBP)	$ (163)		Minor variation in work costs.	WP 11-17, line 4
35		Elbows/Splices Repl (MAT KBQ)	$ (18)		No significant change.	WP 11-17, line 11
36	**2020**	**Recorded Adjusted**	**$ 13,147**			WP 11-17, line 13

Workpaper Table 11-6
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #11, Overhead and Underground Electric Distribution Maintenance
Major Work Category KB – Forecast Walk
MWC KB - Underground Maintenance
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$ 13,147**			WP 11-17, line 13
2		Transformer Labor and Reclassification and Sand/Gravel and Spoil (MAT KB#)	$ (241)		Decrease due to change in reclass.	WP 11-17, line 9
3		Forecast Adjustment (MAT KB#)	$ (1,629)		Decrease due to forecast adjustment in 2021	WP 11-17, line 10
4		Underground Notifications (MAT KBA)	$ 2,719		Increase due to forecast in completing additional notifications based off risk prioritization of lower priority notifications.	WP 11-17, line 2
5		Underground COE (MAT KBC)	$ 427		Increase in unit cost due to COVID impacts on operations in 2020.	WP 11-17, line 3
6		Nitrogen Cylinders (MAT KBD)	$ (25)		No significant change	WP 11-17, line 7
7		BART Cable Repair (MAT KBE)	$ 52		Minor variation in work costs	WP 11-17, line 8
8		UG Projects (MAT KBP)	$ 630		Increase in cost primarily based off forecast of WYE transformer replacements found.	WP 11-17, line 4
9		Elbows/Splices Repl (MAT KBQ)	$ (0)		No significant change	WP 11-17, line 11
10	**2021**	**Forecast**	**$ 15,079**			WP 11-17, line 13
11		Transformer Labor and Reclassification and Sand/Gravel and Spoil (MAT KB#)	$ -		No significant change	WP 11-17, line 9
12		Forecast Adjustment (MAT KB#)	$ (2)		No significant change	WP 11-17, line 10
13		Underground Notifications (MAT KBA)	$ 21		No significant change	WP 11-17, line 2
14		Underground COE (MAT KBC)	$ 2		No significant change	WP 11-17, line 3
15		Nitrogen Cylinders (MAT KBD)	$ 0		No significant change	WP 11-17, line 7
16		BART Cable Repair (MAT KBE)	$ 0		No significant change	WP 11-17, line 8
17		UG Projects (MAT KBP)	$ 1		No significant change	WP 11-17, line 4
18	**2022**	**Forecast**	**$ 15,101**			WP 11-17, line 13
19		Transformer Labor and Reclassification and Sand/Gravel and Spoil (MAT KB#)	$ 706		Increase in reclass cost forecast	WP 11-17, line 9
20		Forecast Adjustment (MAT KB#)	$ 1,632		Increase due to end of forecast adjustment in 2022	WP 11-17, line 10
21		Underground Notifications (MAT KBA)	$ 1,349		Increase due to escalation and minor increase in forecasted units.	WP 11-17, line 2
22		Underground COE (MAT KBC)	$ 83		Minor variation in work costs	WP 11-17, line 3
23		Nitrogen Cylinders (MAT KBD)	$ 1		No significant change	WP 11-17, line 7
24		BART Cable Repair (MAT KBE)	$ 4		No significant change	WP 11-17, line 8
25		UG Projects (MAT KBP)	$ 62		Minor variation in work costs	WP 11-17, line 4
26	**2023**	**Forecast**	**$ 18,938**			WP 11-17, line 13

Workpaper Table 11-7
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #11, Overhead and Underground Electric Distribution Maintenance
Major Work Category BK – Recorded Walk
MWC BK - Equipment Repair
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$ 1,548**			WP 11-21, line 10
2		Line Equipment Overhauls (Emeryville) (MAT BKA)	$ (72)		Minor variation in work costs.	WP 11-21, line 2
3		Line Equipment Overhauls (Division Up/Down Labor) (MAT BKJ)	$ (89)		Minor variation in work costs.	WP 11-21, line 5
4		Failure Analysis/Warranty (MAT BKK)	$ 75		Minor variation in work costs.	WP 11-21, line 6
5		Standard Cost Variance (MAT BK#)	$ (7)		No significant change	WP 11-21, line 7
6	**2017**	**Recorded Adjusted**	**$ 1,455**			WP 11-21, line 10
7		Line Equipment Overhauls (Emeryville) (MAT BKA)	$ (82)		Minor variation in work costs.	WP 11-21, line 2
8		Line Equipment Overhauls (Division Up/Down Labor) (MAT BKJ)	$ 4		No significant change	WP 11-21, line 5
9		Failure Analysis/Warranty (MAT BKK)	$ 37		No significant change	WP 11-21, line 6
10	**2018**	**Recorded Adjusted**	**$ 1,414**			WP 11-21, line 10
11		Line Equipment Overhauls (Emeryville) (MAT BKA)	$ 557		Increase due to reduced demand in field repairs in 2019.	WP 11-21, line 2
12		Line Equipment Overhauls (Division Up/Down Labor) (MAT BKJ)	$ 9		No significant change	WP 11-21, line 5
13		Failure Analysis/Warranty (MAT BKK)	$ (53)		Minor variation in work costs.	WP 11-21, line 6
14	**2019**	**Recorded Adjusted**	**$ 1,927**			WP 11-21, line 10
15		Line Equipment Overhauls (Emeryville) (MAT BKA)	$ (144)		Decrease due to COVID impacts on work completion.	WP 11-21, line 2
16		Line Equipment Overhauls (Division Up/Down Labor) (MAT BKJ)	$ 69		Minor variation in work costs.	WP 11-21, line 5
17		Failure Analysis/Warranty (MAT BKK)	$ (1)		No significant change	WP 11-21, line 6
18	**2020**	**Recorded Adjusted**	**$ 1,851**			WP 11-21, line 10

Workpaper Table 11-8
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #11, Overhead and Underground Electric Distribution Maintenance
Major Work Category BK – Forecast Walk
MWC BK - Equipment Repair
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$ 1,851**			WP 11-21, line 10
2		Line Equipment Overhauls (Emeryville) (MAT BKA)	$ 252		Minor variation in work costs	WP 11-21, line 2
3		Line Equipment Overhauls (Division Up/Down Labor) (MAT BKJ)	$ (205)		Minor variation in work costs	WP 11-21, line 5
4		Failure Analysis/Warranty (MAT BKK)	$ (100)		Minor variation in work costs	WP 11-21, line 6
5		Forecast Adjustment (MAT BK#)	$ (180)		Decrease due to forecast adjustment in 2021	WP 11-21, line 8
6	**2021**	**Forecast**	**$ 1,619**			WP 11-21, line 10
7		Line Equipment Overhauls (Emeryville) (MAT BKA)	$ 3		No significant change	WP 11-21, line 2
8		Line Equipment Overhauls (Division Up/Down Labor) (MAT BKJ)	$ -		No significant change	WP 11-21, line 5
9		Failure Analysis/Warranty (MAT BKK)	$ -		No significant change	WP 11-21, line 6
10		Forecast Adjustment (MAT BK#)	$ (0)		No significant change	WP 11-21, line 8
11	**2022**	**Forecast**	**$ 1,621**			WP 11-21, line 10
12		Line Equipment Overhauls (Emeryville) (MAT BKA)	$ 111		Minor variation in work costs	WP 11-21, line 2
13		Line Equipment Overhauls (Division Up/Down Labor) (MAT BKJ)	$ -		No significant change	WP 11-21, line 5
14		Failure Analysis/Warranty (MAT BKK)	$ -		No significant change	WP 11-21, line 6
15		Forecast Adjustment (MAT BK#)	$ 180		Increase due to end of forecast adjustment in 2022	WP 11-21, line 8
16	**2023**	**Forecast**	**$ 1,912**			WP 11-21, line 10

Workpaper Table 11-9
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 11, Overhead and Underground Electric Distribution Maintenance
Expenses by Major Work Category KA – Forecast Details
(Thousands of Nominal Dollars)

Line No.		MAT CODE	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	Assumptions	Reference
1	**Total Cost by Activity Type**											
2	Total Cost of Overhead Notifications	KAA	$ 13,708	$ 16,282	$ 21,276	$ 87,190	$ 98,711	$ 49,612	$ 48,622	$ 58,425		WP 11-10
3	Total Cost of Bird Safe	KAC	$ 561	$ 491	$ 699	$ 813	$ 756	$ 1,033	$ 829	$ 1,130		WP 11-11
4	Total Cost of Bird Retrofits	KAD	$ 536	$ 533	$ 1,354	$ 354	$ 439	$ 1,240	$ 1,242	$ 1,318		WP 11-12
5	Total Cost of Overhead COE	KAF	$ 6,484	$ 5,143	$ 4,743	$ 5,377	$ 6,259	$ 6,228	$ 6,237	$ 6,619		WP 11-13
6	Total Cost of Streetlight Burnouts	KAH	$ 2,808	$ 2,057	$ 1,738	$ 1,544	$ 1,603	$ 1,875	$ 1,878	$ 1,993		WP 11-14
7	Wood Pole Bonding	KAQ	$ 46	$ 7	$ -	$ -	$ 20	$ 1	$ 1	$ 1		WP 11-15
8	Total Cost of FAS Overhead expense	KAS	$ 1,617	$ 1,405	$ 1,524	$ 1,562	$ 1,681	$ 1,551	$ 1,554	$ 1,649		WP 11-16
9	**Subtotal Cost by Activity Type**		$ 25,760	$ 25,919	$ 31,333	$ 96,841	$ 109,469	$ 61,541	$ 60,362	$ 71,135		
10	**Additional Project Cost**											
11	Total Cost of Radio and Television Interference (RTVI) Investigations	KAK	$ 111	$ 64	$ 53	$ 35	$ 45	$ 109	$ 109	$ 116	(1)	
12	Total Cost of Surge Arrestor Grounding	KAR	$ 4,824	$ 529	$ 174	$ (0)	$ -	$ -	$ -	$ -	(2)	
13	Insulator Washing	KAM	$ 57	$ 108	$ 22	$ 3	$ 48	$ 213	$ 213	$ 226	(3)	
14	Streetlight Group Replacements	KAG	$ 4	$ -	$ 0	$ -	$ -	$ -	$ -	$ -	(4)	
15	Regs/Recls CM Tag	KAB	$ 4	$ (3)	$ -	$ 0	$ -	$ -	$ -	$ -	(5)	
16	Notifications Validate	KAN	$ 1	$ -	$ -	$ -	$ -	$ -	$ -	$ -	(6)	
17	OH Projects	KAP	$ 72	$ 18	$ 154	$ 5,680	$ 6,618	$ 3,558	$ 2,946	$ 1,645	(7)	
18	Transformer Labor Expense	KA#	$ 605	$ 664	$ 915	$ (377)	$ 885	$ -	$ -	$ 815	(8)	
19	Forecast Adjustment	KA#	$ -	$ -	$ -	$ -	$ -	$ (3,613)	$ (3,618)	$ -	(9)	Chapter 2, Section
20	Idle facilities Investigations	KAO	$ 731	$ 138	$ 479	$ 337	$ 681	$ 700	$ 701	$ 197	(10)	
21	Capacitor Controllers Replacements	KAL	$ 5	$ 0	$ -	$ 0	$ -	$ -	$ -	$ -	(11)	
22	**Subtotal Additional Project Costs**		$ 6,415	$ 1,518	$ 1,797	$ 5,677	$ 8,276	$ 967	$ 351	$ 2,999		
23	**Total MWC KA**		**$ 32,175**	**$ 27,436**	**$ 33,130**	**$ 102,518**	**$ 117,745**	**$ 62,508**	**$ 60,713**	**$ 74,135**		

Forecast Assumptions and Details

(1) Investigation of radio and television interference where cause is linked to Company equipment. Forecast based on future anticipated needs.
(2) No forecast as program no longer in effect.
(3) Distribution insulator washing targets mainline poles in identified areas to minimize pole-fire related outages. Forecast based off 2020 GRC and 2021 workplan.
(4) No forecast as program no longer in effect.
(5) No forecast as program no longer in effect.
(6) No forecast as program no longer in effect.
(7) Includes forecast of replacing Nova Actuator boards and forecasted cost of maintenance of remote grid.
(8) Transformer labor expense is for work performed to refurbish transformers removed from service instead of purchasing new transformers. Project costs are related to the work to restore existing transformers back to working condition.
(9) Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecas
(10) Idle facility investigations are conducted to identify idle electric distribution facilities with no foreseeable future use. Once a facility is determined to be idle and of no future use, it will be removed as part of either the Overhead or Underground Idl
Facility Removal Programs (MATS 2AF & 2BF).
(11) No forecast as program no longer in effect.

Workpaper Table 11-10
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT KAA

Line No.		
1	**MAT Code**	KAA
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	OH General CM Tag – Repair OH facilities or replace individual components that are not an imminent hazard and have not caused an outage. Facilities include: connectors, insulators, low conductors, leaning poles, slack guys, etc. Repair, replace, or install grounds, moldings, leaking bushings, and related work on all OH transformers and equipment associated with transformers. Units measured: Number of notifications. This program relates to safety, reliability, or maintenance because it addresses a non-conformance identified by preventative maintenance programs such as inspections and patrols, as well as internal operational processes.

	Risk ID	Type	Name
4	DOVHD-C003	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead
5	WLDFR-C008	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead

6	**Program Area**	Maintenance and Compliance
7	**Forecast Method**	Unit cost
8	**Unit of Measure**	# of Notifications Completed
9	**Unit Cost (2023)**	$ 2,419
10	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
11	**Unit Forecast Basis**	2019-2020 average recorded units adjusted to match forecast spend target.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
12	**Recorded Costs**	$ 13,707,686	$ 16,282,178	$ 21,275,963	$ 87,190,387	$ 98,710,568	Calculated - Line 13 * Line 14
13	**No. of Units**	20,937	26,867	29,501	49,232	40,176	
14	**Unit Cost**	$ 655	$ 606	$ 721	$ 1,771	$ 2,457	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
15	**Forecast Costs**	$ 49,612,461	$ 48,622,465	$ 58,425,421	Calculated - Line 16 * Line 17
16	**No. of Units**	21,438	20,443	24,151	
17	**Unit Cost**	$ 2,314	$ 2,378	$ 2,419	

18	**Notes**	
	(A)	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 11-11
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT KAC

Line No.		
1	**MAT Code**	KAC
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	Bird Safe Retrofit – Repair, replace, or install bird guard materials such as jumper covers, bushing covers, perch guards, or perching platforms on incident and/or adjacent poles in response to a bird electrocution, per U.S. Fish and Wildlife Service (USFWS) requirements and Utility Operating Standard S2321. Units measured: Number of notifications. This program relates to safety and reliability by mitigating outages due to bird incidents.

	Risk ID	Type	Name
4	DOVHD-C003	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead
	WLDFR-C011	Control	Animal Abatement

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Notifications Completed
8	**Unit Cost (2023)**	$ 1,771
9	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
10	**Unit Forecast Basis**	2021 approved work plan.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 560,607	$ 490,917	$ 698,952	$ 813,052	$ 756,186	Calculated - Line 12 * Line 13
12	**No. of Units**	725	755	732	528	507	
13	**Unit Cost**	$ 773	$ 650	$ 955	$ 1,540	$ 1,491	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 1,033,123	$ 829,262	$ 1,130,130	Calculated - Line 15 * Line 16
15	**No. of Units**	620	555	638	
16	**Unit Cost**	$ 1,666	$ 1,495	$ 1,771	

17	**Notes**	
	(A)	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 11-12
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT KAD

Line No.		
1	**MAT Code**	KAD
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	Bird Safe Retrofit Annual – Install bird guard materials such as jumper covers, bushing covers, perch guards, or perching platforms on poles identified in the Annual Pole Retrofit Program to prevent bird electrocutions, per USFWS requirements and Utility Operating Standard S2321. Units measured: Number of notifications. This program relates to safety, reliability, or maintenance due to PG&E's commitment made to USFWS to retrofit poles in raptor concentration zones to mitigate bird related outages.

	Risk ID	Type	Name
4	WLDFR-C011	Control	Animal Abatement

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Notifications Completed
8	**Unit Cost (2023)**	$ 1,290
9	**Unit Cost Forecast Basis**	Program inception to April 2020 average unit cost, escalated for inflation.
10	**Unit Forecast Basis**	Address targeted units in support of Avian Protection Plan.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 536,232	$ 533,193	$ 1,353,719	$ 354,411	$ 438,808	Calculated - Line 12 * Line 13
12	**No. of Units**	829	962	941	262	292	
13	**Unit Cost**	$ 647	$ 554	$ 1,439	$ 1,353	$ 1,503	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 1,240,122	$ 1,241,930	$ 1,318,074	Calculated - Line 15 * Line 16
15	**No. of Units**	1,022	993	1,022	
16	**Unit Cost**	$ 1,213	$ 1,251	$ 1,290	

17	**Notes**	
	(A)	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 11-13
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT KAF

Line No.		
1	**MAT Code**	KAF
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	OH COE Corrective Maintenance Tag – Also includes ordering batteries for work in MAT BFG. Units measured: Number of notifications. This program relates to safety, reliability, or maintenance because it addresses a non-conformance identified by preventative maintenance programs such as battery and equipment testing, as well as internal operational processes.

	Risk ID	Type	Name
4	WLDFR-C008	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Notifications Completed
8	**Unit Cost (2023)**	$ 4,797
9	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
10	**Unit Forecast Basis**	Steady-state rate calculated from 2018-19 two-year average of the find rate for new overhead COE maintenance notifcations.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 6,484,346	$ 5,143,293	$ 4,742,564	$ 5,377,224	$ 6,259,343	Calculated - Line 12 * Line 13
12	**No. of Units**	1,449	1,213	1,302	1,233	1,203	
13	**Unit Cost**	$ 4,475	$ 4,240	$ 3,643	$ 4,361	$ 5,203	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 6,227,715	$ 6,236,792	$ 6,619,177	Calculated - Line 15 * Line 16
15	**No. of Units**	1,380	1,341	1,380	
16	**Unit Cost**	$ 4,513	$ 4,651	$ 4,797	

17	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 11-14
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT KAH

Line No.		
1	**MAT Code**	KAH
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	Streetlight Replace Burnouts – Repair or replace lamps, photo cells, and related items associated with non -operating streetlights. If the street light head needs replacement, the time and material to replace the head is charged to 2AA. If the burnout is caused by a secondary UG failure, the time and material to make the repair is charged to 2BA. Units measured: Number of burnout repairs. This program relates to safety, reliability, or maintenance because it addresses a non-conformance identified by preventative maintenance programs such as Troublemen patrols and customer call-ins.

	Risk ID	Type	Name
4	DOVHD-C003	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Burnout Repairs
8	**Unit Cost (2023)**	$ 170
9	**Unit Cost Forecast Basis**	Three year average UC escalated for inflation.
10	**Unit Forecast Basis**	2021 approved workplan.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 2,808,222	$ 2,056,782	$ 1,738,196	$ 1,543,961	$ 1,602,826	Calculated - Line 12 * Line 13
12	**No. of Units**	20,617	15,223	11,067	8,853	7,789	
13	**Unit Cost**	$ 136	$ 135	$ 157	$ 174	$ 206	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 1,874,771	$ 1,877,504	$ 1,992,613	Calculated - Line 15 * Line 16
15	**No. of Units**	11,714	11,383	11,714	
16	**Unit Cost**	$ 160	$ 165	$ 170	

17	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 11-15
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT KAQ

Line No.		
1	**MAT Code**	KAQ
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	Wood Pole Bridge Bonding - Wood Pole Bonding maintenance activity where an existing wood pole supporting both electric transmission and distribution line facilities is retrofitted with grounding protection to prevent fires which can occur at the location on the pole where the electric distribution cross arm is bolted to the pole. This program relates to safety, reliability, or maintenance because it serves to prevent ignitions.

	Risk ID	Type	Name
4	WLDFR-C008	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Notifications Completed
8	**Unit Cost (2023)**	$ 539
9	**Unit Cost Forecast Basis**	2021 YTD average unit cost.
10	**Unit Forecast Basis**	2021 approved workplan.

		Recorded Costs & Units (A)					Reference
	Year	**2016 (B)**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 45,676	$ 6,896	$ -	$ -	$ 19,834	Calculated - Line 12 * Line 13
12	**No. of Units**	-	2	-	-	9	
13	**Unit Cost**	-	$ 3,448	$ -	$ -	$ 2,204	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 984	$ 591	$ 1,077	$ 1,106	$ 1,136	$ 1,167	Calculated - Line 15 * Line 16
15	**No. of Units**	2	1	2	2	2	2	
16	**Unit Cost**	$ 492	$ 608	$ 539	$ 553	$ 568	$ 584	

Notes

17 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

18 **(B)** Units not available for 2016

Workpaper Table 11-16
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT KAS

Line No.		
1	**MAT Code**	KAS
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	FAS OH Expense – FAS OH expense is work that is identified during a field job and completed by a single Troubleman. This program relates to safety, reliability, or maintenance because it addresses a non-conformance identified by preventative maintenance programs such as Troublemen patrols.

	Risk ID	Type	Name
4	DOVHD-C003	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Notifications Completed
8	**Unit Cost (2023)**	$ 158
9	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
10	**Unit Forecast Basis**	2018-19 average recorded units.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 1,616,935	$ 1,405,444	$ 1,523,945	$ 1,561,842	$ 1,681,320	Calculated - Line 12 * Line 13
12	**No. of Units**	9,783	10,706	9,964	10,670	9,207	
13	**Unit Cost**	$ 165	$ 131	$ 153	$ 146	$ 183	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 1,551,385	$ 1,553,646	$ 1,648,902	Calculated - Line 15 * Line 16
15	**No. of Units**	10,453	10,158	10,453	
16	**Unit Cost**	$ 148	$ 153	$ 158	

17	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 11-17
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 11, Overhead and Underground Electric Distribution Maintenance
Expenses by Major Work Category KB – Forecast Details
(Thousands of Nominal Dollars)

Line No.		MAT CODE	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	Assumptions	Reference
1	**Total Cost by Activity Type**											
2	Total Cost of Underground Notifications	KBA	$ 11,428	$ 11,860	$ 15,498	$ 15,164	$ 11,878	$ 14,596	$ 14,618	$ 15,967		WP 11-18
3	Total Cost of Underground COE	KBC	$ 1,748	$ 635	$ 654	$ 1,017	$ 929	$ 1,356	$ 1,358	$ 1,442		WP 11-19
4	UG Projects	KBP	$ 1,033	$ 489	$ 515	$ 205	$ 43	$ 672	$ 673	$ 735		WP 11-20
5	**Subtotal Cost by Activity Type**		$ 14,210	$ 12,984	$ 16,667	$ 16,386	$ 12,849	$ 16,625	$ 16,649	$ 18,144		
6	**Additional Project Cost**											
7	Nitrogen Cylinders	KBD	$ 31	$ 28	$ 61	$ 32	$ 47	$ 22	$ 22	$ 23	(1)	
8	BART Cable Repair	KBE	$ 169	$ 66	$ 50	$ 6	$ 10	$ 62	$ 62	$ 66	(2)	
9	Transformer Labor and Reclassification and Sand/Gravel and Spoil	KB#	$ 1,483	$ 543	$ 98	$ -	$ 241			$ 706	(3)	
10	Forecast Adjustment	KB#						$ (1,629)	$ (1,632)		(4)	Chapter 2, Section D
11	Elbows/Splices Repl	KBQ	$ 240	$ 23	$ 201	$ 18	$ 0	$ -	$ -	$ -	(5)	
12	**Subtotal Additional Project Costs**		$ 1,923	$ 659	$ 410	$ 56	$ 298	$ (1,545)	$ (1,548)	$ 795		
13	**Total MWC KB**		**$ 16,133**	**$ 13,643**	**$ 17,077**	**$ 16,442**	**$ 13,147**	**$ 15,079**	**$ 15,101**	**$ 18,938**		

Forecast Assumptions and Details

(1) Nitrogen filled cables require nitrogen injections in order to ensure proper operation. The forecast costs represent an estimate of potential future work.
(2) BART Cable repairs are costs associated with maintaining dedicated cable and backup systems which provide power to BART at seven locations. The forecast costs represent an estimate of potential future work based off 2020 GRC forecast.
(3) Transformer labor and reclassification costs are incurred when a transformer is refurbished and re-used instead of being replaced with a new unit. Costs for this category are labor to refurbish the transformer.
(4) Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast.
(5) Costs in this category are for special splicing or elbow replacement projects. Splices are installed in order to fix portions of cable rather than replacing the entire cable. For the forecast years there are no new special projects identified.

Workpaper Table 11-18
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT KBA

Line No.		
1	**MAT Code**	KBA
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	UG General CM Tag – Repair UG facilities (including UG infrared tags) or replace individual components that are not an imminent hazard and have not caused an outage. Includes cleaning enclosures, re-securing equipment, resurfacing lids, and tagging. Repair, replace, or install grounds, moldings, leaking bushings, and related work on all UG transformers and equipment associated with transformers. This program relates to safety, reliability, or maintenance because it addresses a non-conformance identified by preventative maintenance programs such as inspections and patrols, as well as internal operational processes.

	Risk ID	Type	Name
4	DUNGD-C002	Control	Underground Notifications

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Notifications Completed
8	**Unit Cost (2023)**	$ 2,591
9	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
10	**Unit Forecast Basis**	2019-2020 average recorded units adjusted for addressing high risk ECs each year.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 11,428,191	$ 11,859,805	$ 15,497,805	$ 15,164,036	$ 11,877,519	Calculated - Line 12 * Line 13
12	**No. of Units**	7,504	7,161	7,371	6,040	4,813	
13	**Unit Cost**	$ 1,523	$ 1,656	$ 2,103	$ 2,511	$ 2,468	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 14,596,475	$ 14,617,751	$ 15,966,985	Calculated - Line 15 * Line 16
15	**No. of Units**	5,988	5,819	6,163	
16	**Unit Cost**	$ 2,438	$ 2,512	$ 2,591	

17	**Notes**	
	(A)	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 11-19
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT KBC

Line No.		
1	**MAT Code**	KBC
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	UG COE Corrective Maintenance Tag – Repair of UG COE. This program relates to reliability and maintenance because it identifies certain asset life replacements (e.g., UG Cable Testing).

	Risk ID	Type	Name
4	DUNGD-C003	Control	Equipment Maintenance and Replacement

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Notifications Completed
8	**Unit Cost (2023)**	$ 8,238
9	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
10	**Unit Forecast Basis**	Steady-state rate calculated from 2018-19 two-year average of the find rate for new overhead COE maintenance notifcations.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 1,748,195	$ 635,139	$ 653,908	$ 1,016,717	$ 929,321	Calculated - Line 12 * Line 13
12	**No. of Units**	534	221	155	137	165	
13	**Unit Cost**	$ 3,274	$ 2,874	$ 4,219	$ 7,421	$ 5,632	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 1,356,449	$ 1,358,426	$ 1,441,713	Calculated - Line 15 * Line 16
15	**No. of Units**	175	170	175	
16	**Unit Cost**	$ 7,751	$ 7,988	$ 8,238	

17	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 11-20
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT KBP

Line No.		
1	**MAT Code**	KBP
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	UG Expense Projects –Projects for the replacement of UG electric facilities that are not an imminent hazard and have not caused an outage. This program relates to safety because it addresses WYE (three-phase star configuration) transformer grounding configurations.

	Risk ID	Type	Name
4	DUNGD-C004	Control	Planned Major Projects

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Locations
8	**Unit Cost (2023)**	$ 2,880
9	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
10	**Unit Forecast Basis**	2021 approved workplan.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 1,033,429	$ 488,887	$ 515,476	$ 205,235	$ 42,521	Calculated - Line 12 * Line 13
12	**No. of Units**	4,895	3,540	2,638	865	259	
13	**Unit Cost**	$ 211	$ 138	$ 195	$ 237	$ 164	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 672,032	$ 673,012	$ 735,131	Calculated - Line 15 * Line 16
15	**No. of Units**	248	241	255	
16	**Unit Cost**	$ 2,710	$ 2,793	$ 2,880	

17	**Notes**	
	(A)	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 11-21
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 11, Overhead and Underground Electric Distribution Maintenance
Expenses by Major Work Category BK – Forecast Details
(Thousands of Nominal Dollars)

Line No.		MAT CODE	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	Assumptions	Reference
1	**Total Cost by Activity Type**											
2	Total Cost of Line Equipment Overhauls (Emeryville)	BKA	$ 1,288	$ 1,216	$ 1,134	$ 1,691	$ 1,547	$ 1,799	$ 1,802	$ 1,912		WP 11-22
3	**Subtotal Cost by Activity Type**		**$ 1,288**	**$ 1,216**	**$ 1,134**	**$ 1,691**	**$ 1,547**	**$ 1,799**	**$ 1,802**	**$ 1,912**		
4	**Additional Project Cost**											
5	Total Cost of Line Equipment Overhauls (Division Up/Down Labor)	BKJ	$ 212	$ 122	$ 126	$ 136	$ 205	$ -	$ -	$ -	(1)	
6	Failure Analysis/Warranty	BKK	$ 42	$ 117	$ 154	$ 101	$ 100	$ -	$ -	$ -	(2)	
7	Standard Cost Variance	BK#	$ 7	$ -	$ -	$ -	$ -	$ -	$ -	$ -	(3)	
8	Forecast Adjustment	BK#	$ -	$ -	$ -	$ -	$ -	$ (180)	$ (180)	$ -	(4)	Chapter 2, Section D
9	**Subtotal Additional Project Costs**		**$ 261**	**$ 239**	**$ 280**	**$ 237**	**$ 304**	**$ (180)**	**$ (180)**	**$ -**		
10	**Total MWC BK**		**$ 1,548**	**$ 1,455**	**$ 1,414**	**$ 1,927**	**$ 1,851**	**$ 1,619**	**$ 1,621**	**$ 1,912**		

Forecast Assumptions and Details

(1) No forecast as program no longer in effect
(2) Failure Analysis costs are for testing of failed equipment to determine if repairs should be conducted in order for the unit to be reintroduced into the grid.
(3) Standard Cost Variance is not forecasted.
(4) Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added to ensure the total forecasts did not exceed the POR forecast.

Workpaper Table 11-22
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT BKA

Line No.		
1	**MAT Code**	BKA
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	Line Equipment Overhauls (Emeryville) – For Emeryville's use only of scheduled transformer repair. Units measured: Number of equipment overhauls. This program relates to safety, reliability, or maintenance because of the overhaul, repair, and testing of all distribution line equipment at the Emeryville Repair facility.

	Risk ID	Type	Name
4	None	N/A	N/A

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	Equipment overhauls
8	**Unit Cost (2023)**	$ 1,869
9	**Unit Cost Forecast Basis**	2017-2019 average recorded unit cost for MWC BK.
10	**Unit Forecast Basis**	2017-2019 average recorded units for MWC BK.

		Recorded Costs & Units (A) (B)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 1,287,537	$ 1,215,525	$ 1,133,967	$ 1,690,609	$ 1,547,050	Calculated - Line 12 * Line 13
12	**No. of Units**	1,207	1,170	708	773	864	
13	**Unit Cost**	$ 1,067	$ 1,039	$ 1,602	$ 2,187	$ 1,791	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 1,798,963	$ 1,801,585	$ 1,912,125	Calculated - Line 15 * Line 16
15	**No. of Units**	1,023	922	1,023	
16	**Unit Cost**	$ 1,759	$ 1,954	$ 1,869	

	Notes	
17	**(A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.
18	**(B)**	Prior to 2021, work in this MAT code was split across three MAT codes (BKA, BKJ, BKK). For those years, only BKA recorded costs and units are reflected in this workpaper.

Workpaper Table 11-23
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 11
Overhead and Underground Electric Distribution Maintenance
Capital Expenditures by Major Work Category
(Thousands of Nominal Dollars)

			Capital Expenditures											
No.	**MWC**	**MWC Description**	**2016 Recorded Adjusted**	**2017 Recorded Adjusted**	**2018 Recorded Adjusted**	**2019 Recorded Adjusted**	**2020 Recorded Adjusted**	**2021 Forecast**	**2022 Forecast**	**2023 Forecast**	**2024 Forecast**	**2025 Forecast**	**2026 Forecast**	**Reference**
1	2A	E Dist Inst/Repl OH General	112,181	114,340	224,518	314,491	305,856	416,195	267,155	280,507	305,280	310,591	323,852	WP 11-27, WP 11-29
2	2B	E Dist Inst/Repl UG	48,693	49,965	70,325	60,873	47,590	57,340	60,873	63,731	65,459	70,281	72,170	WP 11-32, WP 11-33
3		**Grand Total**	**160,874**	**164,305**	**294,843**	**375,363**	**353,446**	**473,535**	**328,029**	**344,238**	**370,739**	**380,872**	**396,023**	

Workpaper Table 11-24
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 11
Overhead and Underground Electric Distribution Maintenance
Forecast Capital Expenditures Summary
(Thousands of Nominal Dollars)

		Capital Expenditures							
Line No.	**Description**	**2020 CWIP**	**2021 Forecast**	**2022 Forecast**	**2023 Forecast**	**2024 Forecast**	**2025 Forecast**	**2026 Forecast**	**Reference**
1	Projects > $3 Million*	51	364,225	327,501	343,710	370,510	380,642	395,792	WP 11-25
2	Other Work	376	109,310	528	528	229	230	231	WP 11-26
3	**Total**	**427**	**473,535**	**328,029**	**344,238**	**370,739**	**380,872**	**396,023**	

4 * Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.

Workpaper Table 11-25
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 11
Overhead and Underground Maintenance
Recorded CWIP and Forecast Capital Expenditures Details - Projects Over $3 Million*
(Thousands of Nominal Dollars)

					CWIP	Capital Expenditures							
Line No.	Planning Order	Description	MWC	Operative Date	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Subtotal	Reference
	MWC - 2A	**E Dist Inst/Repl OH General**											
1	5501439	CAPITAL EPCM WORK OH-CC	2A		(1)	9,887	-	-	-	-	-	9,887	
2	5501440	CAPITAL EPCM WORK OH-DA	2A		-	12,859	-	-	-	-	-	12,859	
3	5501441	CAPITAL EPCM WORK OH-DI	2A		-	5,600	-	-	-	-	-	5,600	
4	5501442	CAPITAL EPCM WORK OH-EB	2A		-	4,381	-	-	-	-	-	4,381	
5	5501444	CAPITAL EPCM WORK OH-KE	2A		1	3,613	-	-	-	-	-	3,614	
6	5501445	CAPITAL EPCM WORK OH-LP	2A		(0)	5,809	-	-	-	-	-	5,808	
7	5501446	CAPITAL EPCM WORK OH-MI	2A		-	10,382	-	-	-	-	-	10,382	
8	5501447	CAPITAL EPCM WORK OH-NB	2A		-	6,990	-	-	-	-	-	6,990	
9	5501448	CAPITAL EPCM WORK OH-SO	2A		-	6,177	-	-	-	-	-	6,177	
10	5501450	CAPITAL EPCM WORK OH-PN	2A		-	5,060	-	-	-	-	-	5,060	
11	5501451	CAPITAL EPCM WORK OH-SA	2A		(0)	9,609	-	-	-	-	-	9,609	
12	5501452	CAPITAL EPCM WORK OH-SF	2A		-	9,138	-	-	-	-	-	9,138	
13	5501453	CAPITAL EPCM WORK OH-SI	2A		4	5,238	-	-	-	-	-	5,242	
14	5501454	CAPITAL EPCM WORK OH-SJ	2A		-	3,133	-	-	-	-	-	3,133	
15	5501455	CAPITAL EPCM WORK OH-ST	2A		33	4,804	-	-	-	-	-	4,838	
16	5501456	CAPITAL EPCM WORK OH-YO	2A		-	3,124	-	-	-	-	-	3,124	
17	5501799	CAPITAL EPCM WORK OH-HB	2A		1	3,029	-	-	-	-	-	3,029	
18	5510798	PROJ Incandescent Streetlight - SF	2A		-	5,140	-	-	-	-	-	5,140	
19	5512531	E&F EQUIP REPAIR -CAP-HB	2A		-	5,836	-	-	-	-	-	5,836	
20	5512539	E&F EQUIP REPAIR -CAP-NB	2A		-	3,222	-	-	-	-	-	3,222	
21	5512541	E&F EQUIP REPAIR -CAP-NV	2A		-	3,239	-	-	-	-	-	3,239	
22	5512545	E&F EQUIP REPAIR -CAP-SA	2A		-	5,215	-	-	-	-	-	5,215	
23	5512549	E&F EQUIP REPAIR -CAP-SI	2A		-	4,498	-	-	-	-	-	4,498	
24	5512557	E&F EQUIP REPAIR -CAP-YO	2A		-	5,284	-	-	-	-	-	5,284	
25	5526699	NonWood Strlght Pilot-DI WLDFRM4 DOVDHM4	2A		-	1,028	1,028	1,028	1,028	1,028	1,028	6,168	
26	5527562	Surge Arrester Eff Initiative-NV	2A		-	18,529	-	-	-	-	-	18,529	
27	5527566	Surge Arrester Eff Initiative-SI	2A		-	40,803	-	-	-	-	-	40,803	
28	5527568	Surge Arrester Eff Initiative-ST	2A		-	9,928	-	-	-	-	-	9,928	
29	5527569	Surge Arrester Eff Initiative-YO	2A		-	9,842	-	-	-	-	-	9,842	
30	5527570	Surge Arrester Eff Initiative-HB	2A		-	4,171	-	-	-	-	-	4,171	
31	5534440	WSIP D - 2AA - CC	2A		5	11,137	-	-	-	-	-	11,142	
32	5534441	WSIP D - 2AA - DA	2A		-	4,060	-	-	-	-	-	4,060	
33	5534442	WSIP D - 2AA - DI	2A		-	5,800	-	-	-	-	-	5,800	
34	5534443	WSIP D - 2AA - EB	2A		-	4,314	-	-	-	-	-	4,314	
35	5534445	WSIP D - 2AA - HB	2A		-	10,119	-	-	-	-	-	10,119	
36	5534447	WSIP D - 2AA - LP	2A		-	14,261	-	-	-	-	-	14,261	
37	5534449	WSIP D - 2AA - NB	2A		0	7,633	-	-	-	-	-	7,633	
38	5534450	WSIP D - 2AA - NV	2A		-	6,872	-	-	-	-	-	6,872	
39	5534451	WSIP D - 2AA - PN	2A		-	8,799	-	-	-	-	-	8,799	
40	5534453	WSIP D - 2AA - SI	2A		5	14,518	-	-	-	-	-	14,524	
41	5534455	WSIP D - 2AA - SO	2A		-	8,644	-	-	-	-	-	8,644	
42	5534456	WSIP D - 2AA - ST	2A		2	9,452	-	-	-	-	-	9,454	
43	5534457	WSIP D - 2AA - YO	2A		-	7,496	-	-	-	-	-	7,496	
44	5542913	Equip w/Access Issues WLDFRM4 DOVDHM4	2A		-	715	715	715	715	715	715	4,290	
45	5543494	SYSPLAN ED 2AA DOVHD-C003	2A		-	-	54,365	54,259	59,353	64,463	74,599	307,039	
46	5543495	SYSPLAN ED 2AB WLDFR-C011	2A		-	-	3,481	3,474	3,481	3,487	3,494	17,416	
47	5543496	SYSPLAN ED 2AE DOVHD-C003	2A		-	-	28,175	28,120	28,176	28,230	28,285	140,986	
48	5543497	SYSPLAN ED 2AF WLDFR-C008 DOVHD-C003	2A		-	-	2,732	2,726	2,732	2,737	2,742	13,669	
49	5543498	SYSPLAN ED 2AG DOVHD-M007	2A		-	-	-	2,488	2,593	-	-	5,080	
50	5543499	SYSPLAN ED 2AH DOVHD-C003	2A		-	-	2,116	7,075	7,252	7,433	7,619	31,495	
51	5543500	SYSPLAN ED 2AI DOVHD-C003	2A		-	-	-	995	997	999	1,001	3,992	
52	5543502	SYSPLAN ED 2AQ DOVHD-M008	2A		-	-	5,832	5,821	5,832	5,843	5,855	29,183	
53	5543503	SYSPLAN ED 2AS DOVHD-C003	2A		-	-	831	830	831	833	835	4,160	
54	5543601	SYSPLAN FRMMA 2AA WLDFR-C008	2A		-	-	146,951	-	-	-	-	146,951	
55	5544393	SYSPLAN ED 2AC WLDFR-C011	2A		-	-	3,626	3,615	3,927	3,938	3,949	19,055	
56	5545542	SYSPLAN 2AA DOVHD-C003	2A		-	-	-	151,103	152,691	154,253	156,117	614,165	
57	5545559	SYSPLAN Surge Arrestor WLDFR-M003	2A		-	-	16,804	-	-	-	-	16,804	
58	5795579	SYSPLAN ED 2AR DOVHD-M003	2A	Dec-2020	-	-	-	17,759	35,472	36,429	37,413	127,073	
59	**Total**				**51**	**339,384**	**266,655**	**280,007**	**305,080**	**310,391**	**323,652**	**1,825,220**	
	MWC - 2B	**E Dist Inst/Repl UG**											
60	5502560	CAPITAL EPCM WORK-UG-SF	2B		-	9,901	-	-	-	-	-	9,901	
61	5502563	CAPITAL EPCM WORK-UG-MI	2B		0	4,180	-	-	-	-	-	4,180	
62	5502566	CAPITAL EPCM WORK-UG-SJ	2B		-	6,587	-	-	-	-	-	6,587	
63	5502569	CAPITAL EPCM WORK-UG-LP	2B		-	4,173	-	-	-	-	-	4,173	
64	5543504	SYSPLAN ED 2BA DUNGD-C003	2B		-	-	46,391	47,807	49,171	53,333	54,773	251,476	
65	5543505	SYSPLAN ED 2BB DUNGD-C003	2B		-	-	791	863	886	910	934	4,384	
66	5543506	SYSPLAN ED 2BD DUNGD-C003	2B		-	-	6,354	6,926	7,113	7,305	7,502	35,200	
67	5543508	SYSPLAN ED 2BP DUNGD-C004	2B		-	-	7,309	8,108	8,259	8,703	8,930	41,309	
68	**Total**				**0**	**24,840**	**60,846**	**63,703**	**65,430**	**70,251**	**72,139**	**357,209**	
69		**Grand Total**			**51**	**364,225**	**327,501**	**343,710**	**370,510**	**380,642**	**395,792**	**2,182,430**	

70 * Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.

Workpaper Table 11-26
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 11
Overhead and Underground Electric Distribution Maintenance
Recorded and Forecast Capital Expenditures Details - Other Work*
(Thousands of Nominal Dollars)

			Capital Expenditures											
Line No.	MWC	MWC Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference
1	2A	E Dist Inst/Repl OH General	85,352	81,050	148,076	83,487	66,664	76,811	500	500	200	200	200	WP 11-35
2	2B	E Dist Inst/Repl UG	44,530	42,520	65,362	51,693	35,570	32,499	28	28	29	30	31	WP 11-45
3	**Grand Total**		**129,882**	**123,570**	**213,438**	**135,180**	**102,234**	**109,310**	**528**	**528**	**229**	**230**	**231**	

4 * Excludes projects greater than $3M

Workpaper Table 11-27
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #11, Overhead and Underground Electric Distribution Maintenance
Major Work Category 2A – Recorded Walk
MWC 2A - Overhead Maintenance
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$ 112,181**			WP 11-35, line 20
2		Standard Cost Variance (MAT 2A#)	$ 252		Cost increase in due to a positive standard cost variance compared to 2016.	WP 11-35, line 18
3		Overhead Notifications (MAT 2AA)	$ 4,955		Cost increase due to additional notifications completed compared to 2016 offset by an incrementally lower unit cost.	WP 11-35, line 2
4		Bird Safe Notifications (MAT 2AB)	$ (303)		Cost decrease due to fewer units completed compared to 2016 offset by an increase in unit cost.	WP 11-35, line 3
5		Bird Retrofits Notifications (MAT 2AC)	$ (258)		Cost decrease due to lower unit cost offset by an incremental increase in the number of units completed compared to 2016.	WP 11-35, line 4
6		Overhead COE Notifications (MAT 2AE)	$ (1,558)		Cost decrease due to completing fewer units compared to 2016 offset by an increase in unit cost. Units planned for 2016 were carried over into 2017 due to emergency response requirements following storms and wildfires.	WP 11-35, line 5
7		Idle Facilities Removal (MAT 2AF)	$ 1,140		Cost increase due to additional units completed offset by a reduction in unit cost compared to 2016.	WP 11-35, line 6
8		Regulated Output Streetlight Replacement (MAT 2AG)	$ 2,067		Cost increase due to resolution of issues from 2015 and 2016 allowing for increased execution of regulated output streetlight replacement work in San Francisco compared to 2016.	WP 11-35, line 17
9		San Francisco Decorative Streetlights (MAT 2AI)	$ 462		Cost increase due to a resumption of the project after reaching agreement with the San Francisco Historical Society.	WP 11-35, line 16
10		LED Streetlight Conversions (MAT 2AH)	$ (7,076)		Cost decrease due to fewer LED Streetlight Conversion project units completed compared to 2016.	WP 11-35, line 7
11		Major Notifications and Misc Projects (MAT 2AP)	$ (1,917)		Cost decrease due to lower costs associated with major notifications compared to 2016.	WP 11-35, line 13
12		Equipment with Access Issues (MAT 2AP)	$ (117)		Minor variation in work costs.	WP 11-35, line 14
13		Non-Wood Streetlights (MAT 2AP)	$ 142		Minor variation in work costs.	WP 11-35, line 15
14		Surge Arrester Replacement (MAT 2AR)	$ 4,474		Increase due to program commencing in 2017.	WP 11-35, line 9
15		Ceramic Post Insulators (MAT 2AQ)	$ -		No significant change	WP 11-35, line 8
16		FAS Overhead Capital (MAT 2AS)	$ (102)		Minor variation in work costs.	WP 11-35, line 10
17	**2017**	**Recorded Adjusted**	**$ 114,340**			WP 11-35, line 20
18		Standard Cost Variance (MAT 2A#)	$ 1,052		Cost increase due to positive standard cost variance compared to prior year.	WP 11-35, line 18
19		Overhead Notifications (MAT 2AA)	$ 39,882		Increase in cost due to higher volume of notifications completed as higher volume of exempted and carried over tags from 2017 to 2018 in response to emergency recovery efforts as a result of storms and fires in 2017.	WP 11-35, line 2
20		Bird Safe Notifications (MAT 2AB)	$ (153)		Minor variation in work costs	WP 11-35, line 3
21		Bird Retrofits Notifications (MAT 2AC)	$ 2,504		Increase due to high unit costs from significant contractor spend in 2018.	WP 11-35, line 4
22		Overhead COE Notifications (MAT 2AE)	$ 11,272		Increase due to increase in units of work completed due to carryover of work from 2016	WP 11-35, line 5
23		Idle Facilities Removal (MAT 2AF)	$ 2,272		Increase in cost due to increase in removals performed compared to 2017.	WP 11-35, line 6
24		Regulated Output Streetlight Replacement (MAT 2AG)	$ 11,560		Increase due to continued work on multiple RO loops, including initiating work on newly discovered UCSF RO Loop 369. Work paused on RO Loops 551 and 506 due to 5-year street paving moratorium	WP 11-35, line 17
25		LED Streetlight Conversions (MAT 2AH)	$ (1,949)		Decrease in cost due to less cobrahead conversions completed.	WP 11-35, line 7
26		San Francisco Decorative Streetlights (MAT 2AI)	$ 809		Increase due to conditions found during detailed inspections in 2018	WP 11-35, line 16
27		Major Notifications and Misc Projects (MAT 2AP)	$ (164)		Minor variation in work costs	WP 11-35, line 13
28		Non-Wood Streetlights (MAT 2AP)	$ 76		No significant change	WP 11-35, line 15
29		Surge Arrester Replacement (MAT 2AR)	$ 40,946		Increase in scope from 2017 to 2018. Asset Strategy performed a comprehensive analysis to build a business case to move this program from an expense to capital funded program after the PUC mandated that this work was critical to infrastructure.	WP 11-35, line 9
30		Ceramic Post Insulator Replacement (MAT 2AQ)	$ 1,959		Increase due to start of program in 2018	WP 11-35, line 8
31		Equipment with Access Issue (MAT 2AP)	$ 33		No significant change	WP 11-35, line 14
32		FAS Overhead Capital (MAT 2AS)	$ 80		Minor variation in work costs	WP 11-35, line 10
33	**2018**	**Recorded Adjusted**	**$ 224,518**			WP 11-35, line 20
34		Standard Cost Variance (MAT 2A#)	$ (2,705)		Cost decrease due to negative standard cost variance compared to prior year.	WP 11-35, line 18
35		Overhead Notifications (MAT 2AA)	$ 131,728		Increase in costs due increased volume of notifications completed as a result of the 2019 Wildfire Safety Inspection Program, to higher find rates for EC tags.	WP 11-35, line 2
36		Bird Safe Notifications (MAT 2AB)	$ 478		Increase due to increase in unit cost.	WP 11-35, line 3
37		Bird Retrofits Notifications (MAT 2AC)	$ (3,431)		Decrease due to target revision to capture other pole replacements within raptor concentration zone.	WP 11-35, line 4
38		Overhead COE Notifications (MAT 2AE)	$ (2,089)		Decrease in units completed due to prioritization of wildfire mitigation efforts.	WP 11-35, line 5

Workpaper Table 11-27
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #11, Overhead and Underground Electric Distribution Maintenance
Major Work Category 2A – Recorded Walk
MWC 2A - Overhead Maintenance
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
39		Idle Facilities Removal (MAT 2AF)	$ 5,220		Increase in cost due to additional units completed at higher unit costs.	WP 11-35, line 6
40		Regulated Output Streetlight Replacement (MAT 2AG)	$ (13,339)		Decrease due to completion of work on all RO Loops not impacted by moratorium.	WP 11-35, line 17
41		LED Streetlight Conversions (MAT 2AH)	$ (2,128)		Decrease in cost due to less cobrahead conversions completed.	WP 11-35, line 7
42		San Francisco Decorative Streetlights (MAT 2AI)	$ 501		Increase due to enhanced refurbishments.	WP 11-35, line 16
43		Major Notifications and Misc Projects (MAT 2AP)	$ (985)		Decrease due to decrease in units completed.	WP 11-35, line 13
44		Non-Wood Streetlights (MAT 2AP)	$ 1,231		Increase due to increase in units completed.	WP 11-35, line 15
45		Surge Arrester Replacement (MAT 2AR)	$ (23,652)		Due to PG&E declaring for chapter 11 bankruptcy, program was put on immediate pause in February 2019 for 6 months after minimal units were completed in January. In July of 2019, the program resumed unit completions through the end of the year.	WP 11-35, line 9
46		Ceramic Post Insulator Replacement (MAT 2AQ)	$ (500)		Decrease due to bankruptcy impacts to Surge Arrestor Replacement program (program put on hold)	WP 11-35, line 8
47		Equipment with Access Issue (MAT 2AP)	$ (276)		Minor variation in work costs	WP 11-35, line 14
48		FAS Overhead Capital (MAT 2AS)	$ (81)		Minor variation in work costs	WP 11-35, line 10
49	**2019**	**Recorded Adjusted**	**$ 314,491**			WP 11-35, line 20
50		Standard Cost Variance (MAT 2A#)	$ 722		Cost increase in due to a positive standard cost variance compared to 2019.	WP 11-35, line 18
51		Overhead Notifications (MAT 2AA)	$ (48,277)		Decrease due to fewer notifications completed as WSIP ended in 2019.	WP 11-35, line 2
52		Bird Safe Notifications (MAT 2AB)	$ (482)		Decrease in spend due to work prioritization changes and less units completed.	WP 11-35, line 3
53		Bird Retrofits Notifications (MAT 2AC)	$ 4,163		Increase due to higher unit costs from increased contractor labor spend in 2020.	WP 11-35, line 4
54		Overhead COE Notifications (MAT 2AE)	$ 9,692		Increase due to increased unit costs resulting from labor premiums.	WP 11-35, line 5
55		Idle Facilities Removal (MAT 2AF)	$ (5,878)		Decrease due to less units completed as WSIP ended in 2019.	WP 11-35, line 6
56		Regulated Output Streetlight Replacement (MAT 2AG)	$ (4,468)		Decrease in cost due to work being postponed until moratorium expires in early 2023	WP 11-35, line 17
57		LED Streetlight Conversions (MAT 2AH)	$ (4,218)		Decrease in cost as decorative replacements begins but in lower volumes. Continued decrease in number of cobrahead conversions.	WP 11-35, line 7
58		San Francisco Decorative Streetlights (MAT 2AI)	$ (1,445)		Decrease due to completing remainder of work from 2018 inspections.	WP 11-35, line 16
59		Major Notifications and Misc Projects (MAT 2AP)	$ 89		No significant change	WP 11-35, line 13
60		Non-Wood Streetlights (MAT 2AP)	$ (1,183)		Decrease due to less replacements completed.	WP 11-35, line 15
61		Surge Arrester Replacement (MAT 2AR)	$ 41,730		Program resumed in January 2020 with a shifted focus on executing HFTD T2/T3 units. The Program executed 14,362 units (T1 = 4,099, T2/T3 = 10,263) by the close of 2020 and put the program in a position to focus on the remaining T2/T3 units in the program for the 2021 workplan.	WP 11-35, line 9
62		Ceramic Post Insulator Replacement (MAT 2AQ)	$ 1,294		Increase due to resumption of Surge Arrester program in 2020.	WP 11-35, line 8
63		Equipment with Access Issue (MAT 2AP)	$ 4		No significant change	WP 11-35, line 14
64		FAS Overhead Capital (MAT 2AS)	$ (379)		Decrease in cost as fewer notifications identified in the field.	WP 11-35, line 10
65	**2020**	**Recorded Adjusted**	**$ 305,856**			WP 11-35, line 20

Workpaper Table 11-28
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #11, Overhead and Underground Electric Distribution Maintenance
Major Work Category 2A – Forecast Walk
MWC 2A - Overhead Maintenance
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$ 305,856**			WP 11-35, line 20
2		Standard Cost Variance (MAT 2A#)	$ 1,153		Standard cost variance forecast.	WP 11-35, line 18
3		Overhead Notifications (MAT 2AA)	$ 53,039		Increase due to higher unit costs and increase in units.	WP 11-35, line 2
4		Bird Safe Notifications (MAT 2AB)	$ 1,048		Increase due to higher unit costs and increase in units. Incidents related to raptor incidents are required to be completed within 90 days resulting in work to be completed within same year.	WP 11-35, line 3
5		Bird Retrofits Notifications (MAT 2AC)	$ (2,571)		Decrease in 2021 unit cost due to no longer using contractors in 2021.	WP 11-35, line 4
6		Overhead COE Notifications (MAT 2AE)	$ 10,514		Increase due to planned increase in work completion to address prior year backlog.	WP 11-35, line 5
7		Idle Facilities Removal (MAT 2AF)	$ 15,535		Increase in cost due to higher number of idle facility removals in HFTD areas. Streetlight idle facility removal also underway.	WP 11-35, line 6
8		Regulated Output Streetlight Replacement (MAT 2AG)	$ 5,110		Original 2021 plan anticipated $5.1 million of work in 2021 in the event that moratorium was lifted. However, work has been postponed until 2023 and 2024 once moratorium concludes. Current budget will be re-allocated for other critical work.	WP 11-35, line 17
9		LED Streetlight Conversions (MAT 2AH)	$ (1,492)		Decrease due to fewer units completed as Cobrahead replacements decrease.	WP 11-35, line 7
10		San Francisco Decorative Streetlights (MAT 2AI)	$ (445)		Decrease due to work being planned for later years.	WP 11-35, line 16
11		Surge Arrester Replacement (MAT 2AR)	$ 25,362		Increased units to 21,383 to finish remaining Tier 2 and Tier 3 HFTD units for the program in order to mitigate wildfire risk.	WP 11-35, line 9
12		Major Notifications and Misc Projects (MAT 2AP)	$ (18)		No significant change	WP 11-35, line 13
13		Ceramic Post Insulators (MAT 2AQ)	$ 1,206		Increase in units due to Tier 2 and Tier 3 ramp up in Surge Arrester program.	WP 11-35, line 8
14		Equipment with Access Issue (MAT 2AP)	$ 718		Increase due to forecast of increase spend on projects to relocated or address equipment with access issues.	WP 11-35, line 14
15		Non-Wood Streetlights (MAT 2AP)	$ 762		Increased due to forecast of increased number of replacements required based off historical trends from inspections.	WP 11-35, line 15
16		FAS Overhead Capital (MAT 2AS)	$ 418		Increase based off 2017-2019 average spend.	WP 11-35, line 10
17	**2021**	**Forecast**	**$ 416,195**			WP 11-35, line 20
18		Standard Cost Variance (MAT 2A#)	$ -		No significant change	WP 11-35, line 18
19		Overhead Notifications (MAT 2AA)	$ (31,674)		Decrease in cost due to forecast decrease in completed notifications. EC work is executed based off risk models.	WP 11-35, line 2
20		Bird Safe Notifications (MAT 2AB)	$ 457		Increase due to workplan shift from priority E tags to priority B tags	WP 11-35, line 3
21		Bird Retrofits Notifications (MAT 2AC)	$ 195		Minor variation in work costs.	WP 11-35, line 4
22		Overhead COE Notifications (MAT 2AE)	$ (26,506)		For 2021 and 2022, the GRC forecast was reduced to align with authorized targets, representing unidentified efficiencies that will need to be achieved or reprioritization of work if efficiencies cannot be realized.	WP 11-35, line 5
23		Idle Facilities Removal (MAT 2AF)	$ (17,769)		Decrease due to fewer planned units to be completed as removals will be completed or de-energized in 2021 to support wildfire mitigation and system hardening efforts.	WP 11-35, line 6
24		Regulated Output Streetlight Replacement (MAT 2AG)	$ (5,140)		Decrease due to no work expected to be completed until SF City moratoriums have lifted in 2023.	WP 11-35, line 17
25		LED Streetlight Conversions (MAT 2AH)	$ 1,088		Increase due to forecasted increase in customer opt-ins to convert decorative streetlights as IFC charge will end in 2022.	WP 11-35, line 7
26		San Francisco Decorative Streetlights (MAT 2AI)	$ -		No significant change	WP 11-35, line 16
27		Surge Arrester Replacement (MAT 2AR)	$ (72,055)		Decrease due to targeted completion of Tier 2 and Tier 3 HFTD units in 2021.	WP 11-35, line 9
28		Major Notifications and Misc Projects (MAT 2AP)	$ 300		Minor variation in work costs.	WP 11-35, line 13
29		Ceramic Post Insulators (MAT 2AQ)	$ 1,872		Increase due to plan to perform 2AQ work independent of 2AR	WP 11-35, line 8
30		Equipment with Access Issue (MAT 2AP)	$ (0)		No significant change	WP 11-35, line 14
31		Non-Wood Streetlights (MAT 2AP)	$ -		No significant change	WP 11-35, line 15
32		FAS Overhead Capital (MAT 2AS)	$ 192		Minor variation in work costs.	WP 11-35, line 10
33	**2022**	**Forecast**	**$ 267,155**			WP 11-35, line 20
34		Overhead Notifications (MAT 2AA)	$ 4,046		Increase in cost due to escalation.	WP 11-35, line 2

Workpaper Table 11-28
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #11, Overhead and Underground Electric Distribution Maintenance
Major Work Category 2A – Forecast Walk
MWC 2A - Overhead Maintenance
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
35		Bird Safe Notifications (MAT 2AB)	$ (7)		No significant change	WP 11-35, line 3
36		Bird Retrofits Notifications (MAT 2AC)	$ (11)		No significant change	WP 11-35, line 4
37		Overhead COE Notifications (MAT 2AE)	$ (55)		No significant change	WP 11-35, line 5
38		Idle Facilities Removal (MAT 2AF)	$ (5)		No significant change	WP 11-35, line 6
39		Regulated Output Streetlight Replacement (MAT 2AG)	$ 2,488		Increase due to work resuming in 2023 after moratorium expires.	WP 11-35, line 17
40		LED Streetlight Conversions (MAT 2AH)	$ 4,960		Increase in forecast due to expected increase number of decorative light conversions as more customers are expected to opt-in.	WP 11-35, line 7
41		San Francisco Decorative Streetlights (MAT 2AI)	$ 995		Increase in cost due to work planned over 3-year period to perform major refurbishments.	WP 11-35, line 16
42		Surge Arrester Replacement (MAT 2AR)	$ 954		Increase due to minor increase in units	WP 11-35, line 9
43		Major Notifications and Misc Projects (MAT 2AP)	$ -		No significant change	WP 11-35, line 13
44		Ceramic Post Insulators (MAT 2AQ)	$ (11)		No significant change	WP 11-35, line 8
45		Equipment with Access Issue (MAT 2AP)	$ -		No significant change	WP 11-35, line 14
46		Non-Wood Streetlights (MAT 2AP)	$ -		No significant change	WP 11-35, line 15
47		FAS Overhead Capital (MAT 2AS)	$ (2)		No significant change	WP 11-35, line 10
48	**2023**	**Forecast**	**$ 280,507**			WP 11-35, line 20
49		Overhead Notifications (MAT 2AA)	$ 6,682		Increase in cost due to escalation.	WP 11-35, line 2
50		Bird Safe Notifications (MAT 2AB)	$ 7		No significant change	WP 11-35, line 3
51		Bird Retrofits Notifications (MAT 2AC)	$ 312		Minor variation in work costs.	WP 11-35, line 4
52		Overhead COE Notifications (MAT 2AE)	$ 56		No significant change	WP 11-35, line 5
53		Idle Facilities Removal (MAT 2AF)	$ 5		No significant change	WP 11-35, line 6
54		Regulated Output Streetlight Replacement (MAT 2AG)	$ 105		Minor variation in work costs.	WP 11-35, line 17
55		LED Streetlight Conversions (MAT 2AH)	$ 177		Minor variation in work costs.	WP 11-35, line 7
56		San Francisco Decorative Streetlights (MAT 2AI)	$ 2		No significant change	WP 11-35, line 16
57		Surge Arrester Replacement (MAT 2AR)	$ 17,714		Increase due to re-prioritization of work.	WP 11-35, line 9
58		Major Notifications and Misc Projects (MAT 2AP)	$ (300)		Minor variation in work costs.	WP 11-35, line 13
59		Ceramic Post Insulators (MAT 2AQ)	$ 12		No significant change	WP 11-35, line 8
60		FAS Overhead Capital (MAT 2AS)	$ 2		No significant change	WP 11-35, line 10
61	**2024**	**Forecast**	**$ 305,280**			WP 11-35, line 20
62		Overhead Notifications (MAT 2AA)	$ 6,672		Increase in cost due to escalation.	WP 11-35, line 2
63		Bird Safe Notifications (MAT 2AB)	$ 7		No significant change	WP 11-35, line 3
64		Bird Retrofits Notifications (MAT 2AC)	$ 11		No significant change	WP 11-35, line 4
65		Overhead COE Notifications (MAT 2AE)	$ 54		No significant change	WP 11-35, line 5
66		Idle Facilities Removal (MAT 2AF)	$ 5		No significant change	WP 11-35, line 6
67		Regulated Output Streetlight Replacement (MAT 2AG)	$ (2,593)		Decrease due to program completion in 2024	WP 11-35, line 17
68		LED Streetlight Conversions (MAT 2AH)	$ 181		Minor variation in work costs.	WP 11-35, line 7
69		San Francisco Decorative Streetlights (MAT 2AI)	$ 2		No significant change	WP 11-35, line 16
70		Surge Arrester Replacement (MAT 2AR)	$ 957		Increase due to escalation	WP 11-35, line 9
71		Major Notifications and Misc Projects (MAT 2AP)	$ -		No significant change.	WP 11-35, line 13
72		Ceramic Post Insulators (MAT 2AQ)	$ 11		No significant change.	WP 11-35, line 8
73		FAS Overhead Capital (MAT 2AS)	$ 2		No significant change.	WP 11-35, line 10
74	**2025**	**Forecast**	**$ 310,591**			WP 11-35, line 20

Workpaper Table 11-28
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #11, Overhead and Underground Electric Distribution Maintenance
Major Work Category 2A – Forecast Walk
MWC 2A - Overhead Maintenance
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
75		Overhead Notifications (MAT 2AA)	$ 11,999		Increase due to cost escalation.	WP 11-35, line 2
76		Bird Safe Notifications (MAT 2AB)	$ 7		No significant change	WP 11-35, line 3
77		Bird Retrofits Notifications (MAT 2AC)	$ 11		No significant change	WP 11-35, line 4
78		Overhead COE Notifications (MAT 2AE)	$ 55		No significant change	WP 11-35, line 5
79		Idle Facilities Removal (MAT 2AF)	$ 5		No significant change	WP 11-35, line 6
80		Regulated Output Streetlight Replacement (MAT 2AG)	$ -		No significant change	WP 11-35, line 17
81		LED Streetlight Conversions (MAT 2AH)	$ 186		Minor variation in work costs.	WP 11-35, line 7
82		San Francisco Decorative Streetlights (MAT 2AI)	$ 2		No significant change	WP 11-35, line 16
83		Surge Arrester Replacement (MAT 2AR)	$ 983		Increase due to escalation	WP 11-35, line 9
84		Major Notifications and Misc Projects (MAT 2AP)	$ -		No significant change	WP 11-35, line 13
85		Ceramic Post Insulators (MAT 2AQ)	$ 11		No significant change	WP 11-35, line 8
86		FAS Overhead Capital (MAT 2AS)	$ 2		No significant change	WP 11-35, line 10
87	**2026**	**Forecast**	**$ 323,852**			WP 11-35, line 20

Workpaper Table 11-29
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #11, Overhead and Underground Electric Distribution Maintenance
Major Work Category 2B – Recorded Walk
MWC 2B - Underground Maintenance
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$ 48,693**			WP 11-45, line 11
2		Sand/Gravel/Spoil (MAT 2B#)	$ (2,551)		Cost decrease due to a modification in sand, gravel and spoils allocation charges related to vendor use of centralized dumps sites.	WP 11-45, line 9
3		Underground Notifications (MAT 2BA)	$ 8,051		Cost increase due to both a larger number of units completed and a unit cost increase compared to 2016.	WP 11-45, line 2
4		Fault Indicators (MAT 2BB)	$ 93		Minor variation in work costs.	WP 11-45, line 3
5		Underground COE (MAT 2BD)	$ (1,989)		Cost decrease due to a lower unit cost as a result of facility type mix compared to 2016.	WP 11-45, line 4
6		UG Idle Facility Remove (MAT 2BF)	$ 115		Minor variation in work costs.	WP 11-45, line 5
7		Major Notifications and Submersible Potential Transformers (MAT 2BP)	$ (2,446)		Cost decrease due to a smaller volume of major notifications compared to 2016.	WP 11-45, line 8
8	**2017**	**Recorded Adjusted**	**$ 49,965**			WP 11-45, line 11
9		Sand/Gravel/Spoil (MAT 2B#)	$ (1,933)		Cost decrease due to a modification in sand, gravel and spoils allocation charges related to vendor use of centralized dumps sites.	WP 11-45, line 9
10		Underground Notifications (MAT 2BA)	$ 21,384		Increase due to more notifications completed.	WP 11-45, line 2
11		Fault Indicators (MAT 2BB)	$ 54		Minor variation in work costs	WP 11-45, line 3
12		Underground COE (MAT 2BD)	$ 1,210		Increase due to more units completed.	WP 11-45, line 4
13		UG Idle Facility Remove (MAT 2BF)	$ 88		Minor variation in work costs	WP 11-45, line 5
14		Major Notifications and Submersible Potential Transformers (MAT 2BP)	$ (442)		Decrease due to lower number of high cost tags in 2018.	WP 11-45, line 8
15	**2018**	**Recorded Adjusted**	**$ 70,325**			WP 11-45, line 11
16		Sand/Gravel/Spoil (MAT 2B#)	$ (2,949)		Cost decrease due to a modification in sand, gravel and spoils allocation charges related to vendor use of centralized dumps sites.	WP 11-45, line 9
17		Underground Notifications (MAT 2BA)	$ (5,704)		Decrease due to less notifications completed.	WP 11-45, line 2
18		Fault Indicators (MAT 2BB)	$ (506)		Minor decrease as less fault indicator replacements found.	WP 11-45, line 3
19		Underground COE (MAT 2BD)	$ 927		Increase due to increase in unit cost.	WP 11-45, line 4
20		UG Idle Facility Remove (MAT 2BF)	$ 70		Minor variation in work costs	WP 11-45, line 5
21		Major Notifications and Submersible Potential Transformers (MAT 2BP)	$ (1,290)		Decrease due to lower number of high cost tags in 2018.	WP 11-45, line 8
22	**2019**	**Recorded Adjusted**	**$ 60,873**			WP 11-45, line 11
23		Sand/Gravel/Spoil (MAT 2B#)	$ 3,726		Increase in standard cost variance.	WP 11-45, line 9
24		Underground Notifications (MAT 2BA)	$ (19,154)		Decrease due to less notifications completed.	WP 11-45, line 2
25		Fault Indicators (MAT 2BB)	$ 118		Minor variation in work costs	WP 11-45, line 3
26		Underground COE (MAT 2BD)	$ 605		Increase due to more units completed.	WP 11-45, line 4
27		UG Idle Facility Remove (MAT 2BF)	$ (294)		Decrease due to less notifications completed as higher risk work is addressed based off risk prioritization.	WP 11-45, line 5
28		Major Notifications and Submersible Potential Transformers (MAT 2BP)	$ 1,716		Increase in cost due to non-network manhole cover spend transferred to this MAT.	WP 11-45, line 8
29	**2020**	**Recorded Adjusted**	**$ 47,590**			WP 11-45, line 11

Workpaper Table 11-30
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #11, Overhead and Underground Electric Distribution Maintenance
Major Work Category 2B – Forecast Walk
MWC 2B - Underground Maintenance
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$ 47,590**			WP 11-45, line 11
2		Sand/Gravel/Spoil (MAT 2B#)	$ 701		Decrease due to reduced standard cost variance.	WP 11-45, line 9
3		Underground Notifications (MAT 2BA)	$ 8,817		Increase in cost due to increase in planned higher costs units to be completed in accordance with risk prioritization of notifications.	WP 11-45, line 2
4		Fault Indicators (MAT 2BB)	$ 150		Forecast based off prior years spend.	WP 11-45, line 3
5		Underground COE (MAT 2BD)	$ (1,006)		Decrease due to decrease in unit cost.	WP 11-45, line 4
6		UG Idle Facility Remove (MAT 2BF)	$ (149)		Minor variation in work costs	WP 11-45, line 5
7		Major Notifications and Submersible Potential Transformers (MAT 2BP)	$ 1,237		Increase in cost due to transfer of non-network venting manhole cover replacements.	WP 11-45, line 8
8	**2021**	**Forecast**	**$ 57,340**			WP 11-45, line 11
9		Sand/Gravel/Spoil (MAT 2B#)	$ -		No significant change	WP 11-45, line 9
10		Underground Notifications (MAT 2BA)	$ (289)		Minor variation in work costs	WP 11-45, line 2
11		Fault Indicators (MAT 2BB)	$ (5)		No significant change	WP 11-45, line 3
12		Underground COE (MAT 2BD)	$ (219)		Minor variation in work costs	WP 11-45, line 4
13		UG Idle Facility Remove (MAT 2BF)	$ 1		No significant change	WP 11-45, line 5
14		Major Notifications and Submersible Potential Transformers (MAT 2BP)	$ 4,046		Increase in cost due to transfer of non-network venting manhole cover replacements.	WP 11-45, line 8
15	**2022**	**Forecast**	**$ 60,873**			WP 11-45, line 11
16		Sand/Gravel/Spoil (MAT 2B#)	$ -		No significant change	WP 11-45, line 9
17		Underground Notifications (MAT 2BA)	$ 1,415		Minor increase in forecast due to addressing additional tags and accounts for unit cost escalation.	WP 11-45, line 2
18		Fault Indicators (MAT 2BB)	$ 71		Minor variation in work costs	WP 11-45, line 3
19		Underground COE (MAT 2BD)	$ 572		Increase due to slight increase in units	WP 11-45, line 4
20		UG Idle Facility Remove (MAT 2BF)	$ 1		No significant change	WP 11-45, line 5
21		Major Notifications and Submersible Potential Transformers (MAT 2BP)	$ 799		Minor variation in costs as units of non-network manhole cover replacements increases.	WP 11-45, line 8
22	**2023**	**Forecast**	**$ 63,731**			WP 11-45, line 11
23		Sand/Gravel/Spoil (MAT 2B#)	$ -		No significant change	WP 11-45, line 9
24		Underground Notifications (MAT 2BA)	$ 1,365		Minor increase in forecast due to addressing additional tags.	WP 11-45, line 2
25		Fault Indicators (MAT 2BB)	$ 23		No significant change	WP 11-45, line 3
26		Underground COE (MAT 2BD)	$ 187		Minor variation in work costs	WP 11-45, line 4
27		UG Idle Facility Remove (MAT 2BF)	$ 1		No significant change	WP 11-45, line 5
28		Major Notifications and Submersible Potential Transformers (MAT 2BP)	$ 152		Increase due to escalation	WP 11-45, line 8
29	**2024**	**Forecast**	**$ 65,459**			WP 11-45, line 11
30		Sand/Gravel/Spoil (MAT 2B#)	$ -		No significant change	WP 11-45, line 9
31		Underground Notifications (MAT 2BA)	$ 4,162		Increase in forecast due to addressing additional tags and accounts for unit cost escalation.	WP 11-45, line 2
32		Fault Indicators (MAT 2BB)	$ 24		No significant change	WP 11-45, line 3
33		Underground COE (MAT 2BD)	$ 192		Minor variation in work costs	WP 11-45, line 4
34		UG Idle Facility Remove (MAT 2BF)	$ 1		No significant change	WP 11-45, line 5
35		Major Notifications and Submersible Potential Transformers (MAT 2BP)	$ 444		Minor variation in costs as units of non-network manhole cover replacements increases.	WP 11-45, line 8
36	**2025**	**Forecast**	**$ 70,281**			WP 11-45, line 11
37		Sand/Gravel/Spoil (MAT 2B#)	$ -		No significant change	WP 11-45, line 9
38		Underground Notifications (MAT 2BA)	$ 1,440		Increase in forecast due to addressing additional tags and accounts for unit cost escalation.	WP 11-45, line 2
39		Fault Indicators (MAT 2BB)	$ 25		No significant change	WP 11-45, line 3
40		Underground COE (MAT 2BD)	$ 197		Minor variation in work costs	WP 11-45, line 4

Workpaper Table 11-30
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit 4, Chapter #11, Overhead and Underground Electric Distribution Maintenance
Major Work Category 2B – Forecast Walk
MWC 2B - Underground Maintenance
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
41		UG Idle Facility Remove (MAT 2BF)	$ 1		No significant change	WP 11-45, line 5
42		Major Notifications and Submersible Potential Transformers (MAT 2BP)	$ 227		Minor variation in costs as units of non-network manhole cover replacements increases.	WP 11-45, line 8
43	**2026**	**Forecast**	**$ 72,170**			WP 11-45, line 11

Workpaper Table 11-31
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 11, Overhead and Underground Electric Distribution Maintenance
Major Work Category 2A – Forecast Details
(Thousands of Nominal Dollars)

No.		MAT CODE	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions	Reference
1	**Total Cost by Activity Type**														
2	Total Cost of Overhead Notifications	2AA	$ 51,663	$ 56,618	$ 96,500	$ 228,228	$ 179,951	$ 232,990	$ 201,316	$ 205,363	$ 212,044	$ 218,717	$ 230,716		WP 11-36
3	Total Cost of Bird Safe Notifications	2AB	$ 2,435	$ 2,131	$ 1,978	$ 2,457	$ 1,975	$ 3,023	$ 3,481	$ 3,474	$ 3,481	$ 3,487	$ 3,494		WP 11-37
4	Total Cost of Bird Retrofits Notifications	2AC	$ 3,025	$ 2,767	$ 5,271	$ 1,840	$ 6,003	$ 3,432	$ 3,626	$ 3,615	$ 3,927	$ 3,938	$ 3,949		WP 11-38
5	Total Cost of Overhead COE Notifications	2AE	$ 26,850	$ 25,292	$ 36,564	$ 34,475	$ 44,166	$ 54,680	$ 28,175	$ 28,120	$ 28,176	$ 28,230	$ 28,285		WP 11-39
6	Total Cost of Idle Facilities Removal	2AF	$ 2,211	$ 3,351	$ 5,623	$ 10,843	$ 4,966	$ 20,500	$ 2,732	$ 2,726	$ 2,732	$ 2,737	$ 2,742		WP 11-40
7	Total Cost of LED Streetlight Conversions	2AH	$ 17,891	$ 10,815	$ 8,866	$ 6,738	$ 2,520	$ 1,028	$ 2,116	$ 7,075	$ 7,252	$ 7,433	$ 7,619		WP 11-41
8	Ceramic Post Insulators	2AQ	$ -	$ -	$ 1,959	$ 1,459	$ 2,753	$ 3,960	$ 5,832	$ 5,821	$ 5,832	$ 5,843	$ 5,855		WP 11-42, WP 11-58
9	Surge Arrester Replacement	2AR	$ -	$ 4,474	$ 45,419	$ 21,767	$ 63,497	$ 88,859	$ 16,804	$ 17,759	$ 35,472	$ 36,429	$ 37,413		WP 11-43, WP 11-55
10	Total Cost of FAS Overhead Capital	2AS	$ 703	$ 601	$ 681	$ 600	$ 221	$ 639	$ 831	$ 830	$ 831	$ 833	$ 835		WP 11-44
11	**Subtotal Cost by Activity Type**		$ 104,778	$ 106,049	$ 202,862	$ 308,408	$ 306,053	$ 409,112	$ 264,912	$ 274,781	$ 299,747	$ 307,649	$ 320,908		
12	**Additional Project Costs**														
13	Major Notifications and Misc Projects	2AP	$ 3,196	$ 1,279	$ 1,114	$ 129	$ 218	$ 200	$ 500	$ 500	$ 200	$ 200	$ 200	(1)	
14	Equipment with Access Issue	2AP	$ 353	$ 236	$ 269	$ (7)	$ (3)	$ 715	$ 715	$ 715	$ 715	$ 715	$ 715	(2)	
15	Non-Wood Streetlights	2AP	$ -	$ 142	$ 218	$ 1,448	$ 266	$ 1,028	$ 1,028	$ 1,028	$ 1,028	$ 1,028	$ 1,028		WP 10-54
16	San Francisco Decorative Streetlights	2AI	$ 118	$ 579	$ 1,389	$ 1,890	$ 445	$ -	$ -	$ 995	$ 997	$ 999	$ 1,001		WP 10-52
17	Regulated Output Streetlight Replacement	2AG	$ 4,211	$ 6,277	$ 17,837	$ 4,498	$ 30	$ 5,140	$ -	$ 2,488	$ 2,593	$ -	$ -		WP 10-50
18	Standard Cost Variance	2A#	$ (474)	$ (222)	$ 830	$ (1,875)	$ (1,153)	$ -	$ -	$ -	$ -	$ -	$ -	(3)	
19	**Subtotal Additional Project Costs**		$ 7,403	$ 8,291	$ 21,657	$ 6,083	$ (197)	$ 7,083	$ 2,243	$ 5,726	$ 5,533	$ 2,942	$ 2,944		
20	**Total MWC 2A**		**$ 112,181**	**$ 114,340**	**$ 224,518**	**$ 314,491**	**$ 305,856**	**$ 416,195**	**$ 267,155**	**$ 280,507**	**$ 305,280**	**$ 310,591**	**$ 323,852**		

Forecast Assumptions and Details

(1) Beginning in 2015, only jobs greater than $100,000 have been included in major notifications. Jobs between $25,000 and $100,000 are included in overhead notifications (2AA). The forecast costs are based on the historical costs for projects greater than $100,000.
(2) Equipment with access issues is a list of equipment locations identified by line workers where hazards have been identified associated with accessing the facilities for operations or repairs. This project relocates the equipment.
(3) Standard Cost Variance is not forecasted.

Workpaper Table 11-32
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT 2AA

Line No.		
1	**MAT Code**	2AA
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	OH General Replacement – Replace deteriorated OH facilities that are not an imminent hazard and have not caused an outage. Facilities include crossarms, leaking transformers, and conductor. Units measured: Number of notifications. This program relates to safety, reliability, or maintenance because it addresses a non-conformance identified by preventative maintenance programs such as inspections and patrols, as well as internal operational processes.

	Risk ID	Type	Name
4	DOVHD-C003	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead
5	WLDFR-C008	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead

6	**Program Area**	Maintenance and Compliance
7	**Forecast Method**	Unit cost
8	**Unit of Measure**	# of Notifications Completed
9	**Unit Cost (2023)**	$ 10,506
10	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
11	**Unit Forecast Basis**	2019-2020 average recorded units adjusted for addressing high risk ECs each year.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
12	**Recorded Costs**	$ 51,662,766	$ 56,617,700	$ 96,499,748	$ 228,227,833	$ 179,951,104	Calculated - Line 13 * Line 14
13	**No. of Units**	10,354	11,466	14,687	20,959	13,716	
14	**Unit Cost**	$ 4,990	$ 4,938	$ 6,570	$ 10,889	$ 13,120	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
15	**Forecast Costs**	$ 232,990,043	$ 201,316,166	$ 205,362,647	$ 212,044,473	$ 218,716,729	$ 230,716,023	Calculated - Line 16 * Line 17
16	**No. of Units**	24,641	19,708	19,548	19,728	19,886	20,569	
17	**Unit Cost**	$ 9,455	$ 10,215	$ 10,506	$ 10,748	$ 10,998	$ 11,217	

18	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding

Workpaper Table 11-33
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT 2AB

Line No.		
1	**MAT Code**	2AB
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	Bird Safe Install/Replacement – Capital modifications to bird-safe incident and/or adjacent poles in response to a bird electrocution, per USFWS requirements and Utility Operating Standard S2321. Units measured: Number of notifications. This program relates to safety and reliability by mitigating outages due to bird incidents.

	Risk ID	Type	Name
4	DOVHD-C003	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead
5	WLDFR-C011	Control	Animal Abatement

6	**Program Area**	Maintenance and Compliance
7	**Forecast Method**	Unit cost
8	**Unit of Measure**	# of Notifications Completed
9	**Unit Cost (2023)**	$ 3,593
10	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
11	**Unit Forecast Basis**	Consistent with PG&E's 2019 and 2020 recorded work.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
12	**Recorded Costs**	$ 2,434,528	$ 2,131,499	$ 1,978,138	$ 2,456,637	$ 1,974,878	Calculated - Line 13 * Line 14
13	**No. of Units**	1,188	895	746	664	500	
14	**Unit Cost**	$ 2,049	$ 2,382	$ 2,652	$ 3,700	$ 3,950	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
15	**Forecast Costs**	$ 3,023,258	$ 3,480,503	$ 3,473,731	$ 3,480,670	$ 3,487,401	$ 3,494,182	Calculated - Line 16 * Line 17
16	**No. of Units**	577	995	967	943	920	898	
17	**Unit Cost**	$ 5,240	$ 3,499	$ 3,593	$ 3,690	$ 3,790	$ 3,892	

18	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding

Workpaper Table 11-34
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT 2AC

Line No.		
1	**MAT Code**	2AC
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	Bird Safe Install/Replacement Annual – Capital work performed as part of annual pole retrofit program to prevent bird electrocutions, per USFWS requirements and Utility Operating Standard S2321. Units measured: Number of notifications. This program relates to safety, reliability, or maintenance due to PG&E's commitment made to USFWS to retrofit poles in raptor concentration zones to mitigate bird related outages.

	Risk ID	Type	Name
4	WLDFR-C011	Control	Animal Abatement

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Notifications Completed
8	**Unit Cost (2023)**	$ 3,697
9	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
10	**Unit Forecast Basis**	2021 approved work plan.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 3,025,101	$ 2,767,097	$ 5,270,598	$ 1,839,802	$ 6,002,958	Calculated - Line 12 * Line 13
12	**No. of Units**	1,257	1,305	1,397	740	399	
13	**Unit Cost**	$ 2,407	$ 2,120	$ 3,773	$ 2,486	$ 15,045	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 3,431,682	$ 3,626,258	$ 3,614,840	$ 3,926,541	$ 3,937,891	$ 3,949,326	Calculated - Line 15 * Line 16
15	**No. of Units**	978	1,007	978	1,034	1,010	986	
16	**Unit Cost**	$ 3,509	$ 3,600	$ 3,697	$ 3,797	$ 3,900	$ 4,005	

17	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding

Workpaper Table 11-35
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT 2AE

Line No.		
1	**MAT Code**	2AE
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	OH COE Replacement – Replace OH equipment classified as COE. Units measured: Number of notifications. This program relates to safety, reliability, or maintenance because it addresses a non-conformance identified by preventative maintenance programs such as equipment testing, as well as internal operational processes.

	Risk ID	Type	Name
4	DOVHD-C003	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Notifications Completed
8	**Unit Cost (2023)**	$ 34,174
9	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
10	**Unit Forecast Basis**	Steady-state rate calculated from 2018-19 two-year average of the find rate for new overhead COE maintenance notifcations.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 26,849,575	$ 25,291,949	$ 36,564,281	$ 34,474,896	$ 44,166,493	Calculated - Line 12 * Line 13
12	**No. of Units**	1,493	1,219	1,463	1,207	1,102	
13	**Unit Cost**	$ 17,984	$ 20,748	$ 24,993	$ 28,562	$ 40,078	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 54,680,464	$ 28,174,548	$ 28,119,733	$ 28,175,906	$ 28,230,390	$ 28,285,281	Calculated - Line 15 * Line 16
15	**No. of Units**	1,686	847	823	803	783	764	
16	**Unit Cost**	$ 32,432	$ 33,275	$ 34,174	$ 35,098	$ 36,045	$ 37,018	

17	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding

Workpaper Table 11-36
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT 2AF

Line No.		
1	**MAT Code**	2AF
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	OH Idle Facility Remove – Removal of OH Idle Facilities that have been determined to have no likely foreseeable future use. Units measured: Number of facilities. This program relates to safety and maintenance because it removes equipment no longer in use.

	Risk ID	Type	Name
4	DOVHD-C003	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead
5	WLDFR-C008	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead

6	**Program Area**	Maintenance and Compliance
7	**Forecast Method**	Unit cost
8	**Unit of Measure**	# of Facilities
9	**Unit Cost (2023)**	$ 8,444
10	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
11	**Unit Forecast Basis**	Electric Correctives (ECs) are included in current year work plan based on risk prioritization. 2021 units reflect strategy to complete work in HFTD areas supporting system hardening.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
12	**Recorded Costs**	$ 2,211,485	$ 3,351,072	$ 5,623,266	$ 10,843,478	$ 4,965,509	Calculated - Line 13 * Line 14
13	**No. of Units**	278	908	1,480	1,638	673	
14	**Unit Cost**	$ 7,955	$ 3,691	$ 3,800	$ 6,620	$ 7,378	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
15	**Forecast Costs**	$ 20,500,353	$ 2,731,666	$ 2,726,352	$ 2,731,798	$ 2,737,080	$ 2,742,402	Calculated - Line 16 * Line 17
16	**No. of Units**	2,558	332	323	315	307	300	
17	**Unit Cost**	$ 8,014	$ 8,222	$ 8,444	$ 8,673	$ 8,907	$ 9,147	

18	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding

Workpaper Table 11-37
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT 2AH

Line No.		
1	**MAT Code**	2AH
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	LED Streetlights – Replacement of PG&E LS-1 non-decorative streetlight with LED fixtures and new photocells. Units measured: Number of streetlights. This program relates to safety and maintenance because it provides illumination for pedestrian and vehicular traffic.

	Risk ID	Type	Name
4	DOVHD-C003	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost, multiple
7	**Unit of Measure**	Program
8	**Unit Cost (2023)**	$ 420
9	**Unit Cost Forecast Basis**	2021-2026 forecast unit costs are based on forecasted increase in customer opt-ins of decorative streetlights conversions beginning in 2023 while declining units in non-decorative cobrahead replacements in 2021-2022.
10	**Unit Forecast Basis**	Assuming increase in units in decorative replacements due to increase in customer opt-ins as IFC (Initial Facility Charge) charge ends in 2022.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 17,891,010	$ 10,814,974	$ 8,865,929	$ 6,738,351	$ 2,519,891	Calculated - Line 12 * Line 13
12	**No. of Units**	56,520	41,259	18,967	14,001	8,204	
13	**Unit Cost**	$ 317	$ 262	$ 467	$ 481	$ 307	

	Cobrahead	Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 578,000	$ 820,000	$ 840,500	$ 861,513	$ 441,525	$ 226,282	Calculated - Line 15 * Line 16
15	**No. of Units**	1,445	2,000	2,000	2,000	1,000	500	
16	**Unit Cost**	$ 400	$ 410	$ 420	$ 431	$ 442	$ 453	

	Decorative	Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
17	**Forecast Costs**	$ 450,000	$ 1,295,624	$ 6,234,676	$ 6,390,542	$ 6,991,831	$ 7,392,909	Calculated - Line 18 * Line 19
18	**No. of Units**	500	1,300	6,000	6,000	6,500	6,500	
19	**Unit Cost**	$ 900	$ 997	$ 1,039	$ 1,065	$ 1,076	$ 1,137	

	Total	Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
20	**Forecast Costs**	$ 1,028,000	$ 2,115,624	$ 7,075,176	$ 7,252,055	$ 7,433,356	$ 7,619,190	Calculated - Line 15 + Line 18
21	**No. of Units**	1,945	3,300	8,000	8,000	7,500	7,000	Calculated - Line 16 + Line 19

	Notes	
22	**(A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 11-38
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT 2AQ

Line No.		
1	**MAT Code**	2AQ
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	Ceramic Post Insulators – Replacement of ceramic post insulators that were manufactured in 1972 or prior and are currently installed on PG&E poles. This program relates to safety, reliability, and maintenance because it replaces ceramic post insulators prior to failure.

	Risk ID	Type	Name
4	DOVHD-M008	Mitigation	Ceramic Post Insulator Replacement

5	**Program Area**	Risk Reduction
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	Ceramic post insulators replaced
8	**Unit Cost (2023)**	$ 2,782
9	**Unit Cost Forecast Basis**	Expected decrease in unit cost due to increased volume of High Fire Threat District Tier 2 and 3 units.
10	**Unit Forecast Basis**	2021 approved workplan that shifts focus from High-Fire Threat District Tier 1 units to Tier 2 and 3 units.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ -	$ -	$ 1,959,420	$ 1,459,045	$ 2,753,431	Calculated - Line 12 * Line 13
12	**No. of Units**	-	-	315	256	670	
13	**Unit Cost**	$ -	$ -	$ 6,220	$ 5,699	$ 4,110	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 3,959,669	$ 5,831,898	$ 5,820,552	$ 5,832,179	$ 5,843,457	$ 5,854,819	Calculated - Line 15 * Line 16
15	**No. of Units**	1,500	2,153	2,093	2,042	1,992	1,943	
16	**Unit Cost**	$ 2,640	$ 2,708	$ 2,782	$ 2,857	$ 2,934	$ 3,013	

17	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding

Workpaper Table 11-39
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT 2AR

Line No.		
1	**MAT Code**	2AR
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	Surge Arrester Replacement – Replacement of current (non -exempt) surge arresters with exempt surge arresters to reduce fire risk from electric distribution operations. Non-exempt surge arresters are OH electric distribution equipment that have the potential to expel hot or molten material upon normal operation, leading to an increased risk of wildfire. Units measured: Number of replacements. This program relates to safety and maintenance because it includes replacement of non-exempt surge arresters with exempt equipment types which is a wildfire mitigation in addition to correcting the common grounding which poses a safety risk.

	Risk ID	Type	Name
4	DOVHD-M003	Mitigation	Non-Exempt Surge Arrester Replacement
5	WLDFR-M003	Mitigation	Non-Exempt Surge Arrester Replacement

6	**Program Area**	Risk Reduction
7	**Forecast Method**	Unit cost
8	**Unit of Measure**	# of Replacements
9	**Unit Cost (2023)**	$ 4,494
10	**Unit Cost Forecast Basis**	Three year average unit cost (2018-2020), escalated for inflation.
11	**Unit Forecast Basis**	2021 approved workplan that shifts focus from High-Fire Threat District Tier 1 units to Tier 2 and 3 units.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
12	**Recorded Costs**	$ -	$ 4,473,653	$ 45,419,451	$ 21,767,350	$ 63,497,216	Calculated - Line 13 * Line 14
13	**No. of Units**	-	619	12,857	4,602	14,362	
14	**Unit Cost**	$ -	$ 7,227	$ 3,532	$ 4,730	$ 4,421	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
15	**Forecast Costs**	$ 88,859,389	$ 16,804,435	$ 17,758,607	$ 35,472,244	$ 36,429,359	$ 37,412,696	Calculated - Line 16 * Line 17
16	**No. of Units**	20,837	3,841	3,952	7,686	7,686	7,686	
17	**Unit Cost**	$ 4,264	$ 4,375	$ 4,494	$ 4,615	$ 4,740	$ 4,868	

18	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 11-40
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT 2AS

Line No.		
1	**MAT Code**	2AS
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	FAS OH Capital – FAS OH capital is work that is identified during a field job and completed by a single Troubleman. The work could be replacement or installations of OH facilities: Electric distribution conductors, components, structures, and associated equipment constructed above ground level. Units measured: Number of notifications. This program relates to safety, reliability, or maintenance because it addresses a non-conformance identified by Troublemen.

	Risk ID	Type	Name
4	DOVHD-C003	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Notifications Completed
8	**Unit Cost (2023)**	$ 316
9	**Unit Cost Forecast Basis**	2018-2019 average recorded unit cost, escalated for inflation
10	**Unit Forecast Basis**	2018-19 average recorded units.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 703,210	$ 601,031	$ 680,696	$ 600,135	$ 221,253	Calculated - Line 12 * Line 13
12	**No. of Units**	2,598	2,091	2,129	2,171	1,271	
13	**Unit Cost**	$ 271	$ 287	$ 320	$ 276	$ 174	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 638,927	$ 831,233	$ 829,616	$ 831,273	$ 832,881	$ 834,500	Calculated - Line 15 * Line 16
15	**No. of Units**	2,130	2,701	2,625	2,561	2,498	2,437	
16	**Unit Cost**	$ 300	$ 308	$ 316	$ 325	$ 333	$ 342	

17	**Notes**	
	(A)	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding

Workpaper Table 11-41
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 11, Overhead and Underground Electric Distribution Maintenance
Major Work Category 2B – Forecast Details
(Thousands of Nominal Dollars)

Line		MAT CODE	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions	Reference
1	**Total Cost by Activity Type**														
2	Total Cost of Underground Notifications	2BA	$ 33,286	$ 41,337	$ 62,722	$ 57,017	$ 37,864	$ 46,680	$ 46,391	$ 47,807	$ 49,171	$ 53,333	$ 54,773		WP 11-46
3	Total Cost of Fault Indicators	2BB	$ 888	$ 981	$ 1,035	$ 528	$ 646	$ 796	$ 791	$ 863	$ 886	$ 910	$ 934		WP 11-47
4	Total Cost of Underground COE	2BD	$ 6,827	$ 4,838	$ 6,047	$ 6,974	$ 7,579	$ 6,573	$ 6,354	$ 6,926	$ 7,113	$ 7,305	$ 7,502		WP 11-48
5	Total Cost of UG Idle Facility Remove	2BF	$ 197	$ 311	$ 399	$ 470	$ 176	$ 27	$ 28	$ 28	$ 29	$ 30	$ 31		WP 11-49
6	**Subtotal Cost by Activity Type**		$ 41,198	$ 47,468	$ 70,203	$ 64,989	$ 46,265	$ 54,077	$ 53,565	$ 55,623	$ 57,199	$ 61,578	$ 63,240		
7	**Additional Project Cost**														
8	Major Notifications and Submersible Potential Transformers	2BP	$ 4,489	$ 2,043	$ 1,601	$ 311	$ 2,026	$ 3,263	$ 7,309	$ 8,108	$ 8,259	$ 8,703	$ 8,930	(1)	
9	Sand/Gravel/Spoil	2B#	$ 3,006	$ 454	$ (1,478)	$ (4,427)	$ (701)	$ -	$ -	$ -	$ -	$ -	$ -	(2)	
10	**Subtotal Additional Project Cost**		$ 7,495	$ 2,497	$ 122	$ (4,116)	$ 1,325	$ 3,263	$ 7,309	$ 8,108	$ 8,259	$ 8,703	$ 8,930		
11	**Total MWC 2B**		**$ 48,693**	**$ 49,965**	**$ 70,325**	**$ 60,873**	**$ 47,590**	**$ 57,340**	**$ 60,873**	**$ 63,731**	**$ 65,459**	**$ 70,281**	**$ 72,170**		

Forecast Assumptions and Details

(1) Beginning in 2015, only jobs greater than $100,000 have been included in Major Notifications and jobs between $25,000 and $100,000 have been included in the underground notification category (2BA). As a result, the forecast volume of Major Notifications for 2019-2022 is lower than in the past. Beginning in 2020, includes costs to replace non-network manhole covers. Forecast includes increasing number of non-network manhole cover replacements.

(2) Sand, gravel, spoils and oil filled equipment are used on a variety of underground jobs. In order to simplify accounting, all material costs are recorded separately and allocated to applicable MWCs.

Workpaper Table 11-42
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT 2BA

Line No.		
1	**MAT Code**	2BA
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	UG General Replacement – Replace deteriorated UG facilities that are not an imminent hazard and have not caused an outage. Facilities include leaking transformers, conduit, enclosures, pads, and idle equipment. Units measured: Number of notifications. This program relates to safety, reliability, or maintenance because it addresses a non-conformance identified by preventative maintenance programs such as inspections and patrols, as well as internal operational processes.

	Risk ID	Type	Name
4	DUNGD-C003	Control	Equipment Maintenance and Replacement

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Notifications Completed
8	**Unit Cost (2023)**	$ 26,317
9	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
10	**Unit Forecast Basis**	2021 approved workplan.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 33,286,296	$ 41,337,421	$ 62,721,715	$ 57,017,369	$ 37,863,824	Calculated - Line 12 * Line 13
12	**No. of Units**	2,217	2,599	3,503	2,363	1,365	
13	**Unit Cost**	$ 15,014	$ 15,905	$ 17,905	$ 24,129	$ 27,739	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 46,680,438	$ 46,391,326	$ 47,806,625	$ 49,171,337	$ 53,333,297	$ 54,772,922	Calculated - Line 15 * Line 16
15	**No. of Units**	1,869	1,810	1,817	1,819	1,921	1,921	
16	**Unit Cost**	$ 24,976	$ 25,626	$ 26,317	$ 27,029	$ 27,759	$ 28,508	

17	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding

Workpaper Table 11-43
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT 2BB

Line No.		
1	**MAT Code**	2BB
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	Fault Indicator Replacements – Replace deteriorated fault indicators that are not an imminent hazard and have not caused an outage. Units measured: Number of fault indicators. This program relates to reliability because in the event of an outage it helps sectionalize the outage area.

	Risk ID	Type	Name
4	DUNGD-C003	Control	Equipment Maintenance and Replacement

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	Number of fault indicators
8	**Unit Cost (2023)**	$ 352
9	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
10	**Unit Forecast Basis**	2021 approved workplan.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 887,884	$ 980,998	$ 1,034,569	$ 528,258	$ 646,369	Calculated - Line 12 * Line 13
12	**No. of Units**	3,565	3,990	4,385	2,809	3,060	
13	**Unit Cost**	$ 249	$ 246	$ 236	$ 188	$ 211	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 796,328	$ 791,355	$ 862,534	$ 885,822	$ 909,740	$ 934,303	Calculated - Line 15 * Line 16
15	**No. of Units**	3,150	3,051	3,238	3,238	3,238	3,238	
16	**Unit Cost**	$ 253	$ 259	$ 266	$ 274	$ 281	$ 289	

17	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding

Workpaper Table 11-44
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT 2BD

Line No.		
1	**MAT Code**	2BD
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	UG COE Replacement – Replace UG equipment determined COE by the division operators, Maintenance and Construction, and restoration, and validated by Distribution Engineers. Units measured: Number of notifications. This program relates to reliability and maintenance because it identifies certain asset replacements.

	Risk ID	Type	Name
4	DUNGD-C003	Control	Equipment Maintenance and Replacement

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Notifications
8	**Unit Cost (2023)**	$ 48,096
9	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
10	**Unit Forecast Basis**	Steady-state rate calculated from 2018-19 two-year average of the find rate for new overhead COE maintenance notifcations.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 6,826,951	$ 4,837,773	$ 6,047,390	$ 6,974,131	$ 7,579,265	Calculated - Line 12 * Line 13
12	**No. of Units**	137	136	148	93	108	
13	**Unit Cost**	$ 49,832	$ 35,572	$ 40,861	$ 74,991	$ 70,178	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 6,572,827	$ 6,354,201	$ 6,925,788	$ 7,113,114	$ 7,305,040	$ 7,502,225	Calculated - Line 15 * Line 16
15	**No. of Units**	144	136	144	144	144	144	
16	**Unit Cost**	$ 45,645	$ 46,831	$ 48,096	$ 49,397	$ 50,729	$ 52,099	

17	**Notes (A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding

Workpaper Table 11-45
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 11 - Overhead and Underground Electric Distribution Maintenance
Unit Cost and Forecast Details: MAT 2BF

Line No.		
1	**MAT Code**	2BF
2	**GRC Ch.**	11 - Overhead and Underground Electric Distribution Maintenance
3	**MAT Code Definition**	UG Idle Facility Remove – Removal of UG Idle Facilities that have been determined not to have a likely use in the foreseeable future. This program relates to safety and maintenance because it removes equipment no longer in use and therefore will no longer require maintenance.

	Risk ID	Type	Name
4	DUNGD-C005	Control	UG Idle Facility Removal

5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Locations
8	**Unit Cost (2023)**	$ 22,994
9	**Unit Cost Forecast Basis**	Program inception to August 2020 average unit cost, escalated for inflation.
10	**Unit Forecast Basis**	2021 approved workplan.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 196,513	$ 311,404	$ 399,053	$ 469,523	$ 175,804	Calculated - Line 12 * Line 13
12	**No. of Units**	16	33	40	40	10	
13	**Unit Cost**	$ 12,282	$ 9,436	$ 9,976	$ 11,738	$ 17,580	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 26,964	$ 27,665	$ 28,412	$ 29,179	$ 29,967	$ 30,776	Calculated - Line 15 * Line 16
15	**No. of Units**	2	2	2	2	2	2	
16	**Unit Cost**	$ 13,482	$ 13,833	$ 14,206	$ 14,590	$ 14,984	$ 15,388	

17 **Notes (A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 11, OH & UG ELECTRIC DISTRIBUTION MAINTENANCE
PROJECT SUMMARY – REGULATED OUTPUT (RO) STREETLIGHT REPLACEMENT PROGRAM

Project Title: Regulated Output (RO) Streetlight Replacement
Major Work Categories: MWC 2A, MAT 2AG
Planning Order Numbers: 5510798, 5543498
Project Start Date: 2012
Project Completion Date: 2024
Operative Date (only applies to Capital): Operative as installed

Project Description

This is a program to replace the remaining outdated RO incandescent streetlights that PG&E owns and operates in San Francisco. These RO streetlights are prone to failure and difficult to maintain; in some cases, spare parts are no longer manufactured and cannot be obtained.

In the 2020 GRC, PG&E forecast that it would replace the remaining RO streetlights by 2019. PG&E completed replacement of 22 of 24 RO loops in 2019; there are still 49 additional streetlights that need to be converted to complete work on the remaining 2 RO loops. PG&E is not currently planning to perform any work in this program in 2020-2022 because of the City and County of San Francisco's (CCSF) 5-year paving moratorium, which went into effect in late 2017. Instead, PG&E plans to replace the 49 remaining RO streetlights starting in 2023 when the 5-year moratorium expires (PG&E has approached CCSF about the possibility of making an exception to the paving moratorium for this work. If CCSF agrees, PG&E may complete the remaining replacements prior to 2023).

Justification

This work addresses both safety and reliability. Streetlights illuminate roadways for safe vehicular and pedestrian travel during hours of darkness. Completion of this work increases the reliability of these streetlights. The RO system requires special non-standard transformers and cable which are difficult, if not impossible, to obtain which has resulted in long duration outages. There has also been an increase in the number of burnouts related to the age of the RO system. Replacing the RO system with new streetlights will reduce repair time and improve streetlight reliability in the area serviced by that system.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
PROJ Incandescent Streetlight – SF (PO #5510798)	4,211	6,277	17,837	4,498	30	5,140	-	-	-	-	-	37,993
SYSPLAN ED 2AG DOVHD-M007 (PO #5543498)	-	-	-	-	-	-	-	2,488	2,593	-	-	5,081
Total	**4,211**	**6,277**	**17,837**	**4,498**	**30**	**5,140**	**-**	**2,488**	**2,593**	**-**	**-**	43,074

Work was initially planned to take place in 2021; however, PG&E has not been successful in its appeal to CCSF to lift the moratorium that would have allowed us to proceed with the work. Instead, we moved the work to start in 2023 after the moratorium expires in late 2022.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 11, OH & UG ELECTRIC DISTRIBUTION MAINTENANCE
PROJECT SUMMARY – REGULATED OUTPUT (RO) STREETLIGHT REPLACEMENT PROGRAM

Benefits

The benefits from completing this project include reduction of long duration streetlight outages associated with the existing RO system, improved customer satisfaction, improved public safety, and improved streetlight reliability.

Alternatives Considered (In Addition to the Selected Alternative)

This is an ongoing project. Not proceeding with the remaining work will result in increased maintenance resources needed to address burn outs and outages of the remaining RO streetlights. Replacement parts will continue to be difficult to obtain which will result in long duration outages.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 11, OH & UG ELECTRIC DISTRIBUTION MAINTENANCE
PROJECT SUMMARY – DECORATIVE STREETLIGHT REPLACEMENT PROGRAM

Project Title: Decorative Streetlight Replacement Program
Major Work Categories: MWC 2A, MAT 2AI
Planning Order Numbers: 5543500, 5756438
Project Start Date: 2012
Project Completion Date: Ongoing
Operative Date (only applies to Capital): Operative as installed

Project Description

This project was first described in the 2017 GRC. The project replaces the inner steel pole and refurbishes the decorative cast-iron shell of streetlights in the Golden Triangle area of San Francisco. There are 190 of these streetlights in total, and all have been inspected. The streetlights in this area were identified and prioritized for replacement based on condition with those most likely to fail being replaced first. The original plan was to complete the repair or replacement of these streetlights in 2017 but the program was delayed due to difficulty in selecting suitable replacements. PG&E completed the highest priority work in 2020. However, PG&E now envisions this as an ongoing program based the results of on re-inspections scheduled on a 5-year cycle (next inspection scheduled for 2023).

Justification

In March and April of 2012, two cast-iron decorative streetlights in the Golden Triangle area of San Francisco toppled during severe wind storms. Decorative cast iron streetlights typically weigh in excess of 2,000 pounds and can present a safety concern if they fail. Neither incident resulted in injury but damage did occur to third party property. Both streetlights failures were a result of corrosion of the inner steel pole support structure. An inspection of all decorative streetlights was performed in 2018 and significant corrosion was identified at approximately 45 locations.

This program provides mitigation for the Streetlight Structures risk in the Electric Operations risk register.

Cost

PG&E'soriginal strategy was to replace the streetlights' cast-iron housing structures with a new fiberglass housing designed to maintain the same appearance. After further analysis and discussions with the San Francisco Historic Preservation Commission, PG&E decided to refurbish the existing cast-iron housings as a more cost-effective and authentic alternative. The forecast for the remaining streetlights is based on refurbishing the cast-iron housing structure (which includes labor and material – paint, glass globe, wiring and lamp), replacing the inner steel pole, and installing the refurbished streetlight on a new foundation for $91,400 per location. PG&E plans to complete 10 locations per year from 2023-2026.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
SYSPLAN ED 2AI DOVHD-C003 (PO #5543500)	-	-	-	-	-	-	-	995	997	999	1,001	3,992
PROJ SF Historical Streetlight Replace (PO #5756438)	118	579	1,389	1,890	445	-	-	-	-	-	-	4,421
Total	**118**	**579**	**1,389**	**1,890**	**445**	**-**	**-**	**995**	**997**	**999**	**1,001**	**8,413**

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 11, OH & UG ELECTRIC DISTRIBUTION MAINTENANCE
PROJECT SUMMARY – DECORATIVE STREETLIGHT REPLACEMENT PROGRAM

Benefits

- The decorative streetlight replacement program improves public safety.
- PG&E collaborated with the San Francisco Historic Preservation Committee to develop the proposed strategy.

Alternatives Considered (In Addition to the Selected Alternative)

Alternative 1: Replace cast-iron housing structure (base, shaft, fixture) and inner steel pole. This alternative is higher cost compared to refurbishing.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 11, OH & UG ELECTRIC DISTRIBUTION MAINTENANCE
PROJECT SUMMARY – NON-WOOD STREETLIGHT POLE REPLACEMENT

Project Title: Non-Wood Streetlight Pole Replacement
Major Work Categories: MWC 2A, MAT 2AP
Planning Order Numbers: 5512041, 5526699, 5527379, 5532602, 5532603, 5542918
Project Start Date: 2018
Project Completion Date: Ongoing
Operative Date (only applies to Capital): Operative as installed

Project Description

In 2016, a contractor was preparing to replace a steel streetlight pole when it failed. PG&E investigated the incident and found that some of its older galvanized steel and aluminum streetlight-only poles will corrode after an extended service period. Based on discussions with the pole manufacturer, PG&E determined that poles manufactured before 1975 are most likely to corrode. In March 2017, PG&E conducted a pilot review of streetlight-only poles of this vintage in Walnut Creek and found that approximately 10 percent of the poles evaluated had an unacceptable level of corrosion. PG&E replaced 61 corroded streetlight poles in Walnut Creek and developed a program to evaluate approximately 50,000 streetlight-only poles throughout the PG&E territory in 2018-2021. PG&E has replaced over 350 poles to date and expects to continue to replace poles that have an unacceptable level of corrosion.

Justification

Public Safety: risk mitigation to prevent streetlight pole failure due to corrosion or damage.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
PROJ Streetlight Replacement - SF PO #5512041	-	-	21	42	11	-	-	-	-	-	-	74
NonWood Strlght Pilot-DI WLDFRM4 DOVDHM4 PO #5526699	-	129	-	-	-	1,028	1,028	1,028	1,028	1,028	1,028	6,297
Richmond Park Streetlights PO #5527379	-	13	1	0.8	1	-	-	-	-	-	-	15.8
NonWood Streetlight Replacement - DI PO #5532602	-	-	195	1,403	249	-	-	-	-	-	-	1847
NonWood Streetlight Replacement - FR PO #5532603	-	-	-	2	-	-	-	-	-	-	-	2
Non-Wood Streetlight - CC PO #5542918	-	-	-	-	5	-	-	-	-	-	-	5
Total	**-**	**142**	**218**	**1,448**	**266**	**1,028**	**1,028**	**1,028**	**1,028**	**1,028**	**1,028**	**8,241**

Benefits

This project mitigates public safety risk of catastrophic streetlight pole failure due to corrosion or damage.

Alternatives Considered (In Addition to the Selected Alternative)

Alternative 1: (Status Quo) Do nothing and replace streetlights as they fail on emergency. This option was not chosen because of the potential safety risk of failing streetlight poles.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 11, OH & UG ELECTRIC DISTRIBUTION MAINTENANCE
PROJECT SUMMARY- NON-EXEMPT SURGE ARRESTER REPLACEMENT PROGRAM

Project Title: Non-Exempt Surge Arrester Replacement Program
Major Work Categories: MWC, 2A, MAT 2AR
Planning Order Numbers: 5527564, 5527565, 5795579, 5527570, 5527511, 5527516, 5527517, 5527518, 5527562, 5527566, 5527568, 5527569, 5541243, 5541271, 5541272, 5541276
Project Start Date: August 2017
Project Completion Date: December 2026
Operative Date (only applies to Capital): Operative as installed

Project Description

The Non-Exempt[1] Surge Arrester Replacement program replaces non-exempt surge arresters with exempt surge arresters and corrects abnormal grounding issues where necessary. Exempt surge arresters are designed to reduce the potential for release of electrical arcs, sparks, or hot material during operation.

In its 2020 GRC, PG&E forecast that this program be completed by the end of 2022. Since then, PG&E has adjusted the strategy to focus on completing replacements in Tier 2 and Tier 3 High Fire Threat District (HFTD) areas first, and then shifting to replacements in non-HFTD areas at a slower rate. PG&E expects to complete non-exempt surge arrester replacements in HFTD areas by 2022, and complete replacements system-wide by 2026.

In 2020, PG&E replaced approximately 10,263 non-exempt surge arresters in HFTD areas, with the remaining 21,383 targeted to be completed in 2021 and 2022. The 2020 recorded capital expenditures for the program were $63.5 million. For the non-HFTD locations, PG&E forecasts surge arrester replacement work at 3,841 locations in 2022, 3,952 locations in 2023, and 7,686 locations annually from 2024 through 2026

Justification

Non-exempt surge arresters are overhead distribution equipment that has the potential to expel hot or molten material upon normal operation, leading to an increased risk of wildfire. Due to these characteristics, Public Resources Code (PRC) Section 4292 requires all utilities to maintain at least a 10-foot clearance of vegetation from the outer circumference of any pole that has a surge arrester. However, Cal FIRE has issued final certification to one vendor and provisional certification to another to exempt their surge arresters from PRC Section 4292 requirements because they are safer to use. Poles with these exempt surge arresters may be exempt from the vegetation clearance requirements of PRC Section 4292 if all other equipment installed on the poles is also deemed to be exempt.

Whether or not a pole is considered exempt, the replacement of current surge arresters with exempt surge arresters will reduce fire risk from distribution operations. This program is a mitigation for both the Wildfire and Failure of Electric Distribution Overhead risks (WLDFR-M003 and DOVHD-M003).

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1 "Exempt" and "Non-Exempt" refer the fact that California Public Resources Code Section 4292 requires utilities to maintain a 10-foot radial clearance around poles that have asset types that pose a fire risk [non-exempt equipment] but also provides that CAL FIRE can issue exemptions for particular models of those asset types that have been shown to have a low fire risk [exempt equipment].

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 11, OH & UG ELECTRIC DISTRIBUTION MAINTENANCE
PROJECT SUMMARY- NON-EXEMPT SURGE ARRESTER REPLACEMENT PROGRAM

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
Various POs	-	4,474	45,419	21,767	63,497	88,859	-	-	-	-	-	**224,016**
SYSPLAN Surge Arrestor WLDFR-M003 (PO #5545559)	-	-	-	-	-	-	16,804	-	-	-	-	**16,804**
SYSPLAN ED 2AR DOVHD-M003 (PO #5795579)	-	-	-	-	-	-	-	17,759	35,472	36,429	37,413	**127,073**
Total	**-**	**4,474**	**45,419**	**21,767**	**63,497**	**88,859**	**16,804**	**17,759**	**35,472**	**36,429**	**37,413**	**367,893**

Additional cost information:

Forecast is based on unit cost of $4,195 (in 2020 dollars). Unit cost increases by escalation.

Year	Forecasted Units	Escalated Unit Cost	Forecast (Thousands of Nominal Dollars)
2021	21,383	$ 4,195	$ 88,855
2022	4,005	$ 4,195	$ 16,804
2023	4,233	$ 4,195	$ 17,759
2024	8,455	$ 4,195	$ 35,472
2025	8,683	$ 4,195	$ 36,429
2026	8,918	$ 4,195	$ 37,413

2020 unit cost basis
Labor: $2,795
Non-Construction Cost: 1,399
Total: $4,195

The forecast unit cost associated with non-exempt surge arresters is based upon an operational estimate for the work. Labor includes coordination, project management, and construction (including concrete restoration). Other costs include locate and mark, environmental, traffic plans, and permits.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 11, OH & UG ELECTRIC DISTRIBUTION MAINTENANCE
PROJECT SUMMARY- NON-EXEMPT SURGE ARRESTER REPLACEMENT PROGRAM

Benefits

- Mitigates the risk of wildfire due to normal operation of non-exempt surge arresters.
- Installing exempt surge arrestors may reduce vegetation management cost (all equipment on the pole must be considered exempt from PRC Section 4292).
- Creates efficiencies by combining the surge arrester grounding work with the surge arrestor replacement project.

Alternatives Considered (In Addition to the Selected Alternative)

-
- Alternative is to bundle work with existing maintenance programs and complete locations over 5-10 years. This alternative was not selected because the timeline to complete the work would not allow PG&E to meet our WMP commitments.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 11, OH & UG ELECTRIC DISTRIBUTION MAINTENANCE
PROJECT SUMMARY – CERAMIC POST INSULATOR REPLACEMENT PROGRAM

Project Title: Ceramic Post Insulator Replacement Program
Major Work Categories: MWC 2A, MAT 2AQ
Planning Order Numbers: 5528517, 5528540, 5528541, 5528542, 5528543, 5528544, 5538819, 5538820, 5538821, 5541244, 5541264, 5543502
Project Start Date: 2018
Project Completion Date: 2027
Operative Date (only applies to Capital): Operative as installed

Project Description

The Ceramic Post Insulator Replacement program replaces ceramic post insulators manufactured prior to 1972. Manufacturing techniques for ceramic insulators in the 1960s and 1970s were not as advanced as today. PG&E has determined that over time these older insulators may experience failures at lower-than-rated cantilever strength. PG&E linemen have identified safety concerns regarding these insulators and, depending on failure mode, a failed ceramic post insulator can carry an energized conductor down to the ground creating a potential safety hazard to the public and utility workers.

This program is targeted at replacing the existing population of vintage ceramic insulators with newer post insulators made of composite materials that have a lower risk of breaking. The program will focus on poles that are already being targeted through PG&E's ongoing Non-Exempt Surge Arrester Replacement program. PG&E estimates that it will replace older ceramic post insulators on approximately 4,589 poles in connection with the Non-Exempt Surge Arrester Replacement program. Additional replacements will occur on an ad hoc basis in other ongoing programs when they identify older ceramic post insulators, but these replacements are outside the scope of the mitigation considered here.

In March of 2021, The Ceramic Post Insulator Program started a Distribution Asset Inventory analysis in select divisions (SI, NV, DA, KN, and PN) to identify Ceramic Post Insulator locations of interest to help further refine a necessary workplan for future years.

The Ceramic Post Insulator Replacement program is a mitigation for the Failure of Distribution Overhead Assets risk (DOVHD-M008).

Justification

Due to the manufacturing techniques employed at that time, ceramic insulators manufactured prior to 1972 are subject to failure.

- This issue was first identified in 1977 and a proactive replacement program was initiated, but not fully implemented, between 1984 and 1986.
- As a result, insulators of this type and vintage remain in service on PG&E's system and PG&E linemen have expressed safety concerns associated with these insulators.
- Location installation records are not available. Identification of suspect insulators from the ground is not possible due to the location of the manufacturer/date stamp on the top of the insulators.
- A pilot inspection conducted in 2016 in the Fresno, Stockton, Sierra and Yosemite divisions found ceramic post insulators on 23 percent of the poles installed between 1968 and 1976.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 11, OH & UG ELECTRIC DISTRIBUTION MAINTENANCE
PROJECT SUMMARY – CERAMIC POST INSULATOR REPLACEMENT PROGRAM

- PG&E will leverage the current overhead inspection program to identify the poles with these insulators.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
Post Lapp Insulator – YO (PO #5528517)	-	-	355	181	605	438	-	-	-	-	-	**1,579**
Post Lapp Insulator – FR (PO #5528540)	-	-	354	428	276	82	-	-	-	-	-	**1,140**
Post Lapp Insulator – KE (PO #5528541)	-	-	-	157	-10	-	-	-	-	-	-	**147**
Post Lapp Insulator – NV (PO #5528542)	-	-	1,001	524	1,439	826	-	-	-	-	-	**3,790**
Post Lapp Insulator – SI (PO #5528543)	-	-	250	169	353	1,819	-	-	-	-	-	**2,591**
Post Lapp Insulator – HB (PO #5528544)	-	-	-	-	-	185	-	-	-	-	-	**185**
Post Lapp Insulator – CC (PO #5538819)	-	-	-	-	-	34	-	-	-	-	-	**34**
Post Lapp Insulator – LP (PO #5538820)	-	-	-	-	90	108	-	-	-	-	-	**198**
Post Lapp Insulator – ST (PO #5538821)	-	-	-	-	-	443	-	-	-	-	-	**443**
Post Lapp Insulator – SA (PO #5541244)	-	-	-	-	-	18	-	-	-	-	-	**18**
Post Lapp Insulator – SJ (PO #5541264)	-	-	-	-	-	5	-	-	-	-	-	**5**
SYSPLAN ED 2AQ DOVHD-M008 (PO #5543502)	-	-	-	-	-	-	5,832	5,821	5,832	5,843	5,855	**29,183**
Total	**-**	**-**	**1,959**	**1,459**	**2,753**	**3,960**	**5,832**	**5,820**	**5,832**	**5,843**	**5,855**	**39,313**

Additional Cost Information:
See Workpaper 11-40 for unit cost and forecast details.

Benefits

Replacing ceramic post insulators prior to failure provides improved safety and reliability benefits:

- Reduces a potential safety hazard to workers climbing or working on wood poles installed between 1968 and 1976.
- Reduces the risk of energized conductors falling to the ground presenting a potential safety hazard to the public.
- Reduces potential fire risk.
- Improves system reliability.

Alternatives Considered

- A complete, independent, separation of the 2AQ program from the 2AR program. This will be PG&E's planned approach starting in 2022.
- Bundling the ceramic post insulator replacement work with other overhead and maintenance programs. This alternative was not considered due to the amount of time it would take to complete this work.

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE

Testimony: ☐ **Workpapers:** ☒ **SOQ:** ☐

Exhibit Number: 4 **Chapter Number:** 11

Chapter Title: Overhead and Underground Electric Distribution Maintenance

Witness Name: Mark Esguerra

Page No.	Line No.	Item	As Filed	As Corrected
Errata as of November 5, 2021				
11-44	9	Table 11-40 2AS unit cost forecast basis correction	Three year average unit cost (2018-2020), escalated for inflation.	2018-2019 average recorded unit cost, escalated for inflation
11-47	14	Table 11-43 2BB Forecast Cost correction for 2021-2026	Forecast Cost: $1,051,802 (2021); $1,045,287 (2022); $1,139,315 (2023); $1,170,131 (2024); $1,201,703 (2025); $1,234,141 (2026)	Forecast Cost: $796,328 (2021) $791,355 (2022) $862,534 (2023) $885,822 (2024) $909,740 (2025) $934,303 (2026)
11-47	16	Table 11-43 2BB unit cost correction for 2021-2026	Unit Cost: $334 (2021); $343 (2022); $352 (2023); $361 (2024); $371 (2025); $381 (2026)	Unit Cost: $253 (2021); $259 (2022); $266 (2023); $274 (2024); $281 (2025); $289 (2026)
11-49	14	Table 11-45 2BF Forecast Cost correction for 2021-2026	Forecast Cost: $43,644 (2021); $42,374 (2022); $47,276 (2023); $48,554 (2024); $49,864 (2025); $51,210 (2026)	Forecast Cost: $26,964 (2021) $27,665 (2022) $28,412 (2023) $29,179 (2024) $29,967 (2025) $30,776 (2026)

Page No.	Line No.	Item	As Filed	As Corrected
11-49	16	Table 11-45 2BF unit cost correction for 2021-2026	Unit Cost: $21,822 (2021); $22,389 (2022); $22,994 (2023); $23,616 (2024); $24,253 (2025); $24,907 (2026)	Unit Cost: $13,482 (2021); $13,832 (2022); $14,206 (2023); $14,590 (2024); $14,982 (2025); $15,388 (2026)
Errata as of February 25, 2022				
11-43	13	Table 11-39 2AR 2018 units correction	12,858	12,857

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
EXHIBIT (PG&E-4) ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING
CHAPTER 12, POLE ASSET MANAGEMENT

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Table 12-1
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12
Pole Asset Management
Expenses by Major Work Category
(Thousands of Nominal Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	Reference (A)
1	AB	Misc Expense				228	61	21			WP 12-5
2	GA	E T&D Maint OH Poles	9,153	12,272	10,699	17,692	35,496	46,516	40,749	39,340	WP 12-3, WP 12-4
3	IG	Manage Var Bal Acct Processes			1,374						WP 12-5
4	**Total**		**9,153**	**12,272**	**12,073**	**17,920**	**35,557**	**46,537**	**40,749**	**39,340**	

Table 12-2
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12
Pole Asset Management
Expenses by Major Work Category
(Thousands of Base Year Dollars)

Line No.	MWC	Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast
1	AB	Misc Expense				227	61	21		
2	GA	E T&D Maint OH Poles	10,378	13,139	10,862	17,426	35,496	46,598	39,822	37,421
3	IG	Manage Var Bal Acct Processes			1,385					
4	**Total**		**10,378**	**13,139**	**12,247**	**17,653**	**35,557**	**46,619**	**39,822**	**37,421**

Workpaper Table 12-3
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12, Pole Asset Management
Major Work Category GA – Recorded Walk
MWC GA - Intrusive Inspection/Test and Treat
(Thousands of Nominal Dollars)

Line No.	Year	Program/Activity	Amount	Detailed Description/Assumptions	Reference
1	2016	**Recorded Adjusted**	**$ 9,153**		
2		Intrusive Inspection Program (MAT GAA)	$ (285)	Workload decreased to 244,479 poles in 2017; however, volume was above a typical year in order to maintain inspection program on 10-year cycle. The number of poles varies each year due to schedule and work priorities. Higher unit cost for work in Central/North Coast when compared to prior year. Unit costs vary depending on the divisions being worked. Typica costs are higher in urban areas and locations with difficult access and lower in rural areas.	WP 12-5 Line 2
3		Pole Evaluations (MAT GAI)	$ (288)	Poles requiring evaluation were identified during inspection and vary each year due to the nature of the poles and associated reject rates (reject here means poles that are identified for reinforcement or replacement). Workload decreased to 3,446 as a process change utilizing pole strength software in the test and treat program reduced the volume of evaluati work. This is the final year evaluation work was performed.	WP 12-5 Line 3
4		Pole Restoration Program (MAT GAD)	$ (580)	Poles requiring restoration identified via the inspection and evaluation programs vary each year due to the pole age and nature along with associated reject rates. Workload decreased to 5,277 units driven by reject rates offset by a pull forward of a portion of 2017 stub volume. Higher unit cost for 2017; restoration costs per pole range from $500 to $1,800 with the main driver for cost being the size of the pole. Costs rise as larger poles require more steel for restoration work. Additionally, costs are higher in urban areas and locations with difficult access and lower in rural areas.	WP 12-5 Line 4
5		Joint Pole Credits (MAT GA#)	$ 4,419	The number of poles that qualify for joint pole credit is based on the inspection and restoration work plan and varies each year dependent on the number of jointly owned poles in the work locations. Lower volume of jointly owned poles in Central Coast area led to a decrease in credits (shown as a positive number).	WP 12-5 Line 5
6		Joint Utilities Coordination (MAT GAB, GAE, GAF, GAH)	$ (146)	Higher reimbursable TELCO engineering reviews combined with lower NCJPA dues and IT Joint Pole database costs than the prior year.	WP 12-5 Line 7
7		**Net Change**	**$ 3,119**		
8	2017	**Recorded Adjusted**	**$ 12,272**		
9		Intrusive Inspection Program (MAT GAA)	$ (2,376)	Workload decreased to 138,730 poles in 2018 in order to focus on other work. The number of poles varies each year due to schedule and work priorities.	WP 12-5 Line 2
10		Pole Evaluations (MAT GAI)	$ (471)	Pole Evaluation is no longer performed because PG&E has implemented a series of process improvements that streamlined the intrusive inspection process and increased the data collected during the initial inspection. As a result, PG&E has eliminated the requirement of visiting the pole another time to collect the data.	WP 12-5 Line 3
11		Pole Restoration Program (MAT GAD)	$ (2,017)	Poles requiring restoration identified via the inspection and evaluation programs vary each year due to the pole age and nature along with associated reject rates. Workload decreased to 2,355 units to focus on other work. Higher unit cost for 2018; restoration costs per pole range from $500 to $1,800 with the main driver for cost being the size of the pole. Costs rise as larger poles require more steel for restoration work. Additionally, costs are higher in urban areas and locations with difficult access and lower in rural areas.	WP 12-5 Line 4
12		Joint Pole Credits (MAT GA#)	$ 3,192	The number of poles that qualify for joint pole credit is based on the inspection and restoration work plan and varies each year dependent on the number of jointly owned poles in the work locations. Lower volume of inspections performed in 2018 led to a decrease in credits (shown as a positive number).	WP 12-5 Line 5
13		Joint Utilities Coordination (MAT GAB, GAE, GAF, GAH)	$ 100	Lower reimbursable TELCO engineering reviews combined with higher NCJPA dues and IT Joint Pole database costs than the prior year.	WP 12-5 Line 7
14		**Net Change**	**$ (1,573)**		
15	2018	**Recorded Adjusted**	**$ 10,699**		
16		Intrusive Inspection Program (MAT GAA)	$ 9,006	Workload increased to 221,491 poles in 2019 to maintain inspection program on an approximate 10-year cycle. The number of poles varies ea year due to schedule and work priorities.	WP 12-5 Line 2
17		Pole Evaluations (MAT GAI)	$ (21)	Pole Evaluation is no longer performed because PG&E has implemented a series of process improvements that streamlined the intrusive inspection process and increased the data collected during the initial inspection. As a result, PG&E has eliminated the requirement of visiting the pole another time to collect the data.	WP 12-5 Line 3
18		Pole Restoration Program (MAT GAD)	$ 926	Poles requiring restoration identified via the inspection and evaluation programs vary each year due to the pole age and nature along with associated reject rates. Workload increased to 5,336 units driven by reject rates and catching up from resource shifts in 2018. Lower unit cost for 2019; restoration costs per pole range from $500 to $1,800 with the main driver for cost being the size of the pole. Costs rise as larger poles require more steel for restoration work. Additionally, costs are higher in urban areas and locations with difficult access and lower in rural areas.	WP 12-5 Line 4
19		Pole Loading Program (MAT GAC)	$ 54	Pole Loading Program start-up costs.	WP 12-5 Line 5
20		Joint Pole Credits (MAT GA#)	$ (2,890)	The number of poles that qualify for joint pole credit is based on the inspection and restoration work plan and varies each year dependent on the number of jointly owned poles in the work locations. Higher volume of inspections performed in 2019 led to an increase in credits (shown as a negative number).	WP 12-5 Line 6
21		Joint Utilities Coordination (MAT GAB, GAE, GAF, GAH)	$ (82)	Higher reimbursable TELCO engineering reviews combined with lower NCJPA dues and IT Joint Pole database costs than the prior year.	WP 12-5 Line 7
22		**Net Change**	**$ 6,992**		
23	2019	**Recorded Adjusted**	**$ 17,692**		
24		Intrusive Inspection Program (MAT GAA)	$ (402)	Workload increased to 238,253 poles in 2020 to maintain inspection program on an approximate 10-year cycle. The number of poles varies ea year due to schedule and work priorities.	WP 12-5 Line 2
25		Pole Evaluations (MAT GAI)	$ -	Pole Evaluation is no longer performed because PG&E has implemented a series of process improvements that streamlined the intrusive inspection process and increased the data collected during the initial inspection. As a result, PG&E has eliminated the requirement of visiting the pole another time to collect the data.	WP 12-5 Line 3
26		Pole Restoration Program (MAT GAD)	$ 1,019	Poles requiring restoration identified via the inspection and evaluation programs vary each year due to the pole age and nature along with associated reject rates. Workload decreased to 4,402 units driven by reject rates. Higher unit cost for 2020; restoration costs per pole range from $500 to $1,800 with the main driver for cost being the size of the pole. Costs rise as larger poles require more steel for restoration work. Additionally, costs are higher in urban areas and locations with difficult access and lower in rural areas.	WP 12-5 Line 4
27		Pole Loading Program (MAT GAC)	$ 15,804	Pole Loading Program officially began in 2020, with the goal of performing updated calculations that take into account the current condition of the pole, as well as loading changes that have occurred over the years while in-service. Program analyzed 134,899 poles in 2020.	WP 12-5 Line 5
28		Joint Pole Credits (MAT GA#)	$ 660	The number of poles that qualify for joint pole credit is based on the inspection and restoration work plan and varies each year dependent on the number of jointly owned poles in the work locations. Lower volume of inspections performed on jointly owned poles in 2020 led to a decrease in credits (shown as a positive number).	WP 12-5 Line 6
29		Joint Utilities Coordination (MAT GAB, GAE, GAF, GAH)	$ 724	Lower reimbursable TELCO engineering reviews combined with higher NCJPA dues and IT Joint Pole database costs than the prior year.	WP 12-5 Line 7
30		**Net Change**	**$ 17,805**		
31	2020	**Recorded Adjusted**	**$ 35,496**		

Workpaper Table 12-4
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12, Pole Asset Management
Major Work Category GA – Forecast Walk
MWC GA - Intrusive Inspection/Test and Treat
(Thousands of Nominal Dollars)

Line No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$ 35,496**			
2		Intrusive Inspection Program (MAT GAA)	$ 3,780		Forecast includes 275,000 poles for 2021. Volume is above a typical year in order to maintain inspection program on an approximate 10-year cycle. The number of poles will cary each year due to schedule and work priorities. Unit costs vary depending on the divisions being worked. Typically costs are higher in urban areas and locations with difficult access and lower in rural areas.	WP 12-5 Line 2
3		Pole Restoration Program (MAT GAD)	$ (1,325)		Poles requiring restoration identified via the inspection and evaluation programs vary each year due to the pole age and nature along with associated reject rates. Forecast includes 4,200 units, which is typical compared to prior years. The forecasted unit cost is based on an analysis of recorded contractor costs and program overhead.	WP 12-5 Line 4
4		Joint Pole Credits (MAT GA#)	$ (668)		The number of poles that qualify for joint pole credit is based on the inspection and restoration work plan and varies each year dependent on the number of jointly owned poles in the work locations. Forecasted Joint Pole Credits assumes a recovery of 50% of the contract costs from the joint owner with the estimated number of jointly owned poles to be 50%.	WP 12-5 Line 5
5		Pole Loading Program (MAT GAC)	$ 9,564		Pole Loading Program requires high resolution LiDAR imagery for encorporation into the pole models. LiDAR data acquisition and analysis was previously funded in MWC BF. Starting in 2021, LiDAR data acquisition and analysis is part of the pole loading program and represents roughly $10 million in the annual forecast. Forcast includes evaluation of 160,000 poles in 2021.	WP 12-5 Line 6
6		Joint Utilities Coordination (MAT GAB, GAE, GAF, GAH)	$ (331)		Forecasted costs are based on historical average costs for unreimbursed Telco engineering reviews, NCJPA dues, and IT Joint Pole database upgrade costs.	WP 12-5 Line 7
7		**Net Change**	**$ 11,020**			
8	**2021**	**Forecast**	**46,516**			
9		Intrusive Inspection Program (MAT GAA)	$ 31		Forecast includes 295,000 poles for 2022. Volume is above a typical year in order to maintain inspection program on an approximate 10-year cycle. The number of poles will cary each year due to schedule and work priorities. Unit costs vary depending on the divisions being worked. Typically costs are higher in urban areas and locations with difficult access and lower in rural areas.	WP 12-5 Line 2
10		Pole Restoration Program (MAT GAD)	$ 5		Poles requiring restoration identified via the inspection and evaluation programs vary each year due to the pole age and nature along with associated reject rates. Forecast includes 4,200 units, which is typical compared to prior years. The forecasted unit cost is based on an analysis of recorded contractor costs and program overhead.	WP 12-5 Line 4
11		Joint Pole Credits (MAT GA#)	$ (6)		The number of poles that qualify for joint pole credit is based on the inspection and restoration work plan and varies each year dependent on the number of jointly owned poles in the work locations. Forecasted Joint Pole Credits assumes a recovery of 50% of the contract costs from the joint owner with the estimated number of jointly owned poles to be 50%.	WP 12-5 Line 5
12		Pole Loading Program (MAT GAC)	$ (5,798)		Forecast includes evaluation of 200,000 poles in 2022. LiDAR data acquisition and analysis is also included in the forecasted dollars.	WP 12-5 Line 6
13		Joint Utilities Coordination (MAT GAB, GAE, GAF, GAH)	$ 1		Forecasted costs are based on historical average costs for unreimbursed Telco engineering reviews, NCJPA dues, and IT Joint Pole database upgrade costs.	WP 12-5 Line 7
14		**Net Change**	**(5,768)**			
15	**2022**	**Forecast**	**40,749**			
16		Intrusive Inspection Program (MAT GAA)	$ (1,948)		Forecast includes 260,000 poles for 2023. Volume is above a typical year in order to maintain inspection program on an approximate 10-year cycle. The number of poles will cary each year due to schedule and work priorities. Unit costs vary depending on the divisions being worked. Typically costs are higher in urban areas and locations with difficult access and lower in rural areas.	WP 12-5 Line 2
17		Pole Restoration Program (MAT GAD)	$ 461		Poles requiring restoration identified via the inspection and evaluation programs vary each year due to the pole age and nature along with associated reject rates. Forecast includes 4,500 units, which is typical compared to prior years. The forecasted unit cost is based on an analysis of recorded contractor costs and program overhead.	WP 12-5 Line 4
18		Joint Pole Credits (MAT GA#)	$ (628)		The number of poles that qualify for joint pole credit is based on the inspection and restoration work plan and varies each year dependent on the number of jointly owned poles in the work locations. Forecasted Joint Pole Credits assumes a recovery of 50% of the contract costs from the joint owner with the estimated number of jointly owned poles to be 50%.	WP 12-5 Line 5
19		Pole Loading Program (MAT GAC)	$ 614		Forecast includes evaluation of 200,000 poles in 2023. LiDAR data acquisition and analysis is also included in the forecasted dollars.	WP 12-5 Line 6
20		Joint Utilities Coordination (MAT GAB, GAE, GAF, GAH)	$ 92		Forecasted costs are based on historical average costs for unreimbursed Telco engineering reviews, NCJPA dues, and IT Joint Pole database upgrade costs.	WP 12-5 Line 7
21		**Net Change**	**(1,409)**			
22	**2023**	**Forecast**	**39,340**			

Workpaper Table 12-5
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12, Pole Asset Management
Expense Summary by Activity
(Thousands of Dollars)

Line No.		MAT	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	Assumptions	Reference
2	Intrusive Inspection Program	GAA	$ 11,503	$ 11,218	$ 8,842	$ 17,849	$ 17,447	$ 21,227	$ 21,258	$ 19,310		WP 12-6 Line 4
3	Pole Evaluations	GAI	$ 781	$ 493	$ 21	$ -	$ -	$ -	$ -	$ -		WP 12-6 Line 10
4	Pole Restoration Program	GAD	$ 5,436	$ 4,856	$ 2,839	$ 3,764	$ 4,783	$ 3,458	$ 3,463	$ 3,924		WP 12-6 Line 14
5	Joint Pole Credits	GA#	$ (8,791)	$ (4,372)	$ (1,180)	$ (4,070)	$ (3,410)	$ (4,078)	$ (4,084)	$ (4,712)		WP 12-6 Line 5, 15
6	Pole Loading Program	GAC	$ -	$ -	$ -	$ 54	$ 15,857	$ 25,421	$ 19,623	$ 20,237		WP 12-6 Line 22, WP 12-24
7	Joint Utilities Coordination	GAB, GAE, GAF, GAH	$ 224	$ 77	$ 177	$ 95	$ 819	$ 488	$ 489	$ 581		WP 12-6 Line 28
8	**Subtotal - MWC GA**		**$ 9,153**	**$ 12,272**	**$ 10,699**	**$ 17,692**	**$ 35,496**	**$ 46,516**	**$ 40,749**	**$ 39,340**		
9	Wind Loading Analysis	AB#	$ -	$ -	$ -	$ 228	$ 61	$ 21	$ -	$ -		WP 12-28
10	FHPMA HFTD Poles Forecast	IG#	$ -	$ -	$ 1,374	$ -	$ 0	$ -	$ -	$ -	(1)	
11	**Total Expense**		**$ 9,153**	**$ 12,272**	**$ 12,073**	**$ 17,920**	**$ 35,557**	**$ 46,537**	**$ 40,749**	**$ 39,340**		

Forecast Assumptions and Details
(1) These were one-time costs associated with pole restoration activities in HFTD fire areas. This works aligns with the work recorded in MAT GAD.

Workpaper Table 12-6
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12, Pole Asset Management
MWC GA Forecast Details
(Nominal Dollars)

Line No.	MAT Code		2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	Assumptions	Reference
1		**Intrusive Inspection Program**										
2	GAA	Units	282,835	244,479	138,730	221,491	238,253	275,000	295,000	259,833		WP 12-7
3		Gross Unit Cost	$ 40.67	$ 45.89	$ 63.74	$ 80.58	$ 73.23	$ 77.19	$ 72.06	$ 74.32		WP 12-7
4		**Subtotal**	$11,502,926	$11,218,034	$8,842,355	$17,848,706	$17,446,665	$21,227,066	$21,258,006	$19,309,868		WP 12-7
5	GA#	Less Joint Pole Credits	$ (6,680,833)	$ (3,322,634)	$ (896,776)	$ (3,093,362)	$ (2,932,768)	$ (3,187,987)	$ (3,192,634)	$ (3,683,742)	(1), (6)	
6		**Total Intrusive Inspection Program**	**$ 4,822,093**	**$ 7,895,400**	**$ 7,945,578**	**$ 14,755,344**	**$ 14,513,897**	**$ 18,039,079**	**$ 18,065,372**	**$ 15,626,126**		Line 4 + Line 5
7		**Pole Evaluations**										
8	GAI	Units	7,603	3,446	128	-	-	-	-	-	(2)	
9		Gross Unit Cost	$ 102.66	$ 142.99	$ 167.17	$ -	$ -	$ -	$ -	$ -	(2)	
10		**Total Pole Evaluations**	**$ 780,519**	**$ 492,740**	**$ 21,398**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**		Round(Line 8 * Line 9)
11		**Pole Restoration Program**										
12	GAD	Units	6,054	5,277	3,573	5,336	4,402	4,200	4,200	4,500		WP 12-9
13		Gross Unit Cost	$ 897.94	$ 920.16	$ 794.47	$ 705.46	$ 1,086.66	$ 823.34	$ 824.53	$ 872.04		WP 12-9
14		**Subtotal**	$5,436,124	$4,855,700	$2,838,632	$3,764,324	$4,783,468	$3,458,006	$3,463,046	$3,924,191		WP 12-9
15	GA#	Less Joint Pole Credits	$ (2,109,737)	$ (1,049,253)	$ (283,193)	$ (976,851)	$ (477,427)	$ (890,090)	$ (891,387)	$ (1,028,505)	(1), (6)	
16		**Total Pole Restoration Program**	**$ 3,326,387**	**$ 3,806,448**	**$ 2,555,440**	**$ 2,787,473**	**$ 4,306,041**	**$ 2,567,916**	**$ 2,571,659**	**$ 2,895,686**		Line 14 + Line 15
17		**Pole Loading Program**										
18	GAC	LiDAR Program	$ -	$ -	$ -	$ -	$ 2,205,791	$ 4,500,000	$ 10,500,000	$ 10,000,000	(3), (6)	WP 12-8
19		Poles Analyzed	$0	$0	$0	$53,758	$13,651,558	$20,921,239	$9,122,830	$10,237,025		WP 12-8
20		Units	-	-	-	-	134,899	160,000	200,000	200,000		WP 12-8
21		Gross Unit Cost	$ -	$ -	$ -	$ -	$ 101.20	$ 130.76	$ 45.61	$ 51.19		WP 12-8
22		**Total Pole Loading**				**$ 53,758**	**$ 15,857,349**	**$ 25,421,239**	**$ 19,622,830**	**$ 20,237,025**		Line 18 + Line 19
23		**Joint Utilities Coordination**									(4)	
24	GAB	Pole Joint Util Maint Reimb	-$151,340	-$232,486	-$171,174	-$230,253	$471,413	$0	$0	$0		
25	GAE	Pole Review Engineer Non-Reim	$0	$0	$804	-$455	$18,440	$0	$0	$0	(5)	
26	GAF	Telco Engr Revw Non-Reimbursed	$150,382	$92,877	$13,110	$22,876	-$195	$131,991	$132,183	$156,919		
27	GAH	Pole Joint Util Maint Non-Reim	$224,530	$217,026	$334,283	$302,813	$329,277	$356,000	$356,519	$424,261		
28		**Total Joint Utilities Coordination**	**$ 223,572**	**$ 77,417**	**$ 177,022**	**$ 94,981**	**$ 818,935**	**$ 487,991**	**$ 488,702**	**$ 581,180**		Lines 24-27
29		**Total MWC GA**	**$ 9,152,570**	**$ 12,272,004**	**$ 10,699,439**	**$ 17,691,556**	**$ 35,496,222**	**$ 46,516,225**	**$ 40,748,563**	**$ 39,340,017**		

Forecast Assumptions and Details

(1) Joint Pole Credits are based on recovering 50% of the contract costs from the joint owner. The estimated number of jointly owned poles is 50% of all poles in the PG&E system. The actual number varies within each area. The forecast joint pole credits are based on an estimate of the jointly owned poles in the given area of the planned work and the inspection activities that will occur on the poles.

(2) Pole Evaluation is no longer performed because PG&E has implemented a series of process improvements that streamlined the intrusive inspection process and increased the data collected during the initial inspection. As a result, PG&E has eliminated the requirement of visiting the pole another time to collect the data.

(3) Forecast costs for LiDAR is based on the anticipated costs for both data acquisition and analysis for the forecast system circuit-miles that are anticipated to be surveyed annually. PG&E is prioritizing capture of the High Fire Threat District (HFTD) Tier 2 and 3 areas. This high resolution imagery is the input for the poles analyzed in the pole loading program.

(4) Forecast costs are based on the average costs recorded for the previous three years, plus forecast increased operating costs. Increases include forecasts by the Northern California Joint Pole Association (NCJPA), IT costs for integrating key information and functionality of the joint pole systems into SAP, and developing system control mechanisms to improve timely billing and notification of work completed to other joint owners.

(5) MAT GAE was used for both Transmission and Distribution Engineering Reviews in the past. The costs reflected in this row are effectively for MAT GAB engineering reviews.

(6) 2020 recorded values vary from the values listed in the Results of Operations (RO) Model due to errata. These amounts do not align to the RO Model provided to the Public Advocates Office at the time of filing. The RO will be updated to incorporate these errata with the Joint Comparison Exhibit submittal.

Workpaper Table 12-7
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12 - Pole Asset Management
Unit Cost and Forecast Details: MAT GAA

Line No.

1	**MAT Code**	GAA
2	**GRC Ch.**	12 - Pole Asset Management
3	**MAT Code Definition**	Intrusive Inspection Program - Intrusive testing and treatment of wood poles. Compliance inspection program for GO 95 and GO 165. Units measured: Number of inspections. This program relates to safety, reliability, or maintenance because the costs are incurred to determine that poles are in good condition and prevents premature failure. In addition, this program satisfies the safety and maintenance requirements of the GOs.

	Risk ID	Type	Name
4	WLDFR-C12A	Control	Pole Programs - Intrusive Testing
5	DOVHD-C011	Control	Pole Programs

6	**Program Area**	Maintenance and Compliance
7	**Forecast Method**	Unit cost
8	**Unit of Measure**	#Poles Tested & Treated
9	**Unit Cost (2023)**	$ 74
10	**Unit Cost Forecast Basis**	Negotiated contract costs.
11	**Unit Forecast Basis**	Inspecting roughly 10% of PG&E's in-service pole population.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
12	**Recorded Costs**	$ 11,502,926	$ 11,218,034	$ 8,842,355	$ 17,848,706	$ 17,446,665	Calculated - Line 13 * Line 14
13	**No. of Units**	282,835	244,479	138,730	221,491	238,253	
14	**Unit Cost**	$ 41	$ 46	$ 64	$ 81	$ 73	

		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
15	**Forecast Costs**	$ 21,227,066	$ 21,258,006	$ 19,309,868	Calculated - Line 16 * Line 17
16	**No. of Units**	275,000	295,000	259,833	
17	**Unit Cost**	$ 77	$ 72	$ 74	

Notes

18 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 12-8
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12 - Pole Asset Management
Unit Cost and Forecast Details: MAT GAC

Line No.

1	**MAT Code**	GAC
2	**GRC Ch.**	12 - Pole Asset Management
3	**MAT Code Definition**	Pole Loading Program – Engineer review and analysis of distribution wood pole loading for an overload condition. If the pole is determined to not be overloaded, then assessment and analysis remains in MAT GAC. However, if the pole is determined to be overloaded, then the MAT changes to 07O to replace the pole. Units Measured: Number of poles. This program relates to safety, reliability, or maintenance because it actively works to determine that poles are in good condition and prevents premature failure. In addition, this program satisfies the safety requirements by ensuring poles meet the strength and loading requirements of GO 95.

	Risk ID	Type	Name
4	WLDFR-C12E	Control	Pole Reinforcements
5	WLDFR-C12B	Control	Pole Analyze Loading

6	**Program Area**	Maintenance and Compliance
7	**Forecast Method**	Unit cost
8	**Unit of Measure**	Poles Analyzed
9	**Unit Cost (2023)**	$ -
10	**Unit Cost Forecast Basis**	Program began as proof-of-concept in 2019 and officially started in 2020. A new vendor was chosen in 2021; 2021-2026 unit cost based on negotiated contract costs.
11	**Unit Forecast Basis**	Estimated number of desktop reviews using new technology enhancements.

	Poles Analyzed	**Recorded Costs & Units (A)**					**Reference**
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
12	**Recorded Costs**	$ -	$ -	$ -	$ 53,758	$ 13,651,558	Calculated - Line 13 * Line 14
13	**No. of Units**	-	-	-	-	134,899	
14	**Unit Cost**	$ -	$ -	$ -	$ -	$ 101	

	LiDAR Program	**Recorded Costs & Units (A)**				
	Year	**2016**	**2017**	**2018**	**2019**	**2020**
15	**Recorded Costs**	$ -	$ -	$ -	$ -	$ 2,205,791

	Poles Analyzed	**Forecast Costs & Units (Escalated) (A)**			
	Year	**2021**	**2022**	**2023**	
16	**Forecast Costs**	$ 20,921,239	$ 9,122,830	$ 10,237,025	Calculated - Line 17 * Line 18
17	**Units (Poles)**	160,000	200,000	200,000	
18	**Unit Cost**	$ 131	$ 46	$ 51	

	LiDAR Program	**Forecast Costs & Units (Escalated) (A)**		
	Year	**2021**	**2022**	**2023**
19	**Forecast Costs**	4,500,000	$ 10,500,000	$ 10,000,000

	Total	**Recorded Costs & Units (A)**					
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
21	**Recorded Costs**	$ -	$ -	$ -	$ 53,758	$ 15,857,349	Calculated - Line 12 + Line 15

	Total	**Forecast Costs & Units (Escalated) (A)**			
	Year	**2021**	**2022**	**2023**	
23	**Forecast Costs**	$ 25,421,239	$ 19,622,830	$ 20,237,025	Calculated - Line 16 + Line 20

	Notes	
24	**(A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 12-9
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12 - Pole Asset Management
Unit Cost and Forecast Details: MAT GAD

Line No.		
1	**MAT Code**	GAD
2	**GRC Ch.**	12 - Pole Asset Management
3	**MAT Code Definition**	Pole Restoration Program – Reinforce deteriorated, decayed or damaged poles with steel trusses. Program typically follows one year behind Pole Test and Treat program and restores poles to original design strength. Units measured: Number of reinforcements. This program relates to safety, reliability, or maintenance because the costs are incurred to determine that poles are in good condition and prevent premature failure. In addition, this program satisfies the safety and maintenance requirements of the GOs 95 and 165.

	Risk ID	Type	Name
4	DOVHD-C011	Control	Pole Programs
	WLDFR-C12B	Control	Pole Analyze Loading

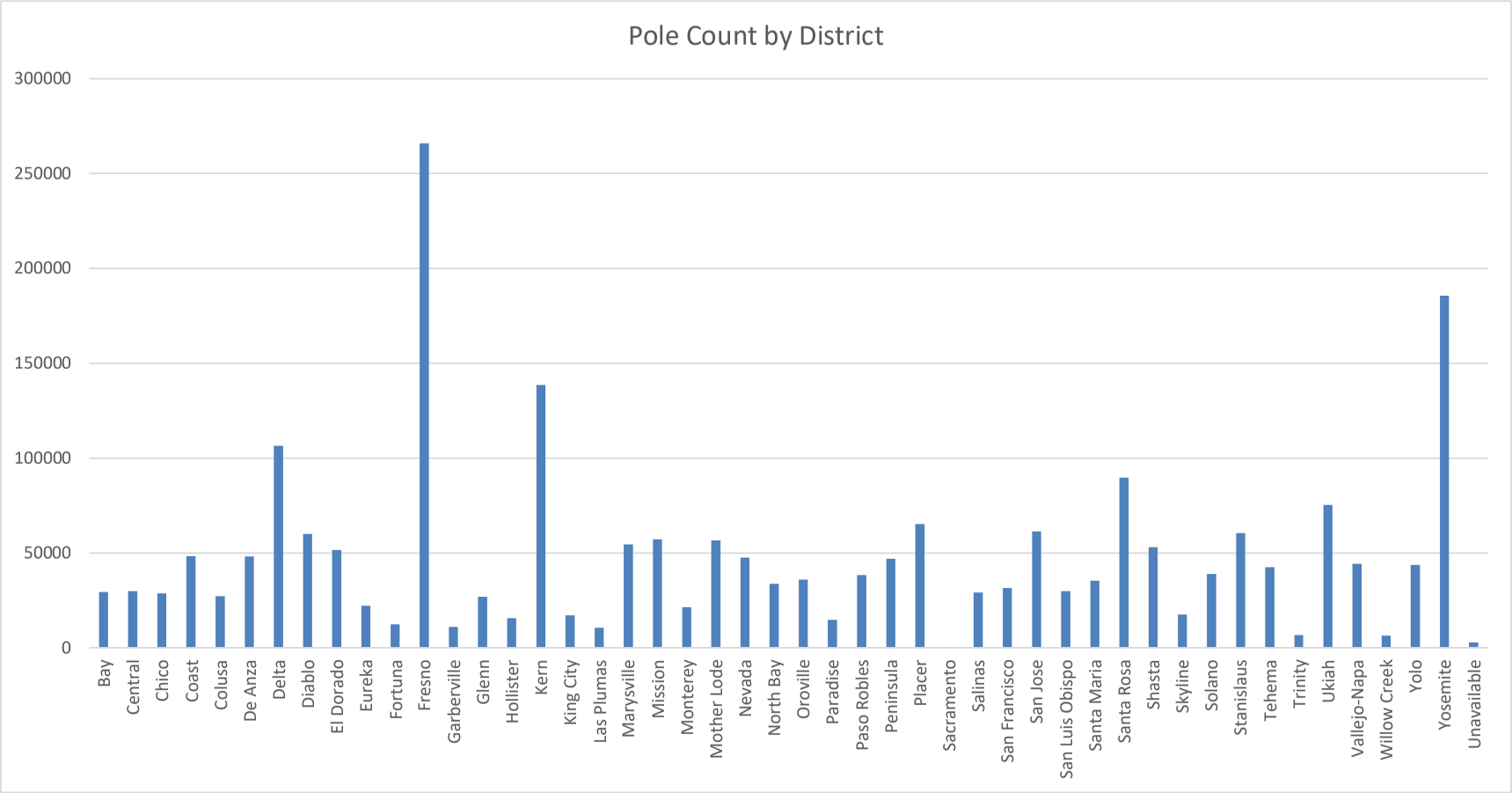
5	**Program Area**	Maintenance and Compliance
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	Poles Reinforced
8	**Unit Cost (2023)**	$ 872
9	**Unit Cost Forecast Basis**	Negotiated contract costs.
10	**Unit Forecast Basis**	2018-20 historic recorded average.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 5,436,124	$ 4,855,700	$ 2,838,632	$ 3,764,324	$ 4,783,468	Calculated - Line 12 * Line 13
12	**No. of Units**	6,054	5,277	3,573	5,336	4,402	
13	**Unit Cost**	$ 898	$ 920	$ 794	$ 705	$ 1,087	

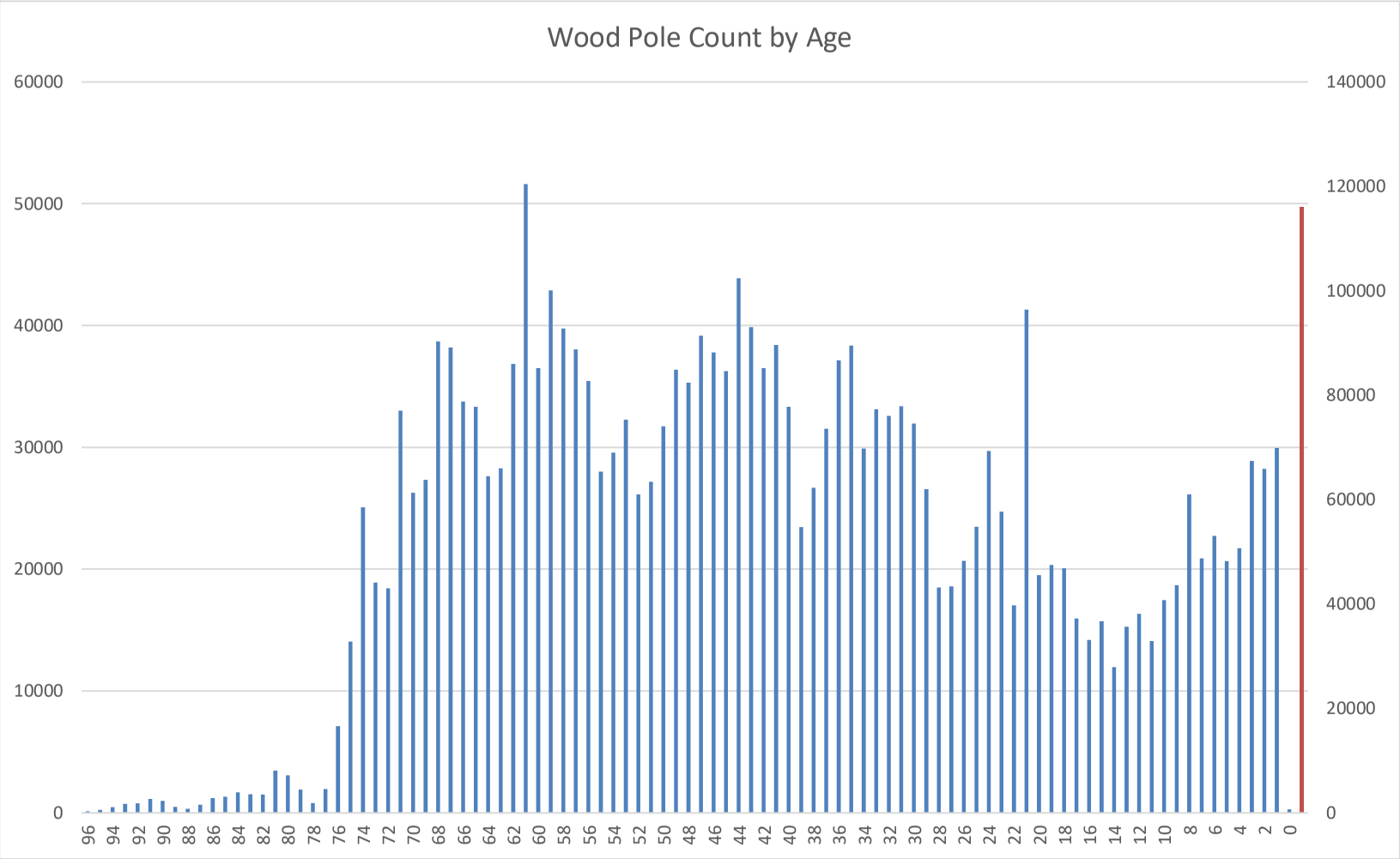
		Forecast Costs & Units (Escalated) (A)			
	Year	**2021**	**2022**	**2023**	
14	**Forecast Costs**	$ 3,458,006	$ 3,463,046	$ 3,924,191	Calculated - Line 15 * Line 16
15	**No. of Units**	4,200	4,200	4,500	
16	**Unit Cost**	$ 823	$ 825	$ 872	

	Notes	
17	**(A)**	Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 12-10
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12, Pole Asset Management
Wood Poles by District

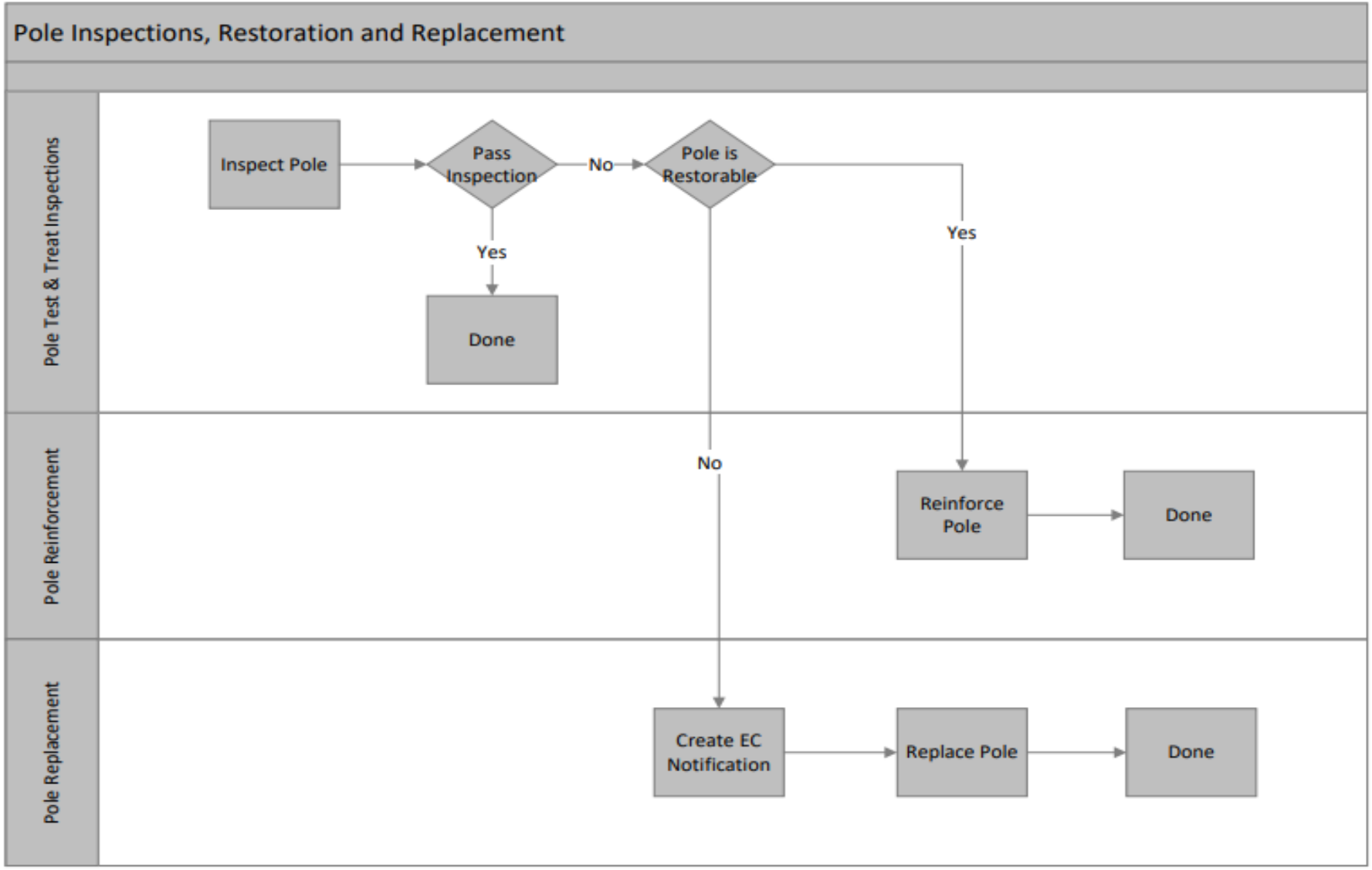


Workpaper Table 12-11
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12, Pole Asset Management
Wood Pole Count by Age



Notes
(1) Data source: Pole Test and Treat Program inspections and additional updates by PG&E mapping.
(2) Pole inventory data is updated when the Pole Test and Treat Program visits particular areas of the PG&E's service territory as part of the 10 year inspection cycle. ED-GIS project and Mapping also update pole inventory data.

Workpaper Table 12-12
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12, Pole Asset Management
Pole Asset Management Work Process Flow



Notes
(1) "EC Notification" stands for Electric Corrective Notification.

Workpaper Table 12-13
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 12
Pole Asset Management
Capital Expenditures by Major Work Category
(Thousands of Nominal Dollars)

			Capital Expenditures												
No.	**MWC**	**MWC Description**	**2016 Recorded Adjusted**	**2017 Recorded Adjusted**	**2018 Recorded Adjusted**	**2019 Recorded Adjusted**	**2020 Recorded Adjusted**	**2021 Forecast**	**2022 Forecast**	**2023 Forecast**	**2024 Forecast**	**2025 Forecast**	**2026 Forecast**	**Note**	**Reference**
1	7	E Dist Inst/Repl OH Poles	81,234	99,641	227,872	361,266	246,582	311,884	366,453	379,514	400,215	400,989	402,489		WP 12-17, WP 12-18
2	21	Misc Capital	-	-	-	3,644	2,656	-	-	-	-	-	-		WP 12-19
3	2A	E Dist Inst/Repl OH General	-	-	-	-	-	-	17,104	300	-	-	-	(1)	
4		**Grand Total**	**81,234**	**99,641**	**227,872**	**364,910**	**249,238**	**311,884**	**383,558**	**379,814**	**400,215**	**400,989**	**402,489**		
5	2A	Errata Adjustment*							(17,104)	(300)				(1)	
6		**Grand Total**	**81,234**	**99,641**	**227,872**	**364,910**	**249,238**	**311,884**	**366,453**	**379,514**	**400,215**	**400,989**	**402,489**		

(1) Line 6, 2022-2023 Forecast values vary from the values listed in the Results of Operations (RO) Model due to errata. These amounts do not align to the RO Model provided to the Public Advocates Office at the time of filing. The RO will be updated to incorporate these errata with the Joint Comparison Exhibit submittal.

Workpaper Table 12-14
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 12
Pole Asset Management
Forecast Capital Expenditures Summary
(Thousands of Nominal Dollars)

		Capital Expenditures							
		2020	2021	2022	2023	2024	2025	2026	
Line No.	Description	CWIP	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Reference
1	Projects > $3 Million*	16	322,208	383,258	379,514	400,215	400,989	402,489	WP 12-15
2	Other Work	127	(10,324)	300	300	-	-	-	WP 12-16
3	**Total**	**143**	**311,884**	**383,558**	**379,814**	**400,215**	**400,989**	**402,489**	

4 * Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.

Workpaper Table 12-15
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 12
Pole Asset Management
Recorded CWIP and Forecast Capital Expenditures Details - Projects Over $3 Million*
(Thousands of Nominal Dollars)

					CWIP	Capital Expenditures							
Line No.	Planning Order	Description	MWC	Operative Date	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Subtotal	Reference
	MWC - 07	**E Dist Inst/Repl OH Poles**											
1	5500766	Pole Replacement - EB	7		-	3,726	-	-	-	-	-	3,726	
2	5500769	Pole Replacement - LP	7		-	10,673	-	-	-	-	-	10,673	
3	5500770	Pole Replacement - MI	7		-	4,098	-	-	-	-	-	4,098	
4	5500773	Pole Replacement - SO	7		6	3,507	-	-	-	-	-	3,513	
5	5500782	Pole Replacement - SI	7		8	3,419	-	-	-	-	-	3,427	
6	5500783	Pole Replacement - ST	7		-	3,638	-	-	-	-	-	3,638	
7	5500784	Pole Replacement - YO	7		1	6,904	-	-	-	-	-	6,904	
8	5534458	WSIP D - 07D - CC	7		0	21,106	-	-	-	-	-	21,106	
9	5534462	WSIP D - 07D - FR	7		-	4,361	-	-	-	-	-	4,361	
10	5534463	WSIP D - 07D - HB	7		-	7,693	-	-	-	-	-	7,693	
11	5534465	WSIP D - 07D - LP	7		-	31,209	-	-	-	-	-	31,209	
12	5534467	WSIP D - 07D - NB	7		-	12,054	-	-	-	-	-	12,054	
13	5534468	WSIP D - 07D - NV	7		0	11,813	-	-	-	-	-	11,813	
14	5534471	WSIP D - 07D - SI	7		1	44,206	-	-	-	-	-	44,208	
15	5534473	WSIP D - 07D - SO	7		0	9,600	-	-	-	-	-	9,600	
16	5534474	WSIP D - 07D - ST	7		-	21,983	-	-	-	-	-	21,983	
17	5534475	WSIP D - 07D - YO	7		-	70,114	-	-	-	-	-	70,114	
18	5542879	Pole Replacement - GO	7		-	52,104	-	-	-	-	-	52,104	
19	5543439	SYSPLAN ED 07O WLDFR-M12D DOVHD-C011	7		-	-	7,852	7,837	8,600	9,391	10,210	43,890	
20	5544389	SYSPLAN ED 07C WLDFR-M013	7		-	-	3,303	3,296	3,500	3,709	3,924	17,732	
21	5544390	SYSPLAN ED 07D WLDFR-C12C DOVHD-C011	7		-	-	127,907	132,617	139,721	139,640	139,808	679,694	
22	5544480	SYSPLAN FRMMA 07D WLDFR-C12C	7		-	-	227,391	-	-	-	-	227,391	
23	5545543	SYSPLAN 07D DOVHD-C011	7		-	-	-	235,764	248,394	248,249	248,547	980,953	
24	**Total**				**16**	**322,208**	**366,453**	**379,514**	**400,215**	**400,989**	**402,489**	**2,271,885**	WP 12-19
	MWC - 2A	**E Dist Inst/Repl OH General**											
25	5545559	SYSPLAN Surge Arrestor WLDFR-M003	2A		-	-	16,804	-	-	-	-	16,804	
26	**Total**				**-**	**-**	**16,804**	**-**	**-**	**-**	**-**	**16,804**	
27		**Grand Total**			**16**	**322,208**	**383,258**	**379,514**	**400,215**	**400,989**	**402,489**	**2,288,690**	

28 * Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.

Workpaper Table 12-16
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 12
Pole Asset Management
Recorded and Forecast Capital Expenditures Details - Other Work*
(Thousands of Nominal Dollars)

			Capital Expenditures											
Line No.	MWC	MWC Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference
1	7	E Dist Inst/Repl OH Poles	35,763	65,589	168,759	151,602	64,795	(10,324)	-	-	-	-	-	WP 12-19
2	21	Misc Capital	-	-	-	3,644	2,656	-	-	-	-	-	-	
3	2A	E Dist Inst/Repl OH General	-	-	-	-	-	-	300	300	-	-	-	
4	**Grand Total**		**35,763**	**65,589**	**168,759**	**155,246**	**67,451**	**(10,324)**	**300**	**300**	**-**	**-**	**-**	

5 * Excludes projects greater than $3M

Workpaper Table 12-17
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12, Pole Asset Management
Major Work Category 07 – Recorded Walk
MWC 07 - Pole Replacement
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$ 81,234**			
2		Pole Replacement Program (MAT 07C, 07D, 07G, 07O, 07#)	$ 18,407		Slight increase in number of poles worked from 6,035 to 6,389. Unit volume greatly impacted due to resources responding to higher priority work (major emergency and mutual aid). Unit costs vary depending on the divisions being worked. Typically costs are higher in urban areas and locations with difficult access and lower in rural areas.	WP 12-19 Line 8
3		**Net Change**	**$ 18,407**			
4	**2017**	**Recorded Adjusted**	**$ 99,641**			
5		Pole Replacement Program (MAT 07C, 07D, 07G, 07O, 07#)	$ 128,231		Large increase in number of poles worked from 6,389 to 12,590. Unit volume greatly impacted by 2017 carryover and higher volume of deteriorated units identified. In addition, CPUC Decision 17-12-024 (Fire Safety Rulemaking) designated poles in High Fire Threat District (HFTD) Tier 2 and 3 areas to be remediated within 12 or 6 months, respectively. This rulemaking accelerated the retirement of 4,748 poles that normally would have been planned for future years. Unit costs vary depending on the divisions being worked. Typically costs are higher in urban areas and locations with difficult access and lower in rural areas.	WP 12-19 Line 8
6		**Net Change**	**$ 128,231**			
7	**2018**	**Recorded Adjusted**	**$ 227,872**			
8		Pole Replacement Program (MAT 07C, 07D, 07G, 07O, 07#)	$ 133,394		Slight increase in number of poles worked from 12,590 to 12,702. Unit volume impacted by higher volume of deteriorated units identified. In addition, CPUC Decision 17-12-024 (Fire Safety Rulemaking) designated poles in High Fire Threat District (HFTD) Tier 2 and 3 areas to be remediated within 12 or 6 months, respectively. This rulemaking accelerated the retirement of 6,127 poles that normally would have been planned for future years. Unit costs vary depending on the divisions being worked. Typically costs are higher in urban areas and locations with difficult access and lower in rural areas.	WP 12-19 Line 8
9		**Net Change**	**$ 133,394**			
10	**2019**	**Recorded Adjusted**	**$ 361,266**			
11		Pole Replacement Program (MAT 07C, 07D, 07G, 07O, 07#)	$ (114,684)		Moderate decrease in number of poles worked from 12,702 to 9,895. Unit volume impacted due to resources responding to higher priority work (major emergency and system hardening). Unit costs vary depending on the divisions being worked. Typically costs are higher in urban areas and locations with difficult access and lower in rural areas.	WP 12-19 Line 8
12		**Net Change**	**$ (114,684)**			
13	**2020**	**Recorded Adjusted**	**$ 246,582**			

Workpaper Table 12-18
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12, Pole Asset Management
Major Work Category 07 – Forecast Walk
MWC 07 - Pole Replacement
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$ 246,582**			
2		Pole Replacement Program (MAT 07D, 07C, 07O)	$ 65,302		In 2019, PG&E performed the WSIP inspections, which identified a significant volume of poles for replacement, creating 101,410 new tags. In 2020, PG&E continued with the enhanced inspection programs and again identified a significant volume of poles for replacement, creating 34,467 new tags. In 2021, PG&E is continuing with the enhanced inspection program and anticipates another significant volume of pole replacements, forecasting creation of approximately 30,000 new tags. PG&E is ramping up pole replacements in response to the increased volume of new tags annually. PG&E's funding for pole replacements is constrained by the targets established in the Plan of Reorganization when PG&E emerged from bankruptcy on July 1, 2020. These targets were less than program managers requested in the planning process, but are significantly above PG&E's 2020 GRC forecast.	WP 12-19 Line 8
3		**Net Change**	**$ 65,302**			
4	**2021**	**Forecast**	**$ 311,884**			
5		Pole Replacement Program (MAT 07D, 07C, 07O)	$ 54,569		In 2022, PG&E will continue performing the enhanced inspection program and forecasts creation of approximately 27,500 new tags. PG&E is continuing to ramp up pole replacements in response to the increased volume of new tags annually.	WP 12-19 Line 8
6		**Net Change**	**$ 54,569**			
7	**2022**	**Forecast**	**$ 366,453**			
8		Pole Replacement Program (MAT 07D, 07C, 07O)	$ 13,061		In 2023, PG&E forecasts creation of approximately 25,000 new tags in response to the enhanced inspection program.	WP 12-19 Line 8
9		**Net Change**	**$ 13,061**			
10	**2023**	**Forecast**	**$ 379,514**			
11		Pole Replacement Program (MAT 07D, 07C, 07O)	$ 20,701		In 2024, PG&E forecasts creation of approximately 22,500 new tags in response to the enhanced inspection program.	WP 12-19 Line 8
12		**Net Change**	**$ 20,701**			
13	**2024**	**Forecast**	**$ 400,215**			
14		Pole Replacement Program (MAT 07D, 07C, 07O)	$ 774		In 2025, PG&E forecasts creation of approximately 20,000 new tags in response to the enhanced inspection program.	WP 12-19 Line 8
15		**Net Change**	**$ 774**			
16	**2025**	**Forecast**	**$ 400,989**			
17		Pole Replacement Program (MAT 07D, 07C, 07O)	$ 1,500		In 2026, PG&E forecasts creation of approximately 17,500 new tags in response to the enhanced inspection program.	WP 12-19 Line 8
18		**Net Change**	**$ 1,500**			
19	**2026**	**Forecast**	**$ 402,489**			

Workpaper Table 12-19
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12, Pole Asset Management
Capital Summary by Activity
(Thousands of Dollars)

Line No.	Costs		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026		
1		MAT	Recorded	Recorded	Recorded	Recorded	Recorded	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Assumptions	Reference
2	Pole Replacement Program	07D	$ 80,060	$ 98,333	$ 220,532	$ 347,046	$ 238,714	$ 301,007	$ 355,298	$ 368,381	$ 388,115	$ 387,889	$ 388,355		WP 12-22
3	Overloaded Poles	07O	$ 8	$ 173	$ 3,385	$ 4,554	$ 11,114	$ 10,877	$ 7,852	$ 7,837	$ 8,600	$ 9,391	$ 10,210		WP 12-23
4	Steel Lattice Structures	07L	$ -	$ 281	$ 58	$ 469	$ 121	$ -	$ -	$ -	$ -	$ -	$ -	(1)	
5	Centerbore Streetlights	07C	$ 316	$ 187	$ 181	$ 24	$ 87	$ -	$ -	$ -	$ -	$ -	$ -		WP 12-21
6	Tree Attachments	07C	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,303	$ 3,296	$ 3,500	$ 3,709	$ 3,924		WP 12-21, WP 12-26
7	Joint Pole/ Standard Cost Variance	07G, 07#	$ 850	$ 667	$ 3,716	$ 9,173	$ (3,455)	$ -	$ -	$ -	$ -	$ -	$ -	(2)	
8	**Subtotal - MWC 07**		**$ 81,234**	**$ 99,641**	**$ 227,872**	**$ 361,266**	**$ 246,582**	**$ 311,884**	**$ 366,453**	**$ 379,514**	**$ 400,215**	**$ 400,989**	**$ 402,489**		
9	Wind Loading Analysis	21A				$ 3,644	$ 2,656	$ -	$ -	$ -	$ -	$ -	$ -		WP 12-28
10	**Total Capital**		**$ 81,234**	**$ 99,641**	**$ 227,872**	**$ 364,910**	**$ 249,238**	**$ 311,884**	**$ 366,453**	**$ 379,514**	**$ 400,215**	**$ 400,989**	**$ 402,489**		

Forecast Assumptions and Details
(1) PG&E has roughly 560 distribution steel lattice structures in its territory. Work in this program is performed when structures are identified as requiring remediation. There is no forecast because no additional structures have been identified.
(2) Standard cost variance is not forecasted.

Workpaper Table 12-20
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 12, Pole Asset Management
MWC 07 - Pole Replacement Forecast Details
(Thousands of Nominal Dollars)

Recorded

Line No.	Division		2016 Units	2016 Unit Cost	2016 Dollars	2017 Units	2017 Unit Cost	2017 Dollars	2018 Units	2018 Unit Cost	2018 Dollars	2019 Units	2019 Unit Cost	2019 Dollars	2020 Units	2020 Unit Cost	2020 Dollars	
1	Central Coast	CC	196	$12,334	$2,418	103	$13,864	$1,428	1,349	$19,426	$26,205	761	$28,189	$21,452	258	$31,968	$8,248	
2	De Anza	DA	34	$19,621	$667	304	$24,032	$7,306	621	$26,028	$16,163	248	$42,248	$10,478	58	$42,545	$2,468	
3	Diablo	DI	299	$21,135	$6,319	410	$16,104	$6,603	408	$20,141	$8,218	427	$28,489	$12,165	164	$32,128	$5,269	
4	East Bay	EB	291	$24,460	$7,118	355	$19,486	$6,917	575	$20,152	$11,587	305	$25,246	$7,700	207	$35,920	$7,435	
5	Fresno	FR	236	$3,388	$800	208	$6,066	$1,262	107	$9,828	$1,052	541	$14,556	$7,875	193	$21,687	$4,186	
6	Humboldt	HB	567	$10,906	$6,184	382	$11,687	$4,464	534	$15,173	$8,103	520	$24,188	$12,578	287	$21,637	$6,210	
7	Kern	KE	52	$12,156	$632	62	$11,654	$723	129	$14,773	$1,906	212	$22,523	$4,775	94	$17,352	$1,631	
8	Los Padres	LP	219	$10,633	$2,329	212	$10,546	$2,236	391	$13,888	$5,430	807	$16,556	$13,360	448	$24,393	$10,928	
9	Mission	MI	182	$23,717	$4,317	386	$15,339	$5,921	429	$18,585	$7,973	113	$23,873	$2,698	134	$31,501	$4,221	
10	North Bay	NB	178	$15,660	$2,787	146	$17,858	$2,607	235	$24,221	$5,692	217	$28,546	$6,195	441	$25,253	$11,137	
11	North Valley	NV	270	$10,662	$2,879	248	$7,204	$1,787	273	$13,076	$3,570	1,109	$49,345	$54,723	1,066	$10,835	$11,551	
12	Peninsula	PN	66	$20,297	$1,340	256	$26,635	$6,819	838	$27,548	$23,085	372	$34,740	$12,923	184	$34,893	$6,420	
13	Sacramento	SA	52	$9,988	$519	52	$14,853	$772	106	$16,255	$1,723	337	$97,373	$32,815	381	$19,582	$7,461	
14	San Francisco	SF	42	$30,502	$1,281	173	$33,561	$5,806	695	$26,755	$18,595	610	$29,670	$18,099	158	$32,758	$5,176	
15	San Jose	SJ	67	$33,931	$2,273	716	$20,852	$14,930	685	$25,020	$17,139	173	$49,488	$8,561	56	$31,856	$1,784	
16	Sierra	SI	405	$10,573	$4,282	942	$15,123	$14,246	2,463	$12,903	$31,779	2,580	$16,294	$42,038	1,751	$34,200	$59,884	
17	Sonoma	SO	102	$11,289	$1,152	140	$15,593	$2,183	1,135	$14,789	$16,785	997	$41,970	$41,844	454	$31,139	$14,137	
18	Stockton	ST	2,161	$12,803	$27,668	628	$8,409	$5,281	551	$10,921	$6,017	1,182	$14,642	$17,307	1,638	$22,271	$36,480	
19	Yosemite	YO	571	$8,925	$5,096	666	$10,575	$7,043	924	$10,293	$9,511	1,020	$19,080	$19,462	1,635	$20,849	$34,089	
20	Center Bore Street Lights		45	$7,016	$316	0	$0	$187	0	$0	$181	0	$0	$24	0	$0	$87	
22	Overloaded Pole Replacement				$8			173	141	$24,009	$3,385	170	$26,787	$4,554	288	$38,592	$11,114	(1)
23	Steel Lattice Structures							$281	1	$57,718	$58	1	$468,762	$469	0	$0	$121	(1)
24	**Total**		**6,035**	**$13,320**	**$80,383**	**6,389**	**$15,491**	**$98,974**	**12,590**	**$17,804**	**$224,156**	**12,702**	**$27,719**	**$352,092**	**9,895**	**$25,269**	**$250,036**	(2)

Forecast

	Division		2021 Units	2021 Unit Cost Targets	2021 Dollars	2022 Units	2022 Unit Cost Targets	2022 Dollars	2023 Units	2023 Unit Cost Targets	2023 Dollars	2024 Units	2024 Unit Cost Targets	2024 Dollars	2025 Units	2025 Unit Cost Targets	2025 Dollars	2026 Units	2026 Unit Cost Targets	2026 Dollars
25	Central Coast	CC	1,017	$21,809	$22,180	958	$23,680	$22,684	709	$25,264	$17,901	727	$25,947	$18,860	707	$26,647	$18,849	690	$27,367	$18,871
26	De Anza	DA	36	$21,918	$789	384	$32,800	$12,604	151	$34,630	$5,236	155	$35,567	$5,516	151	$36,526	$5,513	147	$37,512	$5,520
27	Diablo	DI	183	$21,917	$4,011	245	$21,020	$5,156	214	$22,533	$4,821	219	$23,142	$5,079	214	$23,766	$5,076	208	$24,408	$5,082
28	East Bay	EB	297	$21,769	$6,465	69	$22,309	$1,550	527	$23,856	$12,565	540	$24,501	$13,238	526	$25,162	$13,231	513	$25,842	$13,246
29	Fresno	FR	282	$21,916	$6,180	711	$15,356	$10,923	835	$16,715	$13,959	857	$17,167	$14,706	834	$17,630	$14,698	813	$18,106	$14,715
30	Humboldt	HB	90	$21,916	$1,972	496	$20,853	$10,343	992	$22,361	$22,185	1,018	$22,966	$23,373	990	$23,585	$23,359	966	$24,222	$23,387
31	Kern	KE	1,918	$21,837	$41,883	192	$17,334	$3,330	203	$18,747	$3,808	208	$19,254	$4,012	203	$19,773	$4,010	198	$20,307	$4,015
32	Los Padres	LP	256	$21,916	$5,611	433	$15,211	$6,591	490	$16,567	$8,119	503	$17,015	$8,554	489	$17,474	$8,549	477	$17,945	$8,559
33	Mission	MI	671	$21,917	$14,706	132	$20,878	$2,760	189	$22,386	$4,234	194	$22,992	$4,461	189	$23,612	$4,458	184	$24,249	$4,464
34	North Bay	NB	470	$27,886	$13,106	899	$28,675	$25,790	652	$30,394	$19,806	668	$31,216	$20,867	651	$32,059	$20,855	634	$32,924	$20,880
35	North Valley	NV	633	$21,847	$13,829	313	$28,035	$8,787	1,264	$29,737	$37,596	1,297	$30,541	$39,610	1,262	$31,365	$39,587	1,230	$32,212	$39,635
36	Peninsula	PN	186	$21,563	$4,011	473	$31,215	$14,760	217	$33,002	$7,167	223	$33,895	$7,551	217	$34,809	$7,546	211	$35,749	$7,555
37	Sacramento	SA	156	$21,916	$3,419	526	$26,845	$14,120	826	$28,514	$23,541	847	$29,286	$24,803	824	$30,076	$24,788	803	$30,888	$24,818
38	San Francisco	SF	33	$21,914	$723	106	$26,920	$2,861	303	$28,591	$8,675	311	$29,365	$9,140	303	$30,157	$9,134	295	$30,971	$9,145
39	San Jose	SJ	73	$21,917	$1,600	159	$31,512	$5,024	132	$33,308	$4,390	135	$34,209	$4,625	132	$35,132	$4,622	128	$36,080	$4,628
40	Sierra	SI	2,181	$21,837	$47,625	3,941	$26,131	$102,978	2,467	$27,781	$68,545	2,531	$28,533	$72,216	2,463	$29,302	$72,174	2,401	$30,093	$72,261
41	Sonoma	SO	1,078	$23,767	$25,621	1,355	$29,111	$39,431	765	$30,842	$23,595	785	$31,676	$24,859	764	$32,531	$24,845	745	$33,409	$24,874
42	Stockton	ST	3,539	$21,763	$77,018	2,327	$13,882	$32,311	2,261	$15,202	$34,373	2,319	$15,613	$36,214	2,257	$16,034	$36,193	2,201	$16,467	$36,237
43	Yosemite	YO	702	$14,611	$10,257	2,090	$15,927	$33,294	2,766	$17,302	$47,866	2,838	$17,770	$50,430	2,762	$18,249	$50,401	2,692	$18,742	$50,461
44	Overloaded Pole Replacement		384	$28,327	$10,877	269	$29,138	$7,852	262	$29,925	$7,837	280	$30,734	$8,600	298	$31,564	$9,391	315	$32,416	$10,210
45	Tree Attachments		0	$0	$0	278	$11,902	$3,303	270	$12,223	$3,296	279	$12,554	$3,500	288	$12,892	$3,709	296	$13,240	$3,924
46	**Total**		**14,185**	**$21,987**	**$311,884**	**16,360**	**$22,400**	**$366,453**	**16,495**	**$23,007**	**$379,514**	**16,935**	**$23,633**	**$400,215**	**16,522**	**$24,270**	**$400,989**	**16,148**	**$24,926**	**$402,489**

Forecast Assumptions and Details
(1) MATs offically were created in 2018. Prior years costs were based on program start-up. No units were completed until program initiation in 2018.
(2) Recorded costs in MAT 07G and MAT 07# are not included in this table.

Workpaper Table 12-21
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12 - Pole Asset Management
Unit Cost and Forecast Details: MAT 07C

Line No.

1	**MAT Code**	07C
2	**GRC Ch.**	12 - Pole Asset Management
3	**MAT Code Definition**	Special Criteria Pole Replacement – Replace all wooden center-bore poles in the system. Units measured: Number of poles. This program relates to safety, reliability, or maintenance because it actively works to determine whether poles are in good condition and prevents premature failure. In addition, this program enhances overall system safety by replacing poles identified to be nearing the end of their service life, prior to failure.

	Risk ID	Type	Name
4	WLDFR-M013	Mitigation	Pole Programs – Replace Tree Attachments

5	**Program Area**	Risk Reduction
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Poles Replaced
8	**Unit Cost (2023)**	$ 12,223
9	**Unit Cost Forecast Basis**	2018-20 system average.
10	**Unit Forecast Basis**	Center-bore streetlight replacement program completed in 2016; the only costs that were continued 2017-20 were one-off replacements. 2022 onward, this MAT will be used for tree attachments. Units based on 2023-26 workplan.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 315,724	$ 187,389	$ 180,905	$ 23,757	$ 87,434	Calculated - Line 12 * Line 13
12	**No. of Units**	45	-	-	-	-	
13	**Unit Cost**	$ 7,016	$ -	$ -	$ -	$ -	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ -	$ 3,302,843	$ 3,296,417	$ 3,499,935	$ 3,709,013	$ 3,923,933	Calculated - Line 15 * Line 16
15	**No. of Units**	-	278	270	279	288	296	
16	**Unit Cost**	$ -	$ 11,902	$ 12,223	$ 12,554	$ 12,892	$ 13,240	

Notes

17 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 12-22
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12 - Pole Asset Management
Unit Cost and Forecast Details: MAT 07D

Line No.

1	**MAT Code**	07D
2	**GRC Ch.**	12 - Pole Asset Management
3	**MAT Code Definition**	Pole Replacement – Replace poles identified as deteriorated/damaged and in need of replacement. Units measured: Number of poles. This program relates to safety, reliability, or maintenance because it actively works to determine whether poles are in good condition and prevents premature failure. In addition, this program enhances overall system safety by replacing poles identified to be nearing the end of their service life, prior to premature failure.

	Risk ID	Type	Name
4	WLDFR-C12C	Control	Pole Programs - Replace Damaged/Deteriorated Poles
5	DOVHD-C011	Control	Pole Programs

6	**Program Area**	Maintenance and Compliance
7	**Forecast Method**	Unit cost
8	**Unit of Measure**	# of Poles Replaced
9	**Unit Cost (2023)**	$ 23,076

10	**Unit Cost Forecast Basis**	2018-20 system average. 2019-20 unit costs were higher due to contractor costs, acceleration of work in High Fire Threat Districts, and unanticipated adders and overtime. 2021-2026 unit costs are lower due to minimization of adders.
11	**Unit Forecast Basis**	PG&E's detailed replacement plan.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
12	**Recorded Costs**	$ 80,059,643	$ 98,332,807	$ 220,531,732	$ 347,046,275	$ 238,713,708	Calculated - Line 13 * Line 14
13	**No. of Units**	6,009	6,444	12,166	12,498	9,607	
14	**Unit Cost**	$ 13,323	$ 15,260	$ 18,127	$ 27,768	$ 24,848	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
15	**Forecast Costs**	$ 301,006,662	$ 355,298,431	$ 368,381,249	$ 388,114,997	$ 387,888,926	$ 388,354,608	Calculated - Line 16 * Line 17
16	**No. of Units**	13,734	15,813	15,964	16,376	15,936	15,536	
17	**Unit Cost**	$ 21,917	$ 22,469	$ 23,076	$ 23,700	$ 24,340	$ 24,997	

Notes

18 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 12-23
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 12 - Pole Asset Management
Unit Cost and Forecast Details: MAT 07O

Line No.

1	**MAT Code**	07O
2	**GRC Ch.**	12 - Pole Asset Management
3	**MAT Code Definition**	Overloaded Pole Replacements – Replace poles identified as overloaded (additional load applied to the pole beyond what it is designed to hold) and in need of replacement. Units measured: Number of poles. This program relates to safety, reliability, or maintenance because it actively works to determine whether poles are in good condition and prevents premature failure. In addition, this program enhances overall system safety by replacing poles identified as overloaded, prior to premature failure. The program satisfies the safety requirements by ensuring poles meet the strength and loading requirements of GO 95.

	Risk ID	Type	Name
4	DOVHD-C011	Control	Pole Programs
5	WLDFR-C12D	Control	Pole Programs - Replace Overloaded Poles

6	**Program Area**	Maintenance and Compliance
7	**Forecast Method**	Unit cost
8	**Unit of Measure**	# of Poles Replaced
9	**Unit Cost (2023)**	$ 29,925

10	**Unit Cost Forecast Basis**	2018-20 system average.
11	**Unit Forecast Basis**	New MAT code starting in 2018, 2016/17 costs based on program start-up. Units based on 2023-26 workplan.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
12	**Recorded Costs**	$ 7,946	$ 173,096	$ 3,385,292	$ 4,553,724	$ 11,114,499	Calculated - Line 13 * Line 14
13	**No. of Units**	-	-	140	180	288	
14	**Unit Cost**	$ -	$ -	$ 24,181	$ 25,298	$ 38,592	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
15	**Forecast Costs**	$ 10,877,415	$ 7,852,041	$ 7,836,764	$ 8,600,269	$ 9,391,171	$ 10,210,234	Calculated - Line 16 * Line 17
16	**No. of Units**	383	269	262	280	298	315	
17	**Unit Cost**	$ 28,401	$ 29,138	$ 29,925	$ 30,734	$ 31,564	$ 32,416	

18 **Notes**
(A) Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 12, POLE ASSET MANAGEMENT
Project Summary – Pole Loading Program

Project Title: Pole Loading Program
Major Work Categories: GA (Expense)
Planning Order Numbers: 5058333 (Expense)
Project Start Date: 2020
Project Completion Date: 2030

Project Description

PG&E's overall goal for the pole loading program is to perform updated calculations that take into account the current condition of the pole and loading changes that have occurred over the years while in-service. The program is meant to proactively identify if poles have loading deficiencies and correct any issues prior to equipment failure or non-conformance with GO 95.

In 2019, PG&E initiated a proof of concept of performing pole loading calculations via desktop reviews. PG&E's desktop review process utilizes baseline pole loading calculation models that were created using: (1) information captured in the Electric Distribution Geographic Information System (EDGIS), (2) a series of algorithms, (3) the latest intrusive inspection results, and (4) conservative assumptions used to fill in the data gaps. PG&E worked with vendors to compare these baseline calculations to third-party imagery (e.g. Google street view/earth, field collected photographs) to either confirm or update the model.

The proof of concept was successful and is the foundation of PG&E's pole loading program. PG&E has established a 10-year program to analyze all 2.3 million distribution poles. The expanded program commenced in 2020 and is concentrating on poles in High Fire Threat District (HFTD) Tier 2 and 3 areas through 2024. The non-HFTD areas will follow, and PG&E's current estimate is that the entire system will be completed in 2030.

Justification

As part of the 2017 GRC Settlement, PG&E agreed to develop a program to identify overloaded poles. To comply with this agreement, PG&E developed a baseline pole loading calculation for all in-service poles using information about its in-service overhead distribution assets in the EDGIS system. PG&E then expanded the program to include desktop review of the baseline pole loading calculations. PG&E is performing these validations through a 10-year program, completing in 2030.

As discussed above in the Project Description, PG&E is currently concentrating on poles in HFTD Tier 2 and 3 areas, in efforts to reduce the risk of overloaded poles failing and potentially causing future fire ignitions.

Cost

PG&E's pole loading program officially began in 2020. Prior efforts were the proof of concept for the desktop review process and technology enhancements with respect to pole loading analysis. The funding for these earlier projects was mapped to MWC BF.

The recorded costs for 2019 are related to the program initiation. The recorded costs for 2020 represent the analysis of roughly 135,000 pole loading calculations, as well as the initial program costs for obtaining high resolution LiDAR imagery, which was previously funded in MWC BF.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 12, POLE ASSET MANAGEMENT
Project Summary – Pole Loading Program

Starting in 2021, the cost of LiDAR data acquisition and analysis will be funded as part of the pole loading program and represents roughly $10 million of the annual forecast amounts. The other roughly $10 million accounts for the pole loading calculations.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast				
	2016	2017	2018	2019	2020	2021	2022	2023	Total	Workpaper Reference
EXPENSE										
MWC GA PO 5058333				54	15,857	25,421	19,623	20,237	81,192	WP 12-5 Line 6
									-	
Expense Total	**-**	**-**	**-**	**54**	**15,857**	**25,421**	**19,623**	**20,237**	**81,192**	**WP 12-5 Line 6**
TOTAL PROJECT COST	**-**	**-**	**-**	**54**	**15,857**	**25,421**	**19,623**	**20,237**	**81,192**	**WP 12-5 Line 6**

Benefits

This program does not yield benefits in the form of dollars saved. As discussed in the Justification section, this program is a result of the 2017 GRC Settlement and reduces risk of overloaded poles failing and potentially causing future fire ignitions.

Alternatives Considered (in Addition to Selected Alternative)

Status quo – This option does not enhance the baseline pole loading calculations via desktop reviews. This option waits for the pole to be worked to get an up-to-date pole loading calculation. This option does not proactively identify or remediate poles identified as overloaded. PG&E does not recommend this option.

Alternative 1 – Another option considered, different than the desktop review process, is to send Estimators to every pole location and collect field data for the pole loading calculations. This option does not utilize LiDAR or field collected images to approximate the pole model. This option is much more labor intensive, would take a significant longer time period and cost significantly more. PG&E does not recommend this option.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 12, POLE ASSET MANAGEMENT
Project Summary – Tree Attachment Program

Project Title: Tree Attachment Program
Major Work Categories: 07 (Capital)
Planning Order Numbers: 5544389 (Capital)
Project Start Date: 2021
Project Completion Date: On-Going
Operative Date (only applies to Capital): Various

Project Description

In the past, PG&E sometimes attached facilities to living trees for various reasons. When trees with attachments are identified as dead or dying, PG&E replaces them with poles through multiple programs, such as pole replacements, maintenance, or emergency. Recently, PG&E decided to create a dedicated program to proactively install new poles and move PG&E facilities from existing trees to the new poles.

Justification

This program is a Wildfire mitigation (WLDRF-M013). Most tree attachments are located in Tier 2 and Tier 3 High Fire Threat District (HFTD) areas. PG&E is prioritizing replacement of dead and dying trees (vs. green trees) and trees in HFTD Tier areas, as a means to reduce the risk of future potential fire ignitions. By removing PG&Es facilities from the trees and installing them on newly installed poles, PG&E is eliminating the fire ignition potential that could result from the facilities being on the ground if the trees were to catastrophically fail.

Cost

PG&E estimated the costs for this program based on 2021 tree attachment costs to date. As discussed above, tree attachments were historically replaced in other programs, so there are no recorded costs in this MWC. The dedicated program began in 2021, with funds being reallocated in the MWC, so there is no forecast for this work for the initial year.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast							
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	Workpaper Reference
CAPITAL													
MWC 07, PO 5544389							3,303	3,296	3,500	3,709	3,924	17,732	WP 12-19 Line 6
Capital Total	-	-	-	-	-	-	3,303	3,296	3,500	3,709	3,924	17,732	WP 12-19 Line 6
TOTAL PROJECT COST	-	-	-	-	-	-	3,303	3,296	3,500	3,709	3,924	17,732	WP 12-19 Line 6

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 12, POLE ASSET MANAGEMENT
Project Summary – Tree Attachment Program

Benefits

This program does not yield any hard benefits in the form of dollars saved. As discussed in the Justification section, it is a Wildfire mitigation (WLDRF-M013) and reduces PG&E's potential of future fire ignitions.

Alternatives Considered

Status quo – This option continues to only replace the dead and dying trees. This option does not proactively replace any trees with poles and does not reduce the risk of potential future fire ignitions. PG&E does not recommend this option.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 12, POLE ASSET MANAGEMENT
Project Summary – Wind Loading Analysis

Project Title: Wind Loading Analysis
Major Work Categories: 21 (Capital) & AB (Expense)
Planning Order Numbers: 5535269 (Capital) & 5049430 (Expense)
Project Start Date: 2019
Project Completion Date: On-Going
Operative Date (only applies to Capital): Various

Project Description

In 2019, PG&E started developing enhanced wind loading analysis software (pre-commercial), for use in pole loading analysis. The enhanced software measures the risk of pole failure under various wind conditions (e.g. speed, direction) and other factors affecting pole reliability (e.g. snow loading, temperature, construction grade, asset condition). Existing commercial software only allows modeling a single pole at a time. The emerging technology software allows for modeling up to several hundred connected poles at once. The new technology will be used in PG&E's pole loading program to enhance the system analysis.

PG&E plans to use this technology to perform wind-loading segmentation to identify the wind-loading impact of each asset on a pole, as well as groups of poles representing a line segment. Resulting data will be integrated into PG&E's systems, including SAP's work management application, the Electric Distribution Geographic Information System (EDGIS), a new pole loading database, and the 2021 Wildfire Distribution Risk Model.

Justification

As discussed in the Project Description, PG&E is using these emerging technologies to enhance the overall pole modeling and incorporating these results into the 2021 Wildfire Distribution Risk Model. This analysis is meant to identify potentially hazardous conditions (e.g. overloaded poles) and prevent premature failure, which could result in a potential future fire ignition.

Cost

PG&E's wind loading analysis project officially began in 2019. The recorded costs are mapped to MWC 21 (Capital) and MWC AB (Expense). The project is forecast through 2022. Although no future years are forecast, PG&E expects costs may continue if additional technology enhancements are required.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 12, POLE ASSET MANAGEMENT
Project Summary – Wind Loading Analysis

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast							
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	Workpaper Reference
EXPENSE													
MWC AB PO 50499430				228	61	21						310	WP 12-5, Line 9
												-	
Expense Total	**-**	**-**	**-**	**228**	**61**	**21**	**-**	**-**	**-**	**-**	**-**	**310**	**WP 12-5, Line 9**
CAPITAL													
MWC 21, PO 5535269				3,644	2,656							6,300	WP 12-19, Line 9
Capital Total	**N/A**	**N/A**	**N/A**	**3,644**	**2,656**	**-**	**-**	**-**	**-**	**-**	**-**	**6,300**	**WP 12-19, Line 9**
TOTAL PROJECT COST	**-**	**-**	**-**	**3,872**	**2,717**	**21**	**-**	**-**	**-**	**-**	**-**	**6,611**	**WP 12-19, Line 9**

Benefits

Financial – This project is expected to yield savings by integrating data into PG&E's systems, as well as enabling groups of poles to be analyzed together, instead of individually. This project will automate the current manually intensive process to analyze each pole individually.

Alternatives Considered

Status quo – This option does not enhance the pole loading software to enable wind-loading impact on each pole asset and groups of poles representing a line segment. This option does not allow for proactively identifying or remediating poles identified as overloaded, due to wind. PG&E does not recommend this option.

2018 and 2019 Accelerated Retirement Pole Population

PG&E was in an unprecedented situation in 2018. The October 2017 wildfires greatly impacted the entire company, shifting priorities and resources to the affected areas to provide crucial assistance.

In addition, the CPUC issued Decision 17-12-024 (Fire Safety Rulemaking) and associated HFTD maps in early 2018. This rulemaking requires that assets in Tier 3 and Tier 2 areas be remediated within 6 months and 12 months, respectively, of the inspection date, which accelerates PG&E's remediation timeframe. It also required that all poles identified for replacement in Tier 3 areas be replaced prior to August 31, 2018, and all poles identified for replacement in Tier 2 areas be replaced by June 30, 2019.

As a result of these changes, PG&E chose to identify poles for the 2018 and 2019 accelerated retirement populations through PG&E's GO 165 inspections. Because of the revised regulation, which accelerates remediation requirements in the newly defined HFTDs, and the Company's desire to decrease wildfire drivers, PG&E ultimately chose to limit the 2018 and 2019 accelerated retirement population to HFTDs, which PG&E considers to be higher risk.

PG&E performed the following pole replacements in 2018 and 2019, compared to the General Rate Case (GRC) imputed adopted amounts:

		Imputed Adopted Amounts	Actuals	Percent Increase
2018	Units	6,125	12,448	103%
	Spend	$ 68.6 M	$ 223.9 M	226%
2019	Units	7,327	12,531	71%
	Spend	$ 76.5M	$ 335.4 M	338%

PG&E performed the following pole replacements in 2018 and 2019 in Tier 3 and 2 areas:

		Tier 3	Tier 2	Total
2018	Units	1,627	3,121	4,748
2019	Units	1,516	4,611	6,127

The following subset of pole replacements occurred in 2018 and 2019 in Tier 3 and 2 areas and were accelerated due to the regulation remediation requirements. This subset of pole replacements would normally have been planned for future years. However, the pole replacements were completed in 2018 and 2019.

		Tier 3	Tier 2	Total
2018	Units	502	229	731
	Spend	$ 8.8 M	$ 4.0 M	$ 12.8 M
2019	Units	919	1,216	2,135
	Spend	$ 38.7 M	$ 56.3 M	$95 M

Due to the extenuating circumstances and heightened focus on continuing to reduce wildfire risk, PG&E accelerated the retirement of 731 pole replacements in 2018, spending $12.8 million and 2,135 pole replacements in 2019, spending $95 million.

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE

Testimony: _____ **Workpapers:** ☒ **SOQ:** _____

Exhibit Number: 4 **Chapter Number:** 12

Chapter Title: Pole Asset Management

Witness Name: Mark Esguerra

Page No.	Line No.	Item	As Filed	As Corrected
Errata as of February 25, 2022				
WP 12-2	4	MWC KA Base Year Expenses	2022: 600 (thousands of dollars) 2023: 902	2022: 0 2023: 0

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE
EXHIBIT (PG&E-4) ELECTRIC DISTRIBUTION

WORKPAPERS SUPPORTING
CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT AND RELIABILITY

TABLE OF CONTENTS

Workpaper Table 13-1
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 13
Overhead and Underground Asset Management and Reliability
Capital Expenditures by Major Work Category
(Thousands of Nominal Dollars)

			Capital Expenditures											
No.	MWC	MWC Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference
1	8	E Dist Overhead Asset Replacement	32,318	26,456	15,874	6,980	16,595	42,105	33,637	44,011	45,487	46,729	47,990	WP 13-5, WP 13-6
2	9	E Dist Automation & Protection	158	31	141	(100)	(1)	-	-	-	-	-	-	
3	2F	Build IT Apps & Infra	2	-	-	-	0	-	-	-	-	-	-	
4	49	Distribution Circuit Zone Reliability	75,406	46,999	25,646	18,840	20,175	21,455	26,722	29,110	28,974	29,578	32,245	WP 13-7, WP 13-8
5	56	E Distr Underground Asset Replacement	107,991	66,915	58,459	45,284	57,995	90,160	85,382	91,317	93,066	94,845	96,660	WP 13-9, WP 13-10
6		**Grand Total**	**215,876**	**140,401**	**100,120**	**71,005**	**94,764**	**153,720**	**145,742**	**164,438**	**167,528**	**171,152**	**176,895**	

Workpaper Table 13-2
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 13
Overhead and Underground Asset Management and Reliability
Forecast Capital Expenditures Summary
(Thousands of Nominal Dollars)

		Capital Expenditures							
Line No.	Description	2020 CWIP	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference
1	Projects > $3 Million*	9,806	113,590	145,615	164,405	167,528	171,141	176,895	WP 13-3
2	Other Work	3,626	40,130	127	32	-	11	-	WP 13-4
3	**Total**	**13,432**	**153,720**	**145,742**	**164,438**	**167,528**	**171,152**	**176,895**	

4 * Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.

Workpaper Table 13-3
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 13
Overhead and Underground Asset Management and Reliability
Recorded CWIP and Forecast Capital Expenditures Details - Projects Over $3 Million*
(Thousands of Nominal Dollars)

					CWIP	Capital Expenditures							
Line No.	Planning Order	Description	MWC	Operative Date	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Subtotal	Reference
	MWC - 08	**E Dist Overhead Asset Replacement**											
1	5505502	CC-OH ANNEALED/DETER CNDCTR: PM MGD	8		165	7,415	-	-	-	-	-	7,580	
2	5505511	FR-OH ANNEALED/DETER CNDCTR: PM MGD	8		132	2,875	-	-	-	-	-	3,007	
3	5505514	LP-OH ANNEALED/DETER CNDCTR: PM MGD	8		26	3,635	-	-	-	-	-	3,661	
4	5508971	08J - OH ANNEAL/DET COND - E-HB: PM MGD	8		309	9,765	-	-	-	-	-	10,073	
5	5543441	SYSPLAN ED 08J DOVHD-C004	8		-	-	32,688	43,036	44,486	45,701	46,934	212,845	
6	5543442	SYSPLAN ED 08S DOVHD-M006	8		-	-	949	975	1,001	1,028	1,056	5,010	
7	5782763	RPL OH.Con.Spence 112318-0074972	8	Jun-2021	47	3,186	-	-	-	-	-	3,232	
8	**Total**				**678**	**26,875**	**33,637**	**44,011**	**45,487**	**46,729**	**47,990**	**245,408**	WP 13-11
	MWC - 49	**Distribution Circuit Zone Reliability**											
9	5514101	49-Reclosers Purchase (Matls Dept Only)	49		-	10,750	-	-	-	-	-	10,750	
10	5541795	49T–2021 Planning WLDFR-M10B DOVHD-C014	49		-	1,110	808	1,393	1,363	1,329	1,290	7,294	
11	5543540	SYSPLAN ED 49	49		-	-	11,581	12,488	11,079	11,378	11,685	58,212	
12	5543542	SYSPLAN ED 49B DOVHD-M010	49		-	-	527	4,398	4,517	4,639	4,764	18,844	
13	5543543	SYSPLAN ED 49C DOVHD-C003	49		-	-	1,392	1,527	1,422	1,485	2,967	8,794	
14	5543547	SYSPLAN ED 49S	49		-	-	2,453	3,721	3,938	4,147	4,341	18,601	
15	5544492	SYSPLAN FRMMA 49X DOVHD-C012	49		-	-	3,631	-	-	-	-	3,631	
16	5545545	SYSPLAN 49X DOVHD-C012	49		-	-	-	3,709	4,764	4,532	5,084	18,088	
17	5795566	SYSPLAN MAT 49A WLDFR-M10A DOVHD-M010	49	Dec-2020	-	-	6,203	1,841	1,891	2,057	2,112	14,105	
18	**Total**				**-**	**11,860**	**26,596**	**29,078**	**28,974**	**29,567**	**32,245**	**158,320**	WP 13-13
	MWC - 56	**E Dist Underground Asset Replacement**											
19	5501921	56A - Cable Replacement-DI	56		3	1,635	4,866	-	-	-	-	6,505	
20	5508934	56C - CABLE REPL - ERR - DI: PM MGD	56		17	4,816	-	-	-	-	-	4,834	
21	5508935	56C - Cable Replacement - ERR - MI	56		654	4,649	-	-	-	-	-	5,303	
22	5508937	56C - Cable Replacement - ERR - SJ	56		237	5,198	-	-	-	-	-	5,435	
23	5508939	56C - Cable Replacement - ERR - FR	56		1,568	3,338	-	-	-	-	-	4,906	
24	5529103	XLP Cable Replace-System DUNGD-C06A	56		-	-	-	10,088	10,381	10,682	10,992	42,143	
25	5529104	HMWPE Cable Replace-System DUNGD-C06A	56		-	-	-	18,342	18,875	19,422	19,985	76,624	
26	5529105	PILC Cable Replace-System DUNGD-C06A	56		-	-	-	8,546	8,359	8,161	7,950	33,016	
27	5536664	Corral 1102 Ph 1of3 Repl.UG zone 9805	56		-	3,766	-	-	-	-	-	3,766	
28	5536665	Corral 1102 Ph 2of3 Repl.UG zone 9807	56		-	4,000	537	-	-	-	-	4,537	
29	5536666	Corral 1102 Ph 3of3 Repl.UG zone L3809	56		-	4,114	-	-	-	-	-	4,114	
30	5537260	56A-DI-KS2105 Robles-Vaquero_ Antioch	56		-	2,796	3,440	-	-	-	-	6,237	
31	5543555	SYSPLAN ED 56C DUNGD-C003	56		-	-	33,030	36,002	36,625	37,258	37,901	180,816	
32	5543557	SYSPLAN ED 56S DUNGD-C007	56		-	9,252	9,493	8,124	8,344	8,569	8,800	52,582	
33	5543558	SYSPLAN ED 56T DUNGD-C008	56		-	-	3,303	9,099	9,345	9,597	9,856	41,200	
34	5544463	SYSPLAN ED 56B DUNGD-C06B	56		-	-	-	1,117	1,136	1,156	1,176	4,584	
35	5734238	56-Angel Island Cable Repl	56	Jun-2022	-	1,000	7,977	-	-	-	-	8,977	
36	5735559	Future Projects	56	Dec-2022	-	9,589	-	-	-	-	-	9,589	
37	5778639	E Dist Replace UG Asset-Gen	56	May-2021	6,648	5,000	-	-	-	-	-	11,648	
38	5795603	SYSPLAN ED 56A DUNGD-C06A	56	Dec-2020	-	15,702	22,736	-	-	-	-	38,437	
39	**Total**				**9,128**	**74,855**	**85,382**	**91,317**	**93,066**	**94,845**	**96,660**	**545,253**	WP 13-16
40		**Grand Total**			**9,806**	**113,590**	**145,615**	**164,405**	**167,528**	**171,141**	**176,895**	**948,980**	

41 * Planning orders where Construction Work in Progress (CWIP) Balance as of December 31, 2020 plus six years (2021-2026) of forecast.

Workpaper Table 13-4
Pacific Gas and Electric Company
2023 GRC
Exhibit (PG&E-4), Chapter 13
Overhead and Underground Asset Management and Reliability
Recorded and Forecast Capital Expenditures Details - Other Work*
(Thousands of Nominal Dollars)

			Capital Expenditures											
Line No.	MWC	MWC Description	2016 Recorded Adjusted	2017 Recorded Adjusted	2018 Recorded Adjusted	2019 Recorded Adjusted	2020 Recorded Adjusted	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference
1	8	E Dist Overhead Asset Replacement	24,034	22,685	8,978	921	10,085	15,230	-	-	-	-	-	WP 13-11
2	9	E Dist Automation & Protection	158	31	141	(100)	(1)	-	-	-	-	-	-	
3	2F	Build IT Apps & Infra	2	-	-	-	0	-	-	-	-	-	-	
4	49	Distribution Circuit Zone Reliability	68,692	40,001	18,736	6,782	3,280	9,595	127	32	-	11	-	WP 13-13
5	56	E Distr Underground Asset Replacement	85,911	37,920	34,383	29,002	26,839	15,305	-	-	-	-	-	WP 13-16
6	**Grand Total**		**178,797**	**100,637**	**62,239**	**36,605**	**40,203**	**40,130**	**127**	**32**	**-**	**11**	**-**	

7 * Excludes projects greater than $3M

Workpaper Table 13-5
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
Major Work Category 08 - Recorded Walk
MWC 08 - Overhead Asset Replacements
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount	Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$ 32,318**		
2		Not Assigned (MAT 08#)	$ (332)	Minor variations consistent with recorded amounts	WP 13-11 Line 3
3		Base Reliability Program (MAT 08B)	$ 2	Program has ended, minor recorded cost variances	WP 13-11 Line 4
4		Cornerstone (MAT 08C)	$ (2)	Program has ended, minor recorded cost variances	WP 13-11 Line 5
5		Cornerstone (MAT 08D)	$ (14)	Program has ended, minor recorded cost variances	WP 13-11 Line 6
6		Cornerstone (MAT 08F)	$ 33	Program has ended, minor recorded cost variances	WP 13-11 Line 7
7		Overhead Conductor Replacement Program (MAT 08J)	$ (5,807)	Decrease due to resources allocated to higher priority work and wildfire support programs.	WP 13-11 Line 8
8		Grasshopper/Overhead Switch Replacement Program (MAT 08S)	$ 130	Decrease in the number of Grasshopper style OH switch replaced, but a significantly larger cost per replacement. Overall there were minor variations in total cost compared to the previous recorded year.	WP 13-11 Line 9
9		System Hardening (MAT 08W)	$ 126	Some recorded costs for reliability conductor replacement are still being represented in MAT 08W but are related to the work that is solely in MAT 08J and shown here for completeness purposes.	WP 13-11 Line 10
10		**Net Change**	**$ (5,863)**		
11	**2017**	**Recorded Adjusted**	**$ 26,456**		
12		Not Assigned (MAT 08#)	$ (109)	No significant change	WP 13-11 Line 3
13		Base Reliability Program (MAT 08B)	$ 0	Program has ended, minor recorded cost variances	WP 13-11 Line 4
14		Cornerstone (MAT 08C)	$ 1	Program has ended, minor recorded cost variances	WP 13-11 Line 5
15		Cornerstone (MAT 08D)	$ 8	Program has ended, minor recorded cost variances	WP 13-11 Line 6
16		Cornerstone (MAT 08F)	$ (183)	No significant change	WP 13-11 Line 7
17		Overhead Conductor Replacement Program (MAT 08J)	$ (9,167)	Decrease due to resources allocated to higher priority work and wildfire support programs.	WP 13-11 Line 8
18		Grasshopper/Overhead Switch Replacement Program (MAT 08S)	$ (310)	Decrease in the number of Grasshopper style OH switch replaced	WP 13-11 Line 9
19		System Hardening (MAT 08W)	$ (822)	Some recorded costs for reliability conductor replacement are still being represented in MAT 08W but are related to the work that is solely in MAT 08J and shown here for completeness purposes.	WP 13-11 Line 10
20		**Net Change**	**$ (10,582)**		
21	**2018**	**Recorded Adjusted**	**$ 15,874**		
22		Not Assigned (MAT 08#)	$ (2,242)	These charges are miscellaneous program costs and adjustments that are not directly attributable to a specific MAT code. There are no forecast costs for this cost type as all forecast costs are included in the separate MAT codes.	WP 13-11 Line 3
23		Base Reliability Program (MAT 08B)	$ (1)	Program has ended, minor recorded cost variances	WP 13-11 Line 4
24		Cornerstone (MAT 08F)	$ 45	No significant change	WP 13-11 Line 7
25		Overhead Conductor Replacement Program (MAT 08J)	$ (6,503)	Decrease due to resources allocated to higher priority work and wildfire support programs.	WP 13-11 Line 8
26		Grasshopper/Overhead Switch Replacement Program (MAT 08S)	$ (192)	Decrease in the number of Grasshopper style OH switch replaced	WP 13-11 Line 9
27		System Hardening (MAT 08W)	$ (1)	No significant change	WP 13-11 Line 10
28		**Net Change**	**$ (8,894)**		
29	**2019**	**Recorded Adjusted**	**$ 6,980**		
30		Not Assigned (MAT 08#)	$ 2,391	These charges are miscellaneous program costs and adjustments that are not directly attributable to a specific MAT code. There are no forecast costs for this cost type as all forecast costs are included in the separate MAT codes.	WP 13-11 Line 3
31		Cornerstone (MAT 08F)	$ 8	No significant change	WP 13-11 Line 7
32		Overhead Conductor Replacement Program (MAT 08J)	$ 6,902	Reprioritized program	WP 13-11 Line 8
33		Grasshopper/Overhead Switch Replacement Program (MAT 08S)	$ 314	Increase in the number of Grasshopper style OH switch replaced	WP 13-11 Line 9
34					
35		**Net Change**	**$ 9,615**		
36	**2020**	**Recorded Adjusted**	**$ 16,596**		

Workpaper Table 13-6
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
Major Work Category 08 - Forecast Walk
MWC 08 - Overhead Asset Replacements
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount	Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$ 16,595**		
2		Not Assigned (MAT 08#)	$ 541	No significant change.	WP 13-11 Line 3
3		Cornerstone (MAT 08F)	$ (10)	No significant change.	WP 13-11 Line 7
4		Overhead Conductor Replacement Program (MAT 08J)	$ 24,589	Restored funding to originally planned levels	WP 13-11 Line 8
5		Grasshopper/Overhead Switch Replacement Program (MAT 08S)	$ 389	The number of Grasshopper style OH switch replacements increased back to historical amounts.	WP 13-11 Line 9
6					
7		**Net Change**	**$ 25,510**		
8	**2021**	**Forecast**	**$ 42,105**		
9		Overhead Conductor Replacement Program (MAT 08J)	$ (8,492)	The variance is primarily driven by re-prioritization of MAT 56A Angel Island Cable Replacement project ($4.5M).	WP 13-11 Line 8
10		Grasshopper/Overhead Switch Replacement Program (MAT 08S)	$ 24	Minor forecast variations reflects with escalation and 30 units replaced.	WP 13-11 Line 9
11					
12		**Net Change**	**$ (8,468)**		
13	**2022**	**Forecast**	**$ 33,637**		
14		Overhead Conductor Replacement Program (MAT 08J)	$ 10,347	Angel Island Project is fully forecasted in MAT 56A; reprioritizing MAT 08J.	WP 13-11 Line 8
15		Grasshopper/Overhead Switch Replacement Program (MAT 08S)	$ 26	Minor forecast variations reflects with escalation and 30 units replaced.	WP 13-11 Line 9
16					
17		**Net Change**	**$ 10,373**		
18	**2023**	**Forecast**	**$ 44,010**		
19		Overhead Conductor Replacement Program (MAT 08J)	$ 1,450	No significant change.	WP 13-11 Line 8
20		Grasshopper/Overhead Switch Replacement Program (MAT 08S)	$ 26	Minor forecast variations reflects with escalation and 30 units replaced.	WP 13-11 Line 9
21					
22		**Net Change**	**$ 1,477**		
23	**2024**	**Forecast**	**$ 45,487**		
24		Overhead Conductor Replacement Program (MAT 08J)	$ 1,215	No significant change.	WP 13-11 Line 8
25		Grasshopper/Overhead Switch Replacement Program (MAT 08S)	$ 27	Minor forecast variations reflects with escalation and 30 units replaced.	WP 13-11 Line 9
26					
27		**Net Change**	**$ 1,242**		
28	**2025**	**Forecast**	**$ 46,729**		
29		Overhead Conductor Replacement Program (MAT 08J)	$ 1,234	No significant change.	WP 13-11 Line 8
30		Grasshopper/Overhead Switch Replacement Program (MAT 08S)	$ 28	Minor forecast variations reflects with escalation and 30 units replaced.	WP 13-11 Line 9
31					
32		**Net Change**	**$ 1,261**		
33	**2026**	**Forecast**	**$ 47,990**		

Workpaper Table 13-7
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
Major Work Category 49 - Recorded Walk
MWC 49 - Distribution Circuit/Zone Reliability
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount		Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$ 75,406**			
2		All Programs	$ (28,408)		Reduction of costs compared to previous year is driven by a shift in focus to decrease reliability work and assist with the increased storm response and wildfire work required	WP 13-14 Line 16
3		**Net Change**	**$ (28,408)**			
4	**2017**	**Recorded Adjusted**	**$ 46,999**			
5		All Programs	$ (21,353)		Continued shift in focus to decrease reliability work and assist with the increased storm response and wildfire work required	WP 13-14 Line 16
6		**Net Change**	**$ (21,353)**			
7	**2018**	**Recorded Adjusted**	**$ 25,646**			
8		Line Recloser Revolving Stock (MAT 49#)	$ 2,936		Increase in costs driven by the need to replenish equipment stock needed to support the storm and wildfire efforts	WP 13-14 Line 3
9		All Other Programs	$ (9,741)		Continued shift in focus to decrease reliability work and assist with the increased storm response and wildfire work required	WP 13-14 Lines 4 - 15
10		**Net Change**	**$ (6,805)**			
11	**2019**	**Recorded Adjusted**	**$ 18,840**			
12		Line Recloser Revolving Stock (MAT 49#)	$ 7,325		Continued purchases to ensure equipment stock can support storm and wildfire efforts	WP 13-14 Line 3
13		Targeted Circuits Program (MAT 49E)	$ (5,139)		Decrease reflects the cancellation of the program and write-off of the majority of the in flight work	WP 13-14 Line 8
14		All Other Programs	$ (852)		No significant change	WP 13-14 Line 4-7, WP 13-14 Line 9-14
15		**Net Change**	**$ 1,334**			
16	**2020**	**Recorded Adjusted**	**$ 20,175**			

Workpaper Table 13-8
Pacific Gas and Electric Company
2020 General Rate Case
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
Major Work Category 49 - Forecast Walk
MWC 49 - Distribution Circuit/Zone Reliability
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount	Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$ 20,175**		
2		Line Recloser Revolving Stock (MAT 49#)	$ (5,608)	Decrease is driven by a forecasted reduction in revolving stock equipment purchases	WP 13-14 Line 3
3		Distribution Automation Recloser SCADA Installations (MAT 49A)	$ (17)	No significant change	WP 13-14 Line 4
4		Line Recloser and Control Replacements (49B)	$ 533	No significant change	WP 13-14 Line 5
5		Overhead Fuses (MAT 49C)	$ 570	No significant change	WP 13-14 Line 6
6		Line Reclosers (MAT 49D)	$ (296)	No significant change	WP 13-14 Line 7
7		Targeted Circuits Program (MAT 49E)	$ 5,903	Forecasting to complete approximately 5 projects that were close to completion and will represent the completion of the project. The forecasted projects are estimated to cost approximately $1.5M but the change from the previous year is increased beyond these levels due to 2020 recorded costs for this program being a credit as a result of the cancellation of the program and the write-off of the majority of the in flight projects	WP 13-14 Line 8
8		Underground Fuses (MAT 49F)	$ 4	No significant change	WP 13-14 Line 9
9		Interrupters (MAT 49G)	$ (1,015)	Continued ramp down of the program	WP 13-14 Line 10
10		Overhead Fault Indicators/Line Sensors (MAT 49I)	$ (318)	No significant change	WP 13-14 Line 12
11		Fault Location, Isolation and Service Restoration (FLISR) (MAT 49S)	$ (1,562)	Decrease in funding, due to reallocation of estimating/construction resources to work on wildfire mitigation work.	WP 13-14 Line 13
12		Tripsavers & Fusesavers (MAT 49T)	$ 625	No significant change	WP 13-14 Line 14
13		Base Reliability Program (MAT 49X)	$ 2,460	Forecasted increase to bring program back to needed levels to ensure reliability	WP 13-14 Line 15
14		**Net Change**	**$ 1,280**		
15	**2021**	**Forecast**	**$ 21,455**		
16		Line Recloser Revolving Stock (MAT 49#)	$ 831	No significant change	WP 13-14 Line 3
17		Distribution Automation Recloser SCADA Installations (MAT 49A)	$ 6,203	Increase in funding due to full scale replacements beginning in 2022. This will include replacing the entire recloser assembly (i.e., both the control and the recloser tank). (49A 2021 is forecast in chapter 4.3. 49A 2022 is in chapter 13.)	WP 13-14 Line 4
18		Line Recloser and Control Replacements (49B)	$ (7)	No significant change	WP 13-14 Line 5
19		Overhead Fuses (MAT 49C)	$ 637	No significant change	WP 13-14 Line 6
20		Line Reclosers (MAT 49D)	$ (278)	No significant change	WP 13-14 Line 7
21		Targeted Circuits Program (MAT 49E)	$ (1,533)	No forecasted costs in 2022, representing the completion of the final projects and the close out of the program	WP 13-14 Line 8
22		Interrupters (MAT 49G)	$ (247)	No significant change	WP 13-14 Line 10
23		Fault Location, Isolation and Service Restoration (FLISR) (MAT 49S)	$ 100	No significant change	WP 13-14 Line 13
24		Tripsavers & Fusesavers (MAT 49T)	$ (302)	No significant change	WP 13-14 Line 14
25		Base Reliability Program (MAT 49X)	$ (137)	No significant change	WP 13-14 Line 15
26		**Net Change**	**$ 5,267**		
27	**2022**	**Forecast**	**$ 26,722**		
28		Line Recloser Revolving Stock (MAT 49#)	$ 907	No significant change	WP 13-14 Line 3
29		Distribution Automation Recloser SCADA Installations (MAT 49A)	$ (4,362)	Decrease is driven by a change in vendor that resulted in a higher unit cost and fewer units forecasted to be completed.	WP 13-14 Line 4
30		Line Recloser and Control Replacements (49B)	$ 3,870	Increase is driven by the change in program focus to perform full recloser changeouts (replace existing reclosers with new reclosers)	WP 13-14 Line 5
31		Overhead Fuses (MAT 49C)	$ 41	No significant change	WP 13-14 Line 6
32		Fault Location, Isolation and Service Restoration (FLISR) (MAT 49S)	$ 1,269	Forecasted increase to bring program back to needed levels to ensure reliability	WP 13-14 Line 13
33		Tripsavers & Fusesavers (MAT 49T)	$ 585	No significant change	WP 13-14 Line 14
34		Base Reliability Program (MAT 49X)	$ 77	No significant change	WP 13-14 Line 15
35		**Net Change**	**$ 2,388**		
36	**2023**	**Forecast**	**$ 29,110**		
37		Line Recloser Revolving Stock (MAT 49#)	$ (1,409)	Fluctuation in costs to arrive at a level of steady level of purchases for the program through 2026	WP 13-14 Line 3
38		Distribution Automation Recloser SCADA Installations (MAT 49A)	$ 50	No significant change	WP 13-14 Line 4
39		Recloser Control Replacements (MAT 49B)	$ 119	No significant change	WP 13-14 Line 5
40		Overhead Fuses (MAT 49C)	$ (138)	No significant change	WP 13-14 Line 6
41		Fault Location, Isolation and Service Restoration (FLISR) (MAT 49S)	$ 217	No significant change	WP 13-14 Line 13
42		Tripsavers & Fusesavers (MAT 49T)	$ (30)	No significant change	WP 13-14 Line 14
43		Base Reliability Program (MAT 49X)	$ 1,055	Continued increase in program costs	WP 13-14 Line 15
44		**Net Change**	**$ (136)**		
45	**2024**	**Forecast**	**$ 28,974**		
46		Line Recloser Revolving Stock (MAT 49#)	$ 299	No significant change	WP 13-14 Line 3
47		Distribution Automation Recloser SCADA Installations (MAT 49A)	$ 165	No significant change	WP 13-14 Line 4
48		Line Recloser and Control Replacements (49B)	$ 122	No significant change	WP 13-14 Line 5
49		Overhead Fuses (MAT 49C)	$ 75	No significant change	WP 13-14 Line 6
50		Fault Location, Isolation and Service Restoration (FLISR) (MAT 49S)	$ 209	No significant change	WP 13-14 Line 13
51		Tripsavers & Fusesavers (MAT 49T)	$ (34)	No significant change	WP 13-14 Line 14
52		Base Reliability Program (MAT 49X)	$ (232)	No significant change	WP 13-14 Line 15
53		**Net Change**	**$ 604**		
54	**2025**	**Forecast**	**$ 29,578**		
55		Line Recloser Revolving Stock (MAT 49#)	$ 307	No significant change	WP 13-14 Line 3
56		Distribution Automation Recloser SCADA Installations (MAT 49A)	$ 56	No significant change	WP 13-14 Line 4
57		Line Recloser and Control Replacements (49B)	$ 125	No significant change	WP 13-14 Line 5
58		Overhead Fuses (MAT 49C)	$ 1,471	Increase reflects returning to historical 2015-2016 funding level for MAT 49C	WP 13-14 Line 6
59		Fault Location, Isolation and Service Restoration (FLISR) (MAT 49S)	$ 194	No significant change	WP 13-14 Line 13
60		Tripsavers & Fusesavers (MAT 49T)	$ (39)	No significant change	WP 13-14 Line 14
61		Base Reliability Program (MAT 49X)	$ 553	No significant change	WP 13-14 Line 15
62		**Net Change**	**$ 2,666**		
63	**2026**	**Forecast**	**$ 32,245**		

Workpaper Table 13-9
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
Major Work Category 56 - Recorded Walk
MWC 56 - Electric Distribution Underground Assets
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount	Detailed Description/Assumptions	Reference
1	**2016**	**Recorded Adjusted**	**$ 107,991**		
2		Program Level Charges (MAT 56#)	$ (2,149)	Program level charges are miscellaneous program costs and adjustments that are not directly attributable to a specific MAT code. There are no forecast costs for this cost type as all forecast costs are included in the separate MAT codes.	WP 13-22 Line 7
3		Reliability Related Cable Replacement (MAT 56A)	$ (350)	Minor program level adjustment and rescheduling of work.	WP 13-22 Line 1
4		Cable Rejuvenation and Testing (MAT 56B)	$ 1,199	Increase due to establishment of cable testing program.	WP 13-22 Line 2
5		Critical Operating Equipment Cable Replacement (MAT 56C)	$ 3,120	Continued ramp up to address volume of existing COE cable replacement work.	WP 13-22 Line 3
6		TGRAM/TGRAL Rocker Arm Line (MWC 56D)	$ (38,283)	Program officially ended in 2016, but a few carry-over units were replaced in 2017	WP 13-22 Line 4
7		Load Break Oil Rotary (LBOR) Switch Replacements (MAT 56S)	$ (4,611)	Rescheduled projects to support higher priority work and respond to high volume of emergencies	WP 13-22 Line 5
8		**Net Change**	**$ (41,076)**		
9	**2017**	**Recorded Adjusted**	**$ 66,915**		
10		Program Level Charges (MAT 56#)	$ (2,388)	Program level charges are miscellaneous program costs and adjustments that are not directly attributable to a specific MAT code. There are no forecast costs for this cost type as all forecast costs are included in the separate MAT codes.	WP 13-22 Line 7
11		Reliability Related Cable Replacement (MAT 56A)	$ 1,634	Increase to complete some rescheduled work from 2017.	WP 13-22 Line 1
12		Cable Rejuvenation and Testing (MAT 56B)	$ (724)	Minor adjustment in funding level to support higher priority work.	WP 13-22 Line 2
13		Critical Operating Equipment Cable Replacement (MAT 56C)	$ (7,812)	Some work rescheduled work to support higher amount of work related to Reliability Related Cable Replacements (56A).	WP 13-22 Line 3
14		TGRAM/TGRAL Rocker Arm Line (MWC 56D)	$ (1,867)	Program officially ended in 2016, a few carry-over units were replaced in 2017	WP 13-22 Line 4
15		Load Break Oil Rotary (LBOR) Switch Replacements (MAT 56S)	$ 1,181	Returning funding closer to historical levels for the program.	WP 13-22 Line 5
16		Temperature Alarm Devices (MAT 56T)	$ 1,519	Increase due to establishment of TAD program.	WP 13-22 Line 6
17		**Net Change**	**$ (8,457)**		
18	**2018**	**Recorded Adjusted**	**$ 58,459**		
19		Program Level Charges (MAT 56#)	$ (7,051)	Program level charges are miscellaneous program costs and adjustments that are not directly attributable to a specific MAT code. There are no forecast costs for this cost type as all forecast costs are included in the separate MAT codes.	WP 13-22 Line 7
20		Reliability Related Cable Replacement (MAT 56A)	$ 237	Minor increase from prior year.	WP 13-22 Line 1
21		Cable Testing and Rejuvenation (MAT 56B)	$ 1,492	Increase driven by contract cost increases from 2018 to 2019 as well as some restoration and cost carryover from 2018.	WP 13-22 Line 2
22		Critical Operating Equipment Cable Replacement (MAT 56C)	$ (9,282)	Rescheduled work to support higher priority work systemwide.	WP 13-22 Line 3
23		TGRAM/TGRAL Rocker Arm Line (MWC 56D)	$ 94	Program officially ended in 2016, initiation of replacement of a few new units identified in field.	WP 13-22 Line 4
24		Load Break Oil Rotary (LBOR) Switch Replacements (MAT 56S)	$ 193	Minor increase from prior year	WP 13-22 Line 5
25		Temperature Alarm Devices (MAT 56T)	$ 1,142	Ramp up of the TAD program.	WP 13-22 Line 6
26		**Net Change**	**$ (13,174)**		
27	**2019**	**Recorded Adjusted**	**$ 45,284**		
28		Program Level Charges (MAT 56#)	$ 9,925	Program level charges are miscellaneous program costs and adjustments that are not directly attributable to a specific MAT code. There are no forecast costs for this cost type as all forecast costs are included in the separate MAT codes.	WP 13-22 Line 7
29		Reliability Related Cable Replacement (MAT 56A)	$ (12,130)	Rescheduled work to support higher priority work systemwide.	WP 13-22 Line 1
30		Cable Rejuvenation and Testing (MAT 56B)	$ (982)	Rescheduled injection work to 2020 due to resource constraints.	WP 13-22 Line 2
31		Critical Operating Equipment Cable Replacement (MAT 56C)	$ 1,820	Ramp up to address volume of existing COE cable replacement work.	WP 13-22 Line 3
32		TGRAM/TGRAL Rocker Arm Line (MWC 56D)	$ 4,718	Program officially ended in 2016, completed replacement of a few new units identified in field in 2018.	WP 13-22 Line 4
33		Load Break Oil Rotary (LBOR) Switch Replacements (MAT 56S)	$ 3,859	Ramp up to address volume of LBOR replacement work.	WP 13-22 Line 5
34		Temperature Alarm Devices (MAT 56T)	$ 5,501	Continued ramp up of the TAD program	WP 13-22 Line 6
35		**Net Change**	**$ 12,710**		
36	**2020**	**Recorded Adjusted**	**$ 57,995**		

Workpaper Table 13-10
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
Major Work Category 56 - Forecast Walk
MWC 56 - Electric Distribution Underground Assets
(Thousands of Nominal Dollars)

Ln. No.	Year	Program/Activity	Amount	Detailed Description/Assumptions	Reference
1	**2020**	**Recorded Adjusted**	**$ 57,995**		
2		Forecast Adjustment (MAT 56#)	$ 953	Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added in 2021 to ensure the total forecasts did not exceed the POR forecast.	WP 13-22 Line 7
3		Reliability Related Cable Replacement (MAT 56A)	$ 20,026	Reestablishing program to historical levels and complete rescheduled work from 2019 and 2020.	WP 13-22 Line 1
4		Cable Rejuvenation and Testing (MAT 56B)	$ (2,114)	Program put on hold for 2021 and 2022 to focus resources on completing large portfolio of cable replacement projects that went through testing or injection.	WP 13-22 Line 2
5		Critical Operating Equipment Cable Replacement (MAT 56C)	$ 13,219	Reestablishing program to historical levels and complete rescheduled work from 2019 and 2020.	WP 13-22 Line 3
6		Transfer Ground Rocker Arm Main/Transfer Ground Rocker Arm Line Replacements (MWC 56D)	$ (5,182)	No forecast planned work for 2021	WP 13-22 Line 4
7		Load Break Oil Rotary (LBOR) Switch Replacements (MAT 56S)	$ 3,837	Ramp up of program to replace over 90 LBOR switches.	WP 13-22 Line 5
8		Temperature Alarm Devices (MAT 56T)	$ 1,426	Ramp up of program to install TADs on more old oil filled equipment.	WP 13-22 Line 6
9		**Net Change**	**$ 32,165**		
10	**2021**	**Forecast**	**$ 90,160**		
11		Forecast Adjustment (MAT 56#)	$ 954	No forecast adjustment in 2022	WP 13-22 Line 7
12		Reliability Related Cable Replacement (MAT 56A)	$ 1,543	Additional funding for program to address submarine cable replacement project and continue completion of rescheduled work.	WP 13-22 Line 1
13		Cable Rejuvenation and Testing (MAT 56B)	$ -	Program put on hold for 2021 and 2022 to focus resources on completing large portfolio of 56A cable replacement projects that went through testing or injection.	WP 13-22 Line 2
14		Critical Operating Equipment Cable Replacement (MAT 56C)	$ (1,230)	Rebalancing of resources across all of Company's portfolio of programs in 2022, including to 56A.	WP 13-22 Line 3
15		Load Break Oil Rotary (LBOR) Switch Replacements (MAT 56S)	$ 241	Minor increase from prior year.	WP 13-22 Line 5
16		Temperature Alarm Devices (MAT 56T)	$ (6,286)	Rebalancing of resources across all of Company's portfolio of programs in 2022.	WP 13-22 Line 6
17		**Net Change**	**$ (4,778)**		
18	**2022**	**Forecast**	**$ 85,382**		
19		Reliability Related Cable Replacement (MAT 56A)	$ (2,581)	Ramp down to more historical level of funding for program.	WP 13-22 Line 1
20		Cable Rejuvenation and Testing (MAT 56B)	$ 1,117	Reestablishing program after pause in 2021 and 2020 to focus resources on completing large portfolio of 56A cable replacement projects that went through testing or injection.	WP 13-22 Line 2
21		Critical Operating Equipment Cable Replacement (MAT 56C)	$ 2,971	Reestablishing program to more historical level.	WP 13-22 Line 3
22		Load Break Oil Rotary (LBOR) Switch Replacements (MAT 56S)	$ (1,368)	Rebalancing of resources across all of Company's portfolio of programs in 2022.	WP 13-22 Line 5
23		Temperature Alarm Devices (MAT 56T)	$ 5,796	Ramp up of program to install TADs on more old oil filled equipment.	WP 13-22 Line 6
24		**Net Change**	**$ 5,935**		
25	**2023**	**Forecast**	**$ 91,317**		
26		Reliability Related Cable Replacement (MAT 56A)	$ 641	Minor increase from prior year.	WP 13-22 Line 1
27		Cable Testing and Rejuvenation (MAT 56B)	$ 19	Minor increase from prior year.	WP 13-22 Line 2
28		Critical Operating Equipment Cable Replacement (MAT 56C)	$ 624	Minor increase from prior year.	WP 13-22 Line 3
29		Load Break Oil Rotary (LBOR) Switch Replacements (MAT 56S)	$ 220	Minor increase from prior year.	WP 13-22 Line 5
30		Temperature Alarm Devices (MAT 56T)	$ 246	Minor increase from prior year.	WP 13-22 Line 6
31		**Net Change**	**$ 1,750**		
32	**2024**	**Forecast**	**$ 93,066**		
33		Reliability Related Cable Replacement (MAT 56A)	$ 649	Minor increase from prior year.	WP 13-22 Line 1
34		Cable Rejuvenation and Testing (MAT 56B)	$ 20	Minor increase from prior year.	WP 13-22 Line 2
35		Critical Operating Equipment Cable Replacement (MAT 56C)	$ 632	Minor increase from prior year.	WP 13-22 Line 3
36		Load Break Oil Rotary (LBOR) Switch Replacements (MAT 56S)	$ 225	Minor increase from prior year.	WP 13-22 Line 5
37		Temperature Alarm Devices (MAT 56T)	$ 252	Minor increase from prior year.	WP 13-22 Line 6
38		**Net Change**	**$ 1,779**		
39	**2025**	**Forecast**	**$ 94,845**		
40		Reliability Related Cable Replacement (MAT 56A)	$ 661	Minor increase from prior year.	WP 13-22 Line 1
41		Cable Rejuvenation and Testing (MAT 56B)	$ 20	Minor increase from prior year.	WP 13-22 Line 2
42		Critical Operating Equipment Cable Replacement (MAT 56C)	$ 644	Minor increase from prior year.	WP 13-22 Line 3
43		Load Break Oil Rotary (LBOR) Switch Replacements (MAT 56S)	$ 231	Minor increase from prior year.	WP 13-22 Line 5
44		Temperature Alarm Devices (MAT 56T)	$ 259	Minor increase from prior year.	WP 13-22 Line 6
45		**Net Change**	**$ 1,815**		
46	**2026**	**Forecast**	**$ 96,660**		

Workpaper Table 13-11
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
MWC 08 Forecast Details
(Thousands of Dollars)

Line No.															
1	**Distribution Base Reliability**		**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**		
2	**MAT Code**	**Project Category**	**Actual**	**Actual**	**Actual**	**Actual**	**Actual**	**Forecast**	**Forecast**	**Forecast**	**Forecast**	**Forecast**	**Forecast**	**Assumptions**	**Reference**
3	#	# Not Assigned	$ (249)	$ (581)	$ (690)	$ (2,932)	$ (541)	$ -	$ -	$ -	$ -	$ -	$ -	**(1)**	
4	08B	Base Reliability Program	$ (2)	$ 0	$ 1	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
5	08C	Cornerstone	$ 1	$ (1)	$ 0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**(2)**	
6	08D	Cornerstone	$ 6	$ (8)	$ 0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**(2)**	
7	08F	Cornerstone	$ 107	$ 140	$ (44)	$ 1	$ 10	$ -	$ -	$ -	$ -	$ -	$ -	**(2)**	
8	08J	Overhead Conductor Replacement Program	$ 31,166	$ 25,359	$ 16,192	$ 9,689	$ 16,591	$ 41,180	$ 32,688	$ 43,036	$ 44,486	$ 45,701	$ 46,934		WP 13-12
9	08S	Grasshopper/Overhead Switch Replacement Program	$ 593	$ 723	$ 414	$ 222	$ 536	$ 925	$ 949	$ 975	$ 1,001	$ 1,028	$ 1,056		WP 13-13
10	08W	System Hardening	$ 697	$ 822	$ 1	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		WP 13-12
11		**Total**	**$ 32,318**	**$ 26,456**	**$ 15,874**	**$ 6,980**	**$ 16,595**	**$ 42,105**	**$ 33,637**	**$ 44,011**	**$ 45,487**	**$ 46,729**	**$ 47,990**		

Notes

(1) These charges are miscellaneous program costs and adjustments that are not directly attributable to a specific MAT code.

(2) In D.10-06-048, the Commission approved the Cornerstone Improvement Project (Cornerstone) for 2010 through 2013, and authorized PG&E to recover the authorized costs of the Cornerstone project in electric distribution rates (D.10-06-048, mimeo, Ordering Paragraphs 1 and 4). The Commission included an "Attachment A" to its decision, which contained adopted capital expenditures for the years 2010-2013 (D.10-06-048, mimeo, Attachment A). Although Cornerstone work was planned to have been completed by the end of 2013, some Cornerstone capital projects carried over to subsequent years.

Workpaper Table 13-12
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
MAT 08J Overhead Conductor Program Forecast Details
(Nominal Dollars)

Line No.		MAT Code	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Reference
1	**Overhead Conductor Replacement Program**													
2	**OH Conductor Replacement**													
3	Circuit Feet		393,624	247,864	192,913	78,275	155,442	392,004	303,284	388,795	391,293	391,441	391,446	(1)
4	Circuit Miles		74.6	46.9	36.5	14.8	29.4	74.2	57.4	73.6	74.1	74.1	74.1	
5	Replacement Cost per Circuit Foot		$ 79.18	$ 102.31	$ 83.93	$ 123.78	$ 106.73	$ 105.05	$ 107.78	$ 110.69	$ 113.69	$ 116.75	$ 119.90	(2)
6	**OH Conductor Replacement Program Cost**	**08J**	$ 31,166,157	$ 25,359,238	$ 16,191,883	$ 9,688,726	$ 16,590,640	$ 41,180,001	$ 32,687,997	$ 43,035,716	$ 44,486,110	$ 45,700,768	$ 46,934,368	
7	**Additional Recorded Costs**	**08W**	$ 696,789	$ 822,342	$ 675	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	(3)

Forecast Assumptions and Details

(1) PG&E has approximately 81,000 overhead circuit miles in its electric distribution system. 55,000 circuit miles of overhead conductor is within non-High Fire Threat District (non-HFTD) with approximately 40,000 circuit miles consisting of small conductor defined by less than 1/0 in size. Conductor, in particular small conductor, may become annealed or deteriorated over time due to various factors. Starting in 2018, Wire Down related conductor replacement was combined with other proactive conductor replacement in MAT 08J, while MAT 08W was repurposed for the System Hardening Program. In order to help improve safety and system integrity, PG&E is forecasting to replace an average of 71 miles annually in the MAT 08J program from 2022-2026. Projects will be identified based on replacement factors such as asset age, public exposure, environmental conditions, outage history, short circuit current, and field assessments. As PG&E moves forward with this program and evaluates its performance, the number of annually replaced overhead conductor miles may increase.

(2) Cost per circuit foot is based on actual units from projects completed between 2016-2020 against the program during the year recorded. Although the unit cost fluctuates slightly from year to year, the average unit cost of this program is approximately $100/ft. For forecasting purposes, the unit costs from 2022-2026 are based on the 2021 forecast level with escalation. Fluctuations in recorded costs can be due to the following factors: large projects being completed with transmission projects and some of their associated costs being incurred by transmission, and some materials only projects that do not incur labor costs.

(3) Costs for overhead conductor replacement prior to 2018 were recorded to both MAT 08J and MAT 08W. Beginning in 2018, wire-down related conductor replacement was moved solely to MAT 08J. MAT 08W was repurposed for the System Hardening program which is discussed in chapter 4. Some recorded costs for reliability conductor replacement are still being represented in MAT 08W but are related to the work that is solely in MAT 08J and shown here for completeness purposes.

Workpaper Table 13-13
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 13 - Overhead and Underground Asset Management and Reliability
Unit Cost and Forecast Details: MAT 08S

Line No.		
1	**MAT Code**	08S
2	**GRC Ch.**	13 - Overhead and Underground Asset Management and Reliability
3	**MAT Code Definition**	Replace Obsolete OH Switches – Replace "grasshopper" OH switches installed between 1950 and 1970 to minimize potential safety issues during routine and emergency switching operations and improve reliability. Units measured: Number of switches. This program relates to safety, reliability, or maintenance because it replaces obsolete switches that have limited to load-break capabilities.

	Risk ID	Type	Name
4	DOVHD-M006	Mitigation	Grasshopper and KPF Switch Replacement

5	**Program Area**	Risk Reduction
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	Grasshopper switches installed/replaced
8	**Unit Cost (2023)**	$ 32,496
9	**Unit Cost Forecast Basis**	Implied based on forecast and planned units.
10	**Unit Forecast Basis**	Planned installation of 30 units per year.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 592,793	$ 723,292	$ 413,704	$ 221,538	$ 535,972	Calculated - Line 12 * Line 13
12	**No. of Units**	23	14	13	6	10	
13	**Unit Cost**	$ 25,774	$ 51,664	$ 31,823	$ 36,923	$ 53,597	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 925,207	$ 949,255	$ 974,883	$ 1,001,251	$ 1,028,267	$ 1,056,023	Calculated - Line 15 * Line 16
15	**No. of Units**	24	30	30	30	30	30	
16	**Unit Cost**	$ 38,550	$ 31,642	$ 32,496	$ 33,375	$ 34,276	$ 35,201	

Notes

17 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 13-14
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
MWC 49 Forecast Details
(Thousands of Dollars)

Line No.	Distribution Circuit/Zone Reliability		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026		
2	MAT Code	Project Category	Actual	Actual	Actual	Actual	Actual	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	Assumptions	Reference
3	#	Line Recloser Revolving Stock	$6,667	$6,437	$6,096	$9,033	$16,358	$10,750	$11,581	$12,488	$11,079	$11,378	$11,685		WP 13-15
4	49A	Distribution Automation Recloser SCADA Installations	$1,279	$1,904	$548	-$109	$17	$0	$6,203	$1,841	$1,891	$2,057	$2,112		WP 13-16
5	49B	Line Recloser and Control Replacements	$238	$115	$319	$16	$1	$535	$527	$4,398	$4,517	$4,639	$4,764		WP 13-17
6	49C	Overhead Fuses	$1,722	$1,721	$496	$76	$312	$882	$1,519	$1,560	$1,422	$1,497	$2,967		WP 13-18
7	49D	Line Reclosers	$2,598	$997	$703	$1,082	$573	$278	$0	$0	$0	$0	$0	(1)	
8	49E	Targeted Circuits Program	$24,838	$8,279	$4,175	$768	-$4,370	$1,533	$0	$0	$0	$0	$0	(1)	
9	49F	Underground Fuses	$774	$400	$634	$231	-$4	$0	$0	$0	$0	$0	$0	(1)	
10	49G	Interrupters	$4,020	$3,137	$196	$24	$1,262	$247	$0	$0	$0	$0	$0	(1)	
11	49H	PSPS Sect Device Inst/Repl	$89	$416	$45	$0	$0	$0	$0	$0	$0	$0	$0		
12	49I	OH Fault Indicators / Line Sensors	$2,913	$1,763	$377	$214	$318	$0	$0	$0	$0	$0	$0	(1)	
13	49S	Fault Location, Isolation and Service Restoration (FLISR)	$11,126	$9,037	$6,593	$4,764	$3,915	$2,353	$2,453	$3,721	$3,938	$4,147	$4,341		WP 13-19
14	49T	Trip Savers / Fusesavers	$11,579	$7,313	$1,549	$809	$485	$1,110	$808	$1,393	$1,363	$1,329	$1,290		WP 13-20
15	49X	Base Reliability Program	$7,563	$5,480	$3,914	$1,933	$1,308	$3,768	$3,631	$3,709	$4,764	$4,532	$5,084		WP 13-21
16	**Total**		**$ 75,406**	**$ 46,999**	**$ 25,646**	**$ 18,840**	**$ 20,175**	**$ 21,455**	**$ 26,722**	**$ 29,110**	**$ 28,974**	**$ 29,578**	**$ 32,245**		

Notes

(1) PG&E is suspending the routine work in this program in order to focus on the System Hardening program and other Wildfire risk mitigations. 2021 forecasted expenditures cover the anticipated costs to finish the programs.

Workpaper Table 13-15
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
MAT 49# Line Recloser Revolving Stock Forecast Details
(Nominal Dollars)

Line No.	Forecasted Recloser Usage	MAT	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions	Reference
1	Capacity		37	29	174	160	225	96	103	111	99	101	104	(3)	
2	Distribution Maintenance		141	166	534	439	494	251	271	292	259	266	273	(3)	
3	Electric Emergency Response		27	45	39	36	32	18	20	21	19	19	20	(3)	
4	Electric Ops & Automation		10	13	10	13	1	4	4	5	4	4	4	(3)	
5	Electric Reliability		132	95	85	279	492	147	158	170	151	155	160	(3)	
6	New Business/WRO		75	62	132	98	127	61	66	71	63	65	67	(3)	
7	Pole Management		2	1	4	12	23	7	7	8	7	7	7	(3)	
8	State Infrastructure Projects		2		0	0	0	0	0	0	0	0	0	(3)	
9	Substation Management		4	5	11	10	15	6	7	7	6	7	7	(3)	
10	Other		7	1	2	31	6	7	7	8	7	7	7	(3)	
11	**Total Program Units**		437	417	991	1,078	1,415	597	643	694	616	632	649	(1) (2)	
12	**Line Recloser Revolving Stock**														
13	Number of Line Recloser Units		437	417	991	1,078	1,415	597	643	694	616	632	649	(1)	
14	Cost per Line Recloser		$ 15	$ 15	$ 6	$ 8	$ 12	$ 18	$ 18	$ 18	$ 18	$ 18	$ 18		
15	**Total Program Cost**	**49#**	$ 6,667	$ 6,437	$ 6,096	$ 9,033	$ 16,358	$ 10,750	$ 11,581	$ 12,488	$ 11,079	$ 11,378	$ 11,685		

Forecast Assumptions and Details:

(1) Differences between recloser purchases and usage vary due to timing differences between material purchase and job construction. Reclosers are long lead-time material requiring advance purchase. Differences also exist due to inventory stock additions and depletions.
(2) Forecasts are performed at system usage level and not identified by specific program.
(3) Forecasted units per program is based on a 3-year average from 2018 to 2020, maintaining the same mix of units across programs

Workpaper Table 13-16
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 13 - Overhead and Underground Asset Management and Reliability
Unit Cost and Forecast Details: MAT 49A

Line No.		
1	**MAT Code**	49A
2	**GRC Ch.**	13 - Overhead and Underground Asset Management and Reliability
3	**MAT Code Definition**	Electric Distribution Automation Initiative, installing new Remote Terminal Units to improve operating control and visibility plus continuing to upgrade and replace obsolete, and deficient Supervisory Control and Data Acquisition (SCADA) equipment. MAT 49A 2021 Wildfire Mitigation work to upgrade the remaining Tier 3/2 existing SCADA Line Reclosers is a part of Chapter 4.3. The 2022-2026 MAT 49A Forecasts are for Base Reliability work to improve customer service reliability by install/replace distribution line SCADA equipment, majority of these locations are in Tier 1. This program relates to safety, wildfire mitigation, reliability, or maintenance because it supports the installation of electric distribution line equipment to remotely isolate electric lines and quickly de-energize facilities to address urgent safety issues such as wire down events.

	Risk ID	Type	Name
4	DOVHD-M010	Mitigation	3A and 4C Line Recloser Replacement

5	**Program Area**	Risk Reduction
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of recloser locations
8	**Unit Cost (2023)**	$ 102,303
9	**Unit Cost Forecast Basis**	2019-2020 recorded costs for similar work (MAT 49H).
10	**Unit Forecast Basis**	Together with 49B, plan to change out all 3A and 4C recloser controls.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 1,279,019	$ 1,903,802	$ 547,863	$ (109,386)	$ 17,143	Calculated - Line 12 * Line 13
12	**No. of Units**	-	-	-	-	-	
13	**Unit Cost**	$ -	$ -	$ -	$ -	$ -	

		Forecast Costs & Units (Escalated)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ -	$ 6,203,333	$ 1,841,446	$ 1,891,253	$ 2,056,535	$ 2,112,047	Calculated - Line 15 * Line 16
15	**No. of Units**	-	62	18	19	21	21	
16	**Unit Cost**	$ -	$ 100,054	$ 102,303	$ 99,540	$ 97,930	$ 100,574	

17	**Notes**	
	(A)	MAT was repurposed in 2021, 2016-2020 recorded costs reflect different type of work

Workpaper Table 13-17
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 13 - Overhead and Underground Asset Management and Reliability
Unit Cost and Forecast Details: MAT 49B

Line No.		
1	**MAT Code**	49B
2	**GRC Ch.**	13 - Overhead and Underground Asset Management and Reliability
3	**MAT Code Definition**	Recloser Control Install/Replace – Strategic upgrade of reclosers (units in-service, NOT deteriorated or damaged), includes minor communication, or other minor upgrades to expand or improve SCADA coverage and improve reliability. Units measured: Number of recloser locations. This program relates to safety, reliability, or maintenance because it provides replacement electronic recloser controls to improve the functionality of distribution line protective devices.

	Risk ID	Type	Name
4	DOVHD-M010	Mitigation	3A and 4C Line Recloser Replacement

5	**Program Area**	Risk Reduction
6	**Forecast Method**	Unit Cost
7	**Unit of Measure**	# of recloser locations
8	**Unit Cost (2023)**	$ 99,950
9	**Unit Cost Forecast Basis**	2019-2020 recorded costs for similar work (MAT 49H).
10	**Unit Forecast Basis**	Together with 49A, plan to change out all 3A and 4C recloser controls.

		Recorded Costs & Units (A) (B)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 238,022	$ 115,154	$ 319,003	$ 15,671	$ 1,480	Calculated - Line 12 * Line 13
12	**No. of Units**	-	-	-	-	-	
13	**Unit Cost**	$ -	$ -	$ -	$ -	$ -	

		Forecast Costs & Units (Escalated)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 534,558	$ 527,364	$ 4,397,807	$ 4,516,756	$ 4,638,628	$ 4,763,838	Calculated - Line 15 * Line 16
15	**No. of Units**	5	5	44	45	46	48	
16	**Unit Cost**	$ 100,000	$ 105,473	$ 99,950	$ 100,372	$ 100,840	$ 99,247	

Notes

17 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

18 **(B)** MAT was repurposed in 2021, 2016-2020 recorded costs reflect different type of work

Workpaper Table 13-18
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 13 - Overhead and Underground Asset Management and Reliability
Unit Cost and Forecast Details: MAT 49C

Line No.		
1	**MAT Code**	49C
2	**GRC Ch.**	13 - Overhead and Underground Asset Management and Reliability
3	**MAT Code Definition**	OH Fuses Install/Replace – Install New OH Fuses to improve reliability. Units measured: Number of fuses. This program relates to safety, reliability, or maintenance because it provides funding to support the installation of devices to quickly de-energize faulted lines and improve electric reliability to customers.

	Risk ID	Type	Name
4	DOVHD-C003	Control	Equipment Preventive Maintenance and Replacement - Distribution Overhead

5	**Program Area**	Asset Management and Reliability
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	# of Fused cut-out locations
8	**Unit Cost (2023)**	$ 12,105
9	**Unit Cost Forecast Basis**	Historic costs for similar types of work over past four years.
10	**Unit Forecast Basis**	Project plan that will improve reliability for the greatest number of customers.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 1,722,462	$ 1,720,672	$ 496,447	$ 75,928	$ 311,978	Calculated - Line 12 * Line 13
12	**No. of Units**	136	123	49	4	12	
13	**Unit Cost**	$ 12,665	$ 13,989	$ 10,132	$ 18,982	$ 25,998	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 882,000	$ 1,518,808	$ 1,559,813	$ 1,422,162	$ 1,496,700	$ 2,967,395	Calculated - Line 15 * Line 16
15	**No. of Units**	79	129	129	114	117	226	
16	**Unit Cost**	$ 11,175	$ 11,787	$ 12,105	$ 12,432	$ 12,768	$ 13,112	

Notes

17 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 13-19
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 13 - Overhead and Underground Asset Management and Reliability
Unit Cost and Forecast Details: MAT 49S

Line No.		
1	**MAT Code**	49S
2	**GRC Ch.**	13 - Overhead and Underground Asset Management and Reliability
3	**MAT Code Definition**	Electric Reliability Install FLISR Systems – The FLISR automation system reduces the effect of outages to customers by quickly opening and closing automated switches. This is the same automation work done previously under the Cornerstone project. Units measured: Number of circuits. This program relates to safety, reliability, or maintenance because it directly funds the installation of various electrical equipment designed to isolate faulted lines, limit the scope of electrical outages, and improve electric service reliability.

	Risk ID	Type	Name
4	None	N/A	N/A

5	**Program Area**	Asset Management and Reliability
6	**Forecast Method**	Unit cost
7	**Unit of Measure**	FLISR Circuit Activations
8	**Unit Cost (2023)**	$ 310,123
9	**Unit Cost Forecast Basis**	Historic costs for similar types of work over past years.
10	**Unit Forecast Basis**	Project plan that will improve customer reliability on the worst performing distribution circuits.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018**	**2019**	**2020**	
11	**Recorded Costs**	$ 11,125,753	$ 9,037,160	$ 6,592,847	$ 4,764,035	$ 3,915,154	Calculated - Line 12 * Line 13
12	**No. of Units**	90	92	52	25	16	
13	**Unit Cost**	$ 123,619	$ 98,230	$ 126,786	$ 190,561	$ 244,697	

		Forecast Costs & Units (Escalated) (A)						
	Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
14	**Forecast Costs**	$ 2,353,001	$ 2,452,527	$ 3,721,476	$ 3,938,256	$ 4,147,345	$ 4,341,429	Calculated - Line 15 * Line 16
15	**No. of Units**	10	10	12	15	15	15	
16	**Unit Cost**	$ 235,300	$ 245,253	$ 310,123	$ 262,550	$ 276,490	$ 289,429	

Notes

17 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.

Workpaper Table 13-20
Pacific Gas and Electric Company
2023 General Rate Case
Exhibit (PG&E-4), Chapter 13 - Overhead and Underground Asset Management and Reliability
Unit Cost and Forecast Details: MAT 49T

Line No.		
1	**MAT Code**	49T
2	**GRC Ch.**	13 - Overhead and Underground Asset Management and Reliability
3	**MAT Code Definition**	Electric Distribution Single-Phase Cutout-Mounted Recloser – Install new FuseSaver equipment and several TripSaver locations, until existing stock is exhausted. The FuseSavers installed as part of chapter 4.3 are only in wildfire locations. Units measured: Number of TripSavers/FuserSavers. This program relates to safety, reliability, or maintenance because it directly funds the installation of electrical overhead equipment designed to isolate faulted lines, limit the scope of electrical outages, and improve electric service reliability.

	Risk ID	Type	Name
4	DOVHD-C014	Control	Additional System Automation and Protection - FuseSaver
5	WLDFR-M10B	Control	Additional System Automation and Protection - FuseSaver
6	WLDFR-M10B	Mitigation	Additional System Automation and Protection - FuseSaver

7	**Program Area**	Risk Reduction / Asset Management and Reliability
8	**Forecast Method**	Unit cost
9	**Unit of Measure**	TripSavers/FuseSavers installed
10	**Unit Cost (2023)**	$ 36,880
11	**Unit Cost Forecast Basis**	Based on historic costs.
12	**Unit Forecast Basis**	Based on 2020 recorded units.

		Recorded Costs & Units (A)					Reference
	Year	**2016**	**2017**	**2018 (B)**	**2019 (B)**	**2020**	
13	**Recorded Costs**	$ 11,579,388	$ 7,312,754	$ 1,548,982	$ 809,191	$ 484,931	Calculated - Line 14 * Line 15
14	**No. of Units**	314	300	-	-	34	
15	**Unit Cost**	$ 36,877	$ 24,376	$ -	$ -	$ 14,263	

		Forecast Costs & Units (Escalated)						
	Year	**2021**	**2022 (C)**	**2023**	**2024**	**2025**	**2026**	
16	**Forecast Costs**	$ 1,110,185	$ 808,000	$ 1,392,814	$ 1,363,006	$ 1,329,077	$ 1,290,437	Calculated - Line 17 * Line 18
17	**No. of Units**	32	81	38	36	34	32	
18	**Unit Cost**	$ 34,693	$ 9,975	$ 36,880	$ 37,877	$ 38,899	$ 39,949	

Notes

19 **(A)** Cost calculations of units and unit costs displayed in workpapers may differ from recorded and forecasted amounts due to rounding.
20 **(B)** No TripSavers or FuseSavers were installed in 2018/19, recorded costs were associated with contract estimating and contract construction
21 **(C)** In 2022 only TripSavers are planned for installation, which have lower unit cost. In, 2021 and 2023-2026, only FuseSavers are planned for installation

Workpaper Table 13-21
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
MAT 49X Base Reliability Program Forecast Details
(Nominal Dollars)

Line No.	MAT	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions
1	**Base Reliability Program**												
2	Number of Divisions	19	19	19	19	19	19	19	19	19	19	19	(2)
3	Cost per Division	$ 398,035	$ 288,434	$ 206,021	$ 101,731	$ 68,821	$ 198,316	$ 191,120	$ 195,191	$ 250,719	$ 238,514	$ 267,594	(3)
4	**Base Reliability Total 49X**	7,562,668	5,480,238	3,914,394	1,932,897	1,307,593	3,768,000	3,631,287	3,708,632	4,763,652	4,531,775	5,084,277	(1)
5	**Total Base Reliability**	$ 7,562,668	$ 5,480,238	$ 3,914,394	$ 1,932,897	$ 1,307,593	$ 3,768,000	$ 3,631,287	$ 3,708,632	$ 4,763,652	$ 4,531,775	$ 5,084,277	

Forecast Assumptions and Details

(1) MAT 08B was merged into MAT 49X in 2016-2018 to better align with other reliability work.

(2) PG&E's reliability work on mitigating recurring outages is focused on addressing routine, localized reliability issues not covered by broad system-wide reliability programs. It is the responsibility of the local reliability teams within PG&E's 19 divisions to address recurring outages and ensure that customer impacts are mitigated. Analysis of specific outage events often results in the need for capital improvements such as the installation of fuses, tree-wire, bird / animal guards, etc.

(3) The average cost per division from 2021-2026 has been increased to help offset reductions to the targeted reliability programs associated with the System Hardening and other Wildfire risk mitigation efforts. These forecasts reflect the amount of funding required to return to historical funding and local reliability performance levels. This work involves performing the root cause analysis of past outage events and identifying cost effective reliability mediation work. This work focuses on preventing customers from experiencing 5 or more unplanned outages (CEMI-5) in a given year.

Workpaper Table 13-22
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
MWC 56 Summary by Project Category
(Thousands of Nominal Dollars)

Line No.	MAT - Project Category	MAT Code	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions	References
1	Reliability Related Cable Replacement	56A	$ 28,597	$ 28,246	$ 29,880	$ 30,117	$ 17,987	$ 38,013	$ 39,556	$ 36,976	$ 37,616	$ 38,266	$ 38,927		WP 13-23
2	Cable Rejuvenation and Testing	56B	$ 1,129	$ 2,328	$ 1,604	$ 3,096	$ 2,114	$ -	$ -	$ 1,117	$ 1,136	$ 1,156	$ 1,176	(2)	WP 13-24
3	Critical Operating Equipment (COE) Cable Replacement	56C	$ 33,195	$ 36,315	$ 28,503	$ 19,221	$ 21,041	$ 34,260	$ 33,030	$ 36,002	$ 36,625	$ 37,258	$ 37,901		WP 13-25
4	TGRAM/TGRAL Rocker Arm Line	56D	$ 40,520	$ 2,237	$ 370	$ 464	$ 5,182	$ -	$ -	$ -	$ -	$ -	$ -		WP 13-26
5	Load Break Oil Rotary (LBOR) Switch Replacements	56S	$ 4,793	$ 182	$ 1,362	$ 1,556	$ 5,415	$ 9,252	$ 9,493	$ 8,124	$ 8,344	$ 8,569	$ 8,800		WP 13-27
6	Temperature Alarm Devices	56T	$ -	$ -	$ 1,519	$ 2,661	$ 8,162	$ 9,589	$ 3,303	$ 9,099	$ 9,345	$ 9,597	$ 9,856		WP 13-28
7	Program Level Charges	56#	$ (243)	$ (2,392)	$ (4,780)	$ (11,831)	$ (1,906)	$ (954)	$ -	$ -	$ -	$ -	$ -	(1)	
8		**MWC 56 Total**	$ 107,991	$ 66,915	$ 58,459	$ 45,284	$ 57,995	$ 90,160	$ 85,382	$ 91,317	$ 93,066	$ 94,845	$ 96,660		

Forecast Assumptions and Details

(1) Program level charges are miscellaneous program costs and adjustments that are not directly attributable to a specific MAT code. Through the process of prioritizing work across areas and in accordance with the 2023 GRC forecast process outlined in Exhibit (PG&E-4) Chapter 2, negative forecasts were added in 2021 to ensure the total forecasts did not exceed the POR forecast.

(2) Program put on hold for 2021 and 2022 to focus resources on completing large portfolio of cable replacement projects that went through testing or injection.

Workpaper Table 13-23
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
MAT 56A Reliability Related Cable Replacement Forecast Overview
(Thousands of Nominal Dollars)

Line No.		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Assumptions	Reference
1	**Recorded/Forecast Cost**	Recorded	Recorded	Recorded	Recorded	Recorded	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast		
2	HMWPE Reliability Related Cable Replacement		$ 22,129	$ 19,023	$ 12,170	$ 15,419	$ 31,167	$ 28,106	$ 18,342	$ 18,875	$ 19,422	$ 19,985	(1)(2)	WP 13-39
3	XLP and Other Cable Reliability Related Cable Replacement		$ 427	$ 8,256	$ 3,938	$ 236	$ 6,846	$ 11,450	$ 10,088	$ 10,381	$ 10,682	$ 10,992	(1)(2)	WP 13-42
4	PILC Reliability Related Cable Replacement (Excluding Network)		$ 5,690	$ 2,601	$ 14,010	$ 2,332	$ -	$ -	$ 8,546	$ 8,359	$ 8,161	$ 7,950	(1)(2)	WP 13-46
5	**56A - Reliability Related Cable Replacement**	$ 28,597	$ 28,246	$ 29,880	$ 30,117	$ 17,987	$ 38,013	$ 39,556	$ 36,976	$ 37,616	$ 38,266	$ 38,927	(2)	

		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	
6	**Recorded/Forecast Units (in miles)**	Recorded	Recorded	Recorded	Recorded	Recorded	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	
7	HMWPE Reliability Related Cable Replacement		7.5	22.0	2.8	3.8	21.5	17.6	10.0	10.0	10.0	10.0	(3)(4)
8	XLP and Other Cable Reliability Related Cable Replacement			4.7	1.0	0.2	4.2	3.7	5.5	5.5	5.5	5.5	(3)(4)(5)
9	PILC Reliability Related Cable Replacement (Excluding Network)		1.8	1.1	0.6	3.9	0.0	0.0	2.0	2.0	2.0	2.0	(4)
10	**56A - Reliability Related Cable Replacement**	20.5	9.4	27.8	4.5	7.9	25.7	21.3	17.5	17.5	17.5	17.5	(4)

Notes and Assumptions

(1) Forecasts for cable replacement projects are estimated based on circuit feet being planned for replacement. Detailed cost estimates are used for those projects that have completed the estimating process. For forecasted projects that have not been estimated, 2018 to 2020 normalized average cost per circuit foot is used and escalated for subsequent years. This is approximately $331 per circuit foot for HMWPE and XLP cable replacements, and $672 per circuit foot for PILC cable replacements.

(2) Prior to 2017, projects were not categorized by cable type. Thus only the recorded amount total for the 56A program is shown in line 5 for year 2016.

(3) Prior to 2017, cable units and cable type were not tracked. Hence the recorded and forecast amounts are only shown for 2017 to 2026.

(4) Units and costs shown are determined once work is complete. Since some projects span multiple years and are only partially constructed in a given year, individual calendar year-end units and costs may not be reflective of actual project work performed.

(5) For 2022, the work includes replacing two runs of submarine cables (5200ft each) serving Angel Island.

Workpaper Table 13-24
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
MAT 56B Cable Rejuvenation and Testing Forecast Details
(Thousands of Nominal Dollars)

Line No.

1 **Recorded/Forecast Cost**

	Project Type	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions
3	Cable Testing	$ 954	$ 2,325	$ 1,159	$ 2,595	$ 308	$ -	$ -	$ 619	$ 636	$ 653	$ 670	(1) (2) (3)
4	Cable Rejuvenation	$ 175	$ 3	$ 445	$ 501	$ 1,806	$ -	$ -	$ 498	$ 500	$ 503	$ 505	(4) (5) (6)
5	**Total 56B**	**$ 1,129**	**$ 2,328**	**$ 1,604**	**$ 3,096**	**$ 2,114**	**$ -**	**$ -**	**$ 1,117**	**$ 1,136**	**$ 1,156**	**$ 1,176**	(8)

6 **Recorded/Forecast Units (miles)**

	Project Type	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions
8	Cable Testing		21.7	28.8	31.4	-	-	-	5.0	4.9	4.8	4.7	(2) (3) (8)
9	Cable Rejuvenation					2.0	-	-	0.5	0.5	0.5	0.5	(5) (6) (7) (8)
10	**Total 56B**	**-**	**21.7**	**28.8**	**31.4**	**2.0**	**-**	**-**	**5.5**	**5.4**	**5.2**	**5.1**	(8)

Assumptions and Details

(1) Cable Testing projects are primarily identified from the pool of Reliability Related (56A) Cable Replacement Projects. These identified cables are tested for various reasons, including but not limited to: the desire to reduce replacement scope by targeting only sections that have to be replaced, to address reliability concerns in an area at an accelerated pace, and to gather data on condition of cables in a given area.

(2) PG&E forecasts testing approximately 5 miles of cables per year in 2023 to 2026, at average unit cost of about $99,500 per circuit mile for year 2023, and escalated for proceeding years. This was calculated based on normalized 3-year average unit cost from 2017 to 2019, and escalated for future years.

(3) Future/Emergent cable testing funding is used to address areas where immediate testing may be required due to deteriorating reliability performance, requiring targeted replacements on an accelerated timeframe. In addition, future projects are identified through ongoing prioritization of existing pool of Reliability Related (56A) Cable Replacement Projects.

(4) Cable Rejuvenation projects are primarily identified from the pool of Reliability Related (56A) Cable Replacement Projects. Cable rejuvenation through injection of fluid to restore insulation is used to extend service life of cable where significant concentric neutral corrosion is not an issue.

(5) In 2019 and 2020, PG&E completed a project utilizing a combined Rejuvenation-Replacement approach, where both rejuvenation and cable replacement (for un-injectable sections) were completed under one project. This method allowed for all work to be completed within a shorter period of time. The actual unit cost normalized to 2021 was about $1.2 million per circuit mile, escalated for future years. PG&E forecasts using this approach to address 0.5 miles of cable per year from 2023 to 2026.

(6) Future rejuvenation/injection projects have not been specifically identified at the current time, but will be determined through ongoing activities in areas where testing or rejuvenation may be viable.

(7) The miles shown for 2020 include both rejuvenated and replaced cables, completed as part of a turnkey rejuvenation and replacement pilot initiated in 2019.

(8) Depending on situations and requirements, PG&E may need to modify testing vs. injection approach, all within the forecasted total 56B expenditure. As a result, the forecasted units may change.

Workpaper Table 13-25
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
MAT 56C Critical Operating Equipment (COE) Cable Replacement Forecast Details
(Thousands of Nominal Dollars)

COE Cable Replacement Projects Expenditure Forecast

Line No.	Year	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions	References
3	# of Projects	155	214	208	112	116	197	185	197	195	193	191	(1)	
4	Average Cost per Project	$ 214.2	$ 169.7	$ 137.0	$ 171.6	$ 181.4	$ 174.2	$ 178.8	$ 183.6	$ 188.5	$ 193.6	$ 198.9	(2)(3)	
5	**COE Cable Replacement Forecast MAT 56C**	**$ 33,195**	**$ 36,315**	**$ 28,503**	**$ 19,221**	**$ 21,041**	**$ 34,260**	**$ 33,030**	**$ 36,002**	**$ 36,625**	**$ 37,258**	**$ 37,901**		

Forecast Assumptions and Details

(1) The forecast work is primarily focused on decreasing the existing list of COE cable failure projects, while addressing high-priority new failures. The combined highest priority work from both categories will be addressed.

(2) The average cost per project for each year shown is total program cost divided by number of completed projects for the year. This includes completed projects, as well as projects that were actively worked on but not completed.

(3) The project unit cost for years 2021 to 2026 is based on normalized 3-year average from 2018 to 2020, escalated for 2021 through 2026.

Inventory of Projects

	Year	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast		
6	Beginning of Year Projects Requiring Failed Cable Replacement	238	322	348	358	483	603	633	675	705	737	771	(c)	
7	**Add** - Annual New Failure Projects	239	272	252	283	262	262	262	262	262	262	262	(a)(b)	
8	**Subtract** - Annual Cable Failures (Projects) to be Replaced	(155)	(214)	(208)	(112)	(116)	(197)	(185)	(197)	(195)	(193)	(191)	(1)	Line 3
9	**Subtract** - Cancelled Project		(32)	(34)	(46)	(26)	(35)	(35)	(35)	(35)	(35)	(35)	(d)(e)	
10	**Total** - End of Year Projects Requiring Failed Cable Replacement	322	348	358	483	603	633	675	705	737	771	807		Sum of lines 6 to 9

Notes relating to Inventory of Projects

(a) PG&E estimates approximately 262 new failures per year will be identified and added to the COE projects list . This is based on the 5-year average between 2016 and 2020.

(b) The number of annual new failure projects for 2016 to 2020 are calculated factoring; the beginning and end of year numbers, the replacements completed, as well as the projects cancelled in that year.

(c) The beginning of year projects count for each year is based on actual number of COE Cable Replacement Projects as of January 1. Note that end of year values (line 10) equal beginning of next year values (line 6) (i.e., 2018 end of year value is equal to 2019 beginning of year value).

(d) Some projects were cancelled after determining that the sections had already been replaced or repaired on other programs, such as emergency.

(e) PG&E estimates that about 35 projects per year between 2021 and 2026 will be replaced or repaired under emergency or other programs. This forecast is based on the 4-year average cancellation rate from 2017 to 2020.

Workpaper Table 13-26
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
Transfer Ground Rocker Arm Main/Transfer Ground Rocker Arm Line Replacements (MWC 56D) Replacement Forecast Details
(Thousands of Nominal Dollars)

Line No.	Year	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions
1													
2	Number of Units	173	6	-	1	6	-	-	-	-	-	-	(1)(2)(3)(4)
3	Cost per unit	$ 234	$ 373	NA	$ 464	$ 864							
4	Subtotal MAT 56D	$ 40,520	$ 2,237	$ 370	$ 464	$ 5,182	$ -	$ -	$ -	$ -	$ -	$ -	(4)

Forecast Assumptions and Details

(1) Transfer Ground Rocker Arm Main (TGRAM)/Transfer Ground Rocker Arm Line (TGRAL) Replacement program was initiated in 2009. The number of units above represent units replaced under MAT 56D. A number of switch units were replaced in conjunction with work in other programs; those replacements are not listed here.

(2) All identified TGRAM/TGRAL switches identified as part of the 2009 program were removed from operations by the end of 2017.

(3) Between 2018 and 2020, PG&E found a total 8 additional TGRAM/TGRAL units in the field during routine inspections, of which 7 units were replaced under this program, and 1 unit is being replaced as part of a new business project.

(4) PG&E is not presenting a forecast for MAT 56D because at the time the MWC 56 forecast was finalized, PG&E was unaware off any additional replacements needed to be made. Since then 3 potential additional units were discovered, all will be verified and prioritized for replacement by mid-2023, under 56D and other programs.

Workpaper Table 13-27
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
MAT 56S Load Break Oil Rotary (LBOR) Switch Replacement Forecast Details
(Thousands of Nominal Dollars)

Line No.	Year	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions
1													
2	Number of Units	72	7	23	12	51	93	93	77	77	77	77	(1)
3	Cost per unit	$ 66.6	$ 26.0	$ 59.2	$ 129.7	$ 106.2	$ 99.4	$ 102.0	$ 104.8	$ 107.6	$ 110.5	$ 113.5	(2)
4	Subtotal MAT 56S	$ 4,793	$ 182	$ 1,362	$ 1,556	$ 5,415	$ 9,252	$ 9,493	$ 8,124	$ 8,344	$ 8,569	$ 8,800	

Forecast Assumptions and Details

(1) LBOR Switch Replacement program was initiated in 2013. The program primarily targets replacement of LBOR switches installed prior to 1975. The units above represent units replaced under MAT 56S. Additional switches were replaced in conjunction with work in other programs; those replacements are not listed here.

(2) The project unit cost for 2021-2026 is based on normalized 3-year average of 2018-2020 unit costs, escalated for 2021 through 2026.

LBOR switches replaced under all identified programs in 2020

Line No.	MAT	Count of LBOR Units	
5			
6	10M	1	(b)
7	16H	3	(b)
8	17C	10	(b)
9	17P	2	(b)
10	2BA	8	(b)
11	2BD	13	(b)
12	49H	1	(b)
13	56A	3	(b)
14	56S	51	(a)
15	95B	1	(b)
16	Total	93	(c)

Notes
(a) All LBOR switch replaced under 56S were installed pre-1975.
(b) LBOR switches replaced under other programs were based on failure, condition assessments or redesign of the area as part of a larger project.
(c) The replacements shown here do not necessarily encompass all LBOR switch replacements systemwide. The list of non-56S projects was identified by screening for material codes of new replacement switches charged against the projects. Some emergency replacement projects may have used switches from existing stock, which would not have been captured by this screen.

Workpaper Table 13-28
Pacific Gas and Electric Company
Exhibit (PG&E-4), Chapter 13, Overhead and Underground Asset Management and Reliability
MAT 56T Temperature Alarm Devices Forecast Details
(Thousands of Nominal Dollars)

Line No.	Year	2016 Recorded	2017 Recorded	2018 Recorded	2019 Recorded	2020 Recorded	2021 Forecast	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast	2026 Forecast	Assumptions
1													
2	Number of Units			13	757	2,443	2,547	855	2,294	2,294	2,294	2,294	(1)(2)
3	Cost per unit			$ 116.9	$ 3.5	$ 3.3	$ 3.8	$ 3.9	$ 4.0	$ 4.1	$ 4.2	$ 4.3	(3)
4	Subtotal MAT 56T	$ -	$ -	$ 1,519	$ 2,661	$ 8,162	$ 9,589	$ 3,303	$ 9,099	$ 9,345	$ 9,597	$ 9,856	

Forecast Assumptions and Details

(1) Temperature Alarm Devices are installed on underground oil filled equipment in subsurfaced enclosures, primarily focused on self-protected (SP) transformers.
(2) PG&E forecasts installing an average of 2,096 units per year in 2021 to 2026.

(3) The projected unit cost for 2021 to 2026 is based on a normalized 3-year average from 2018 to 2020, escalated for 2021 through 2026.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-X), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – OVERHEAD PRIMARY CONDUCTOR REPLACEMENT

Project Title: Overhead Primary Conductor Replacement Program – non-HFTD
Major Work Categories: MWC 08J
Planning Order Numbers: Various
Project Start Date: Program started in 2013
Project Completion Date: Ongoing Program
Operative Date (only applies to Capital): Operative as installed

Project Description

Overhead Primary Conductor Replacement Program (MAT 08J)

PG&E's electric distribution system includes approximately 81,000 circuit miles of overhead conductor on its distribution system that operates between 4 and 21 kV, including bare and covered conductors. Approximately 55,000 circuit miles of this distribution conductor, including approximately 40,000 circuit miles of small conductor is in non-High Fire Threat District (HFTD) areas. Conductor may become annealed if it is subjected to excessive heating, typically because of multiple instances of fault current and/or high loads over its operating life. The annealing process can alter the mechanical properties of the conductor, causing it to become weaker and potentially sag more. The conductor's electric current carrying capacity can also decrease as its cross-sectional area shrinks. When overhead conductors become annealed and/or deteriorated, proactively replacing the conductor is an effective way to mitigate overloads and failure rates.

PG&E's Overhead Conductor Replacement Program, recorded in MAT 08J, proactively replaces overhead conductor in non-HFTD areas to address elevated rates of wires down, deteriorated/damaged conductors (example: corroded, annealed) and improve system safety, reliability, and integrity. PG&E also proactively replaces overhead conductor in HFTD areas as part of its System Hardening Program; that work is recorded in MAT 08W and is discussed in Chapter 4 of this exhibit.[1]

PG&E monitors the condition of primary overhead conductor through patrols and inspections consistent with GO 165, and targeted infrared inspections. Replacement plans are developed using failure rates obtained through wires down analysis and conductor-splice data. PG&E conducts post-event investigations of targeted equipment failure caused outages (i.e., wires down events involving conductor or splice failure). These investigations collect physical and environmental attributes to determine conductor replacement justification and priority as well as to determine failure trends. The information collected is entered into the "Engineer Investigation Wires Down Database." Analysis of this data has informed PG&E's strategy to focus replacement work on conductor types with elevated wires down rates, including small (#4 and #6 gauge) copper conductors and #4 ACSR conductors located in corrosion areas.

PG&E updated its prioritization process for overhead conductor replacements to include consideration the RAMP risk tranches with Safety Consequence Zones and/or shared protection zones with critical customer(s). The three focused tranches are: (1) corrosive regions with specific materials (ACSR), (2) elevated wires down [small copper conductors], and (3) poor reliability performance. The final definition of the Safety Consequence

[1] Before 2018, MAT 08W was used specifically for overhead conductor replacements identified during wires-down investigations and infrared inspections. Starting in 2018, that work was merged into MAT 08J, along with other types of overhead conductor replacement in non-HFTD areas, and MAT 08W was repurposed for the System Hardening Program.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-X), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – OVERHEAD PRIMARY CONDUCTOR REPLACEMENT

Zones is being developed, but currently takes into consideration: HFTD area or within buffer zones near Major Transportation Infrastructure, Public Assembly Areas, and Public Safety Entities.

PG&E's Overhead Primary Deteriorated Conductor replacement program work is site-specific and targets replacement of primary conductor segments with elevated wires down rates especially small conductor and overlap of corrosion zones, but may include some or all of the following components within the project scope boundaries:

- Primary Conductor – In most situations, the conductor is replaced with a bare conductor replacement per our standard. In specific situations, the primary conductor may be replaced with conductor insulated with abrasion resistant polyethylene coatings (sometimes referred to as covered conductor or tree wire) depending on vegetation density/type and construction.
- Secondary Conductor – replacement of lower voltage (480V and below) conductor if open wire or if secondary wire is in a deteriorated state
- Overhead distribution self-protected (SP) transformers replacement
- Wood pole condition and loading reviewed with new conductor size/type to determine if replacement is required
- Equipment (crossarm/framing, insulator, fuse, etc.) if outdated/non-standard or in a deteriorated state
- Outstanding compliance work - Typically compliance work is date driven, but if an outstanding tag overlaps 08J project timeline then it may be addressed

The precise scope of primary deteriorated replacement project work will be site-specific and dependent on local conditions. PG&E may perform more, less, or different work than what is described above. For example, where cost-effective or required, PG&E may perform some undergrounding of small sections of overhead lines. In addition, bird/animal guards will also be installed where necessary to help prevent electrical contacts and outages.

PG&E's forecast for MAT 08J is $41.2 million in 2021, $32.7 million in 2022, $43.0 million in 2023, $44.5 million in 2024, $45.7 million in 2025, and $46.9 million in 2026. See WP-13-12 line 6.

PG&E's forecast expenditures will fund the replacement of an average of 71.3 miles of overhead conductor annually from 2021-2026. This proposed level of replacement addresses the conductors with the highest risk of failures through a stringent review process and to maintain a steady replacement of aging conductors in the system. This proposed replacement level also addresses some work originally planned for 2019 and 2020 that was not completed due to estimating (design) and construction resource constraints.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-X), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – OVERHEAD PRIMARY CONDUCTOR REPLACEMENT

Justification

The Overhead Primary Deteriorated Conductor Replacement program is part of the PG&E's plan to control distribution overhead asset failures.

Risk – Overhead Primary Deteriorated Conductor Replacement work helps mitigate PG&E's Failure of Electric Distribution Overhead Assets risk by preventing live line contacts and reducing the likelihood of downed lines while helping to reduce outages and impacts from downed conductors. This work also addresses the risk of ignitions originating from wires down conditions.

Reliability – PG&E expects to achieve improved reliability performance in those areas where deteriorated conductor replacement work has been performed.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
Various POs	31,166	25,359	16,192	9,689	16,591	41,180						140,177
5543441							32,688	43,036	44,486	45,701	46,934	212,845
TOTAL PROJECT COST	**31,166**	**25,359**	**16,192**	**9,689**	**16,591**	**41,180**	**32,688**	**43,036**	**44,486**	**45,701**	**46,934**	**353,022**

Additional Cost Information:
See WP 13-12 for additional cost details

Benefits

- The primary purpose of this project is to improve safety and reliability, including:
  - Reduction in outage frequency to customers
  - Reduction in outage duration
  - Improved customer satisfaction
  - Reduce wires down condition occurrences
  - Reduce ignitions
- PG&E updated prioritization consideration of 08J projects to include RAMP risk tranches with Safety Consequence Zones and/or shared protection zones with critical customer(s). The three focused tranches are:
  - Corrosive regions with specific materials (ACSR)
  - Elevated wires down (especially small copper conductors)
  - Poor reliability performance

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-X), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – OVERHEAD PRIMARY CONDUCTOR REPLACEMENT

Other Alternatives Considered (In Addition to the Selected Alternative)

1 – Do not perform Primary Deteriorated Conductor Replacement

- Discontinuing program will decrease reliability
- Distribution Wires Down occurrences will increase. **Not recommended.**

2 — Replace more primary conductor than currently planned

- Increase capital expenditure to proactively address primary conductor failures in non-HFTD areas before they occur rather than address conductor failures on an emergency basis.
- While expanding overhead conductor replacement in non-HFTD would address the Failure of Distribution Overhead Assets risk, PG&E believes it is a lower priority than ramping up work the MAT 08W System Hardening program (which includes reconductoring with covered conductor in HFTD areas). PG&E will continue to monitor conductor performance system wide and focus on proving execution of the current funding levels of the 08J program. **Not recommended.**

3 – Execute a reduced/delayed primary conductor replacement plan

- Not advised to reduce or delay replacement of primary conductor as this will delay the programs' benefits in terms of improving public safety, preventing wires down and ignitions, and reliability. Historically, this program has not been executing the full plan due to project loading order and higher priority work. Rather than reducing work, PG&E is focusing on proving execution of the current funding levels of the 08J program. **Not recommended.**

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
Project Summary – GRASSHOPPER/OVERHEAD SWITCH REPLACEMENT

Project Title: Grasshopper/Overhead Switch Replacement
Major Work Categories: MAT 08S
Planning Order Numbers: 5541784, 5543442
Project Start Date: Ongoing
Project Completion Date: Estimated 2026
Operative Date (only applies to Capital): Operative as installed

Project Description

Grasshopper switches are an obsolete overhead distribution line switch that PG&E is eliminating from its system. These replacements are necessary as these switches approach their service lifetime and limit operational capabilities, such as breaking the load, making parallel, and breaking parallel. PG&E's ongoing Grasshopper/Overhead Switch Replacement Program proactively replaces obsolete switches installed between 1950 and 1970, to minimize potential safety issues during routine and emergency switching operations and improve reliability.

Justification

Grasshopper switches have no load break capability, subject our customers to more outages, and can be a safety issue to our field personnel. By replacing these outdated and inefficient grasshopper switches, we can mitigate safety risks and improve reliability.

Grasshopper Switch and KPF Switch Replacement is a mitigation for the failure of distribution overhead asset risk (DOVHD-M006).

Compliance- This program does not address Compliance Requirements.

Cost

The forecast unit cost per switch replacement is approximately $31,000 per unit in 2021, escalated for years 2022-2026. The cost per unit is based on 2020 recorded.

PG&E has completed 9 units in 2020 and has plans to complete 30 units in 2021 per year between 2021 and 2026. Additional units that may be completed by other programs.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
Various	593	723	414	222	536							2,487
5541784, 5543442						925	949	975	1,001	1,028	1,056	5,935
Capital Total	**593**	**723**	**414**	**222**	**536**	**925**	**949**	**975**	**1,001**	**1,028**	**1,056**	**8,422**
TOTAL PROJECT COST	**593**	**723**	**414**	**222**	**536**	**925**	**949**	**975**	**1,001**	**1,028**	**1,056**	**8,422**

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
Project Summary – GRASSHOPPER/OVERHEAD SWITCH REPLACEMENT

Benefits

- Increase safety – by replacing outdated and obsolete grasshopper switches with new switches that meet safety requirements, there is potential to avoid future safety incidents
- Reduced outages – grasshopper switches do not have load break capability and thus prolong outages. By replacing these switches, PG&E now has the ability to load break and restore some customers during outages.
- Increase reliability – grasshopper switches have limited capability to open multiple phases of the line thus reducing reliability. By replacing these switches, PG&E now has the ability to increase reliability through additional control without creating a phase imbalance.
- Enables potential automation – By replacing grasshopper switches with newer modern switches, Distribution Control Center operators will have the ability to remotely open and close the switch if SCADA is enabled.

Alternatives Considered

1. **Do not replace grasshopper switches** – this is not a viable alternative due to the fact that PG&E increasingly needs additional load breaking capabilities to manage the grid and mitigate potential impacts of emergency outages and wildfire PSPS events. If grasshopper switches remain in the system, there will be limited capability to reduce outages, which will impact safety and reliability.
2. **Accelerate the replacement of grasshopper switches** – Acceleration to potentially replace all grasshopper switches in a shorter time frame would be beneficial, but based on the current priorities of PG&E, a phased approach is more prudent and cost effective.
3. **Delay the replacement of grasshopper switches –** delaying the replacement of grasshopper switches would prolong the outage, reliability, and safety concerns that these outdated grasshopper switches present.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT AND RELIABILITY
Project Summary – 3A and 4C Line Recloser Replacement

Project Title: 3A and 4C Line Recloser Replacement
Major Work Categories: MWC 49, MATs 49A and 49B
Planning Order Numbers: Various
Project Start Date: 2021 - 2026
Project Completion Date: December 2026
Operative Date (only applies to Capital): Operative as installed.

Project Description

The Distribution Automation Recloser SCADA Installation Program (MAT 49A) includes forecasts for the replacement of outdated line recloser controllers in both HFTD areas (in 2021) and non-HFTD areas (in 2022-2026). The work in HFTD areas is considered a Wildfire risk mitigation work and is discussed in Chapter 4.3 of this exhibit. The work in non-HFTD areas is discussed here.

Work in MAT 49A and 49B is a mitigation for the Failure of Electric Distribution Overhead Assets risk (DOVHD-M10).

PG&E uses line reclosers across its electric distribution overhead system to manage, locate, and isolate faults and to re-energize circuits in the event of an outage. Some of these line recloser units use older Model 3A or 4C controllers, which have limited functionality and limited, or no SCADA capability compared to newer controller models. These functional limitations increase the risk of circuit failure and impact PG&E's ability to isolate faults and re-energize circuits in the event of an outage. Line reclosers are also categorized as protective devices and are programmed to protect customers from safety hazards due to fault conditions including wire-down incidents and sustained outages. There is a high risk of such fault incidents if these devices do not operate as intended. Since the sensor technology in existing 3A and 4C controllers is less sophisticated than in newer controllers, a line recloser equipped with a 3A or 4C controller may not detect all the faults that a newer controller would. Newer controllers have more advanced fault detection capabilities and improved SCADA which can mitigate risk.

The MAT 49A forecast in this chapter includes replacement of Model 3A and 4C recloser controllers and installation/upgrading of SCADA in non-HFTD locations where SCADA is required. SCADA is required for all reclosers located on FLISR circuits. 49A will address FLISR Recloser replacements and other Recloser locations requiring SCADA capability. The 49B Recloser program will replace 3A and 4C reclosers where SCADA capability is optional and will not install SCADA in locations where it is not needed for operating purposes, is uneconomical, or is impractical due to radio coverage limitations and costs. Newer controls are not compatible with the recloser oil-filled tank assemblies associated with the older 3A and 4C installations. Recloser control changeouts will require a complete recloser changeout including the pole in most cases.

Replacing Model 3A and 4C controllers and installing/upgrading line recloser SCADA will improve PG&E's ability to isolate faults and re-energize.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4) CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT AND RELIABILITY
Project Summary – 3A and 4C Line Recloser Replacement

PG&E is targeting replacement of all remaining 3A and 4C controllers over a 9-year period in non-HFTD areas, beginning in 2022. Units will be replaced in both 49A and 49B programs, replacing on average 65-70 units per year over that 9-year period.

Justification

Modern Reclosers have proven to be cost effective and work in conjunction with Sectionalizers, Reclosers (other, same circuit), Circuit Breakers, and overhead line fuses to increase public safety, improve reliability, and reduce costs. Locations installed with SCADA will provide operations with the ability to control and monitor circuit status. This includes the ability to remotely change Recloser settings including disabling automatic reclose. Automatic reclose is a feature designed to test circuitry after a fault has caused a device to open. When the condition that caused the fault is non persistent the Reclose will restore electricity without human intervention. Cutting out the Reclose feature is advantageous during times of high fire danger, for line work, or for other hazards which may present themselves.

Risk – Upgrading these reclosers with help to mitigate the Company's Emergency Preparedness and Response to Catastrophic Events risk by quickly isolating outages, improving reliability, and preventing customer equipment damage such as from single phasing events. Reclosers also help with mitigation of the Failure of Distribution Overhead Assets risk by providing localized isolation, offering remote isolation via SCADA, detecting load characteristics associated with these events, and rapidly opening switches to isolate wire down locations.

Compliance – Upgrading this reclosers supports the safe and reliable operation of PG&E's distribution system by providing system reliability and automatic fault isolation capabilities.

Cost

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast							
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	WP Ref
CAPITAL													
MAT 49A	1,279	1,904	548	(109)	17	-	6,203	1,841	1,891	2,057	2,112	17,743	WP 13-14, Line 4
MAT 49B	238	115	319	16	1	535	527	4,397	4,516	4,639	4,764	20,068	WP 13-14, Line 5
Total	1,517	2,019	867	-93	18	535	6,730	6,238	6,407	6,696	6,876	37,811	

Additional Cost Information:
Original scope of work for MAT 49A and 49B only involved replacing the recloser controls. Due to a change in PG&E's recloser standard, PG&E is now planning to replace both the recloser controller

and recloser tank to ensure compatibility between the two. The forecasted cost for a controller and tank recent installations is running at about $100,000 per location.

Benefits

- The primary purpose of this project is to improve safety and reliability:
  - Improved public safety by helping to isolate energized downed wires
  - Enable protective features which will address high impedance fault conditions in Non Fire Areas.
  - Reduction in outage frequency to customers
  - Reduction in outage duration
  - Improved customer satisfaction
  - Provides SCADA functionality with current communication protocals where economical to do so.
  - Platform will allow future protection elements under development to reliably detect high impedance faults.
  - Microprocessor controller with protection elements like Downed Conductor Detection and Sensitive Ground Fault will improve the ability to detect high impedance faults.

Distribution Automation MAT - Work Type	Unit Type	Projected 10 Year Workplan	2022	2023	2024	2025	2026
MAT 49B - Elect. Dist. Line SCADA - Base Reliability	SCADA Devices	Number of Units	5	44	45	46	48
		Funding	$527,000	$4,397,000	$4,516,000	$4,639,000	$4,764,000

Alternatives Considered

1 – Not replacing only the Cooper Recloser Tank and Controls with GW Viper Tank and Beckwith Controls

- Cooper Recloser tank and Controllers have become unreliable and have periodically failed. Manufacturer was slow to non-responsive to address the issues.
- New platforms allow for Downed Conductor Detection, Sensitive Ground Fault and future protection elements currently under development which will more reliably detect high impedance faults.
- Increased number of energized wires down would occur due to the inability to detect low impedance wire down events and sectionalize faults.

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EXHIBIT (PG&E-4) CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT AND RELIABILITY
Project Summary – 3A and 4C Line Recloser Replacement

- Would limit PG&E's progress on electric outage management, and outage restoration.
- Customers would experience larger and longer duration outages as a result of fewer protective devices and less automatic sectionalizing of system.

2 – Decrease the Number of Future 4C and 3A Recloser Replacements

- This alternative is not recommended as it would limit PG&E's progress on electric outage management, restoration, and wildfire risk reduction. Customers would experience larger and longer duration outages as a result of fewer protective devices and less automatic sectionalizing of system. Increased number of energized wires down would occur due to the inability to detect both high and low impedance wire down events and sectionalize faults.

3 – Increase the Number of Future Installations or escalate current five-year schedule.

- This alternative is not recommended as it would require that PG&E dramatically accelerate the number of field installations and mandate that resources be redirected from other key safety programs.

PG&E is targeting replacement of all remaining 3A and 4C controllers over a 10-year period beginning in 2022. Units will be replaced on both 49B and 49A programs, replacing on average 65-70 units per year.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – HMWPE RELIABILITY RELATED CABLE REPLACEMENT

Project Title: HMWPE Reliability Related Cable Replacement
Major Work Categories: MWC 56, MAT 56A
Planning Order Numbers: Various
Project Start Date: Various
Project Completion Date: Various
Operative Date (only applies to Capital): Operative as installed

Project Description

PG&E plans to proactively replace sections of underground High Molecular Weight Polyethylene (HMWPE) primary distribution cables throughout PG&E system to improve service reliability and customer satisfaction.

All projects will be evaluated for targeted cable replacement using testing or cable rejuvenation is a feasible alternative to wholesale cable replacement.

This program involves HMWPE cable replacement of approximately 21.5 miles in 2021, 17.6 miles in 2022, and 10 miles per year for years 2023 to 2026. Refer to WP 13-23 Line 7 for more details.

Beginning in 2017, the program started tracking the number of miles and types of cables being replaced. While specific projects are identified for current and future years, they may get reprioritized due to escalating reliability concerns in a planned area, new emerging projects, or constructability issues such as moratoriums and delayed permits.

Justification

HMWPE cable, one of the oldest types of cables in the PG&E system, was installed primarily between 1960 and 1978. These cables were mainly installed on the 200 amp underground residential distribution (URD) systems as direct buried (DB) or as cable-in-conduit (CIC). Currently there are approximately 7,600 circuit miles of HMWPE cable (about 29 percent of PG&E's primary underground distribution system), most of which is unjacketed. HMWPE cable has the second highest average failure rate of 5.5 failures per 100 miles. Factoring high failure rate and significant volume remaining in the system, HMPWE cable makes up the majority of PG&E cables that fail in a given year and need to be replaced under the COE Cable Replacement Program (56C).

Generally, the cables identified for replacement are in areas (protective zones) that have experienced 2 or more cable failures within the last 5 years. Some of these areas were subsequently tested or had rejuvenation (injection) attempted on them through Cable Rejuvenation and Testing (56B) program. Wherever practical, PG&E performs targeted replacement of cables that did not past testing or were not injectable; typically, these were found to have significant insulation and/or concentric neutral deterioration.

Replacing underground assets in a proactive manner provides several benefits. Proactive cable replacement avoids incurring higher emergency restoration costs including overtime wages, experiencing material delays, incurring fault locating costs, and unplanned customer service interruptions. In addition, replacing facilities in a proactive fashion reduces the possibility of equipment damage which can occur during a failure. Furthermore,

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – HMWPE RELIABILITY RELATED CABLE REPLACEMENT

proactive replacement supports operational flexibility and improves reliability of the underground system by removing cables that have exceeded their useful operational service lives.

The major criteria used to identify reliability-related cable replacement projects are:

1) History of failures in the area or protective zone.
2) Sections that may not meet compliance standards, such as cables with deteriorated concentric neutrals
3) Type and age of cables, some of which are known to that have an increased likelihood of failure

Risk – The program helps mitigate the risk of deteriorating service reliability and reduced customer satisfaction.

Compliance – This program does not directly address compliance requirements. However, projects within the Reliability Related (56A) Cable Replacement category do address concentric neutral corrosion in support of GO128 and PG&E standards. Many of the currently identified projects were tested under cable rejuvenation and testing program (MAT 56B), and some cable sections were found to have significant concentric neutral deterioration below GO128 requirement.

Safety and Reliability – This program is evaluated in terms of safety and reliability to determine the extent of system risk reduced by completion of the proposed work. This program is necessary for reducing safety issues and for reliability, as it has a major impact to a large number of customers.

Cost

The un-escalated unit cost used to forecast HMWPE cable replacement is about $1,702 per circuit mile ($322 per circuit foot). This is based on normalized 2018 to 2020 average costs, escalated for years 2021 to 2026. Where appropriate, PG&E factors in additional equipment costs related to more costly circuit reconfiguration.

See Workpaper Table 13-23 “56A Reliability Related Cable Replacement Forecast Overview,” for more details.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast							
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	Workpaper Reference
CAPITAL													
MWC 56, MAT 56A	NA	$22,129	$19,023	$12,170	$15,419	$31,167	$28,106	$18,342	$18,875	$19,422	$19,985	204,638	WP 13-23, Line 2
Capital Total	**NA**	**22,129**	**19,023**	**12,170**	**15,419**	**31,167**	**28,106**	**18,342**	**18,875**	**19,422**	**19,985**	**204,638**	WP 13-23, Line 2
TOTAL PROJECT COST	**NA**	**22,129**	**19,023**	**12,170**	**15,419**	**31,167**	**28,106**	**18,342**	**18,875**	**19,422**	**19,985**	**204,638**	WP 13-23, Line 2

Additional Cost Information:
Prior to 2017, cable replacement was not tracked by type. As such, no recorded costs are shown for this program for year 2016.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – HMWPE RELIABILITY RELATED CABLE REPLACEMENT

Benefits

- The primary purpose of this program is to improve service reliability, reduce the possibility of equipment damage, and increase customer satisfaction. These benefits are not readily quantifiable.
- Addressing high priority cables that are reaching the end of their useful lives is a proactive means to address potential failures. Through these actions, PG&E plans to improve service reliability, reduce the possibility of equipment damage, and increase customer satisfaction.

Alternatives Considered

1 – Discontinue Future Cable Replacements
This option does not mitigate the service reliability, equipment damage, or customer satisfaction risks associated with the aging cable system infrastructure that is past its useful service life. Higher volume of failed cables replacement would need to be addressed under MAT 56C or emergency program in MWC 17.

2 – Lower Rate of Future Installations
Reduce the total forecast expenditure by 50% and defer project completion to 2027 and beyond.

- While this alternative is better than discontinuing replacements, the slower rate of work still poses a risk to service reliability and customer satisfaction because of increased outages due to deteriorating cable. In addition, this may result in additional customer dissatisfaction due to an increased number of planned outages required to perform the work over a longer period. Furthermore, it is less efficient for PG&E to extend the length of time for the project, which may result in additional project costs.

3 – Increase Rate of Future Installations
Increase the total forecast expenditure

- This option would mitigate the risks associated with decreased service reliability and equipment damage in areas with HMWPE cables. The increased costs would require reprioritization of other Reliability Related (56A) Cable Replacement projects, which may result in the rescheduling of higher priority work.

PG&E believes that its current rate of replacement is the best option in terms of addressing the service reliability and customer satisfaction concerns at this location, as well as addressing other locations within the system.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – XLP AND OTHER RELIABILTY
RELATED CABLE REPLACEMENT

Project Title: XLP and Other Cable Reliability Related Cable Replacement
Major Work Categories: MWC 56, MAT 56A
Planning Order Numbers: Various
Project Start Date: Various
Project Completion Date: Various
Operative Date (only applies to Capital): Operative as installed

Project Description

PG&E plans to proactively replace sections of underground Cross-Linked Polyethylene (XLP) primary distribution cables throughout its system to improve service reliability and customer satisfaction.

This program involves XLP cable replacement of approximately 4.2 miles in 2021, 3.7 miles in 2022, and 5.5 miles per year in 2023 to 2026. Refer to WP 13-23, Line 8 for more details.

Beginning in 2017, the program started tracking the number of miles and types of cables being replaced. While specific projects are identified for current and future years, project schedules may change due to escalating reliability concerns in a planned area, new emerging projects, or constructability issues such as moratoriums and delayed permits.

Justification

XLP cable was primarily installed from late 1960s to 1998. These cables were installed in both the 600A system in rigid ducts, and in 200A systems as Cable in Conduit (CIC) or Direct Buried (DB). Currently there are approximately 7,796 circuit miles of XLP cables in the PG&E system, and it is estimated that about 30 percent of it is unjacketed. XLP cable has average failure rate of 1.8 failures per 100 miles. Factoring the failure rate and significant volume in the system, this cable type makes up the second largest number of PG&E cables that fail in a given year and need to be replaced under COE Cable Replacement Program (56C).

Generally, the cables identified for replacement are in areas (protective zones) that have experienced 2 or more cable failures within 5 years. Some of these areas were subsequently tested or had rejuvenation (injection) attempted on them through Cable Rejuvenation and Testing (56B) program. Wherever practical, PG&E performs targeted replacement of cables that did not pass testing or were not injectable; typically these were found to have significant insulation and/or concentric neutral deterioration.

This project also addresses replacement of other non-standard cables such as submarine (armored) cables used in water crossing areas. One project planned in 2022 involves replacing approximately 2 miles of submarine cables to Angel Island in the San Francisco Bay area.

Angel Island Submarine Cable Replacement

Angel Island is historically supplied by two submarine cables from Tiburon at a system voltage of 12 kV. Angel Island is a State Park and has about 18 permanent residents. The existing cable design is a 3-conductor #2AWG Cu, 22 kV XLPE cable with copper tape shield and galvanized steel wire armor. The submarine

section is approximately 1 mile long and crosses the Raccoon Strait in an approximately northwest-southeast direction. The two cables serving the island were installed in the 1970's replacing cables that were installed in 1912 and 1937.

On January 17, 2007, one of the two submarine cables failed on the Tiburon side halfway down the embankment. An inspection of the failure showed that the other, still energized cable had lost its armor and copper shielding tapes from the duct edge down to below the water level. In August 2009, about 150ft of the cable in operation was replaced from the shoreline at Tiburon into the water and then spliced into the existing submarine cable. This was done to stop further damage from the tide and currents slapping the cables back and forth. This was considered a temporary repair. The splice that is submerged has lasted several years but will eventually fail because of corrosive saltwater intrusion. The armor of the still operating cable is severely corroded and there is risk of cable failure due to aging and anchor damage.

In last couple of years, PG&E explored alternative micro-grid options to serve power to Angel Island instead of replacing the cables. Considering benefits to costs, reliability and life expectancy of all alternatives, the Company decided that replacing the two submarine cables to the Island is the best alternative.

The project is currently in design phase, with target construction around mid-2022, contingent on obtaining all necessary permits. PG&E forecasts that the total project will cost about $9 million.

Replacing underground assets in a proactive manner provides several benefits. Proactive cable replacement avoids incurring higher emergency restoration costs including overtime wages, experiencing material delays, incurring fault locating costs, and unplanned customer service interruptions. In addition, replacing facilities in a proactive fashion reduces the possibility of equipment damage which can occur during a failure. Furthermore, proactive replacement supports operational flexibility and improves reliability of the underground system by removing cables that have exceeded their useful operational service lives.

The major criteria used to identify reliability-related cable replacement projects are:

1) History of failures in the area or protective zone.
2) Sections that may not meet compliance standards, such as cables with deteriorated concentric neutrals
3) Type and age of cables, some of which are known to that have an increased likelihood of failure

Risk – The program helps mitigate the risk of deteriorating service reliability and reduced customer satisfaction.

Compliance – This program does not directly address the Company's Compliance Requirements. However, projects within the Reliability Related (56A) Cable Replacement category do address concentric neutral corrosion in support of GO128 and PG&E standards. Many of the currently identified projects were tested under cable rejuvenation and testing program (MAT 56B), and some cable sections were found to have significant concentric neutral deterioration below GO128 requirement.

Safety and Reliability – This program is evaluated in terms of safety and reliability to determine the extent of system risk reduced by completion of the proposed work. This program is necessary for reducing safety issues and for reliability, as it has a major impact to a large number of customers.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – XLP AND OTHER RELIABILTY
RELATED CABLE REPLACEMENT

Cost

In general, the un-escalated unit cost used to forecast the cable replacement is about $1.7 million per circuit mile ($322 per circuit foot). This is based on normalized 2018 to 2020 average costs, and escalated for years 2021 to 2026. Where appropriate, in non-standard cases such as those involving submarine cables or insulated conductors installed overhead, PG&E may factor in additional equipment and construction costs related to more complex and costly circuit reconfiguration.

See Workpaper Table 13-23 "56A Reliability Related Cable Replacement Forecast Overview," for more details.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast						
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
CAPITAL												
MWC 56, MAT 56A	NA	$427	$8,256	$3,938	$236	$6,846	$11,450	$10,088	$10,381	$10,682	$10,992	73,296
Capital Total	**NA**	**427**	**8,256**	**3,938**	**236**	**6,846**	**11,450**	**10,088**	**10,381**	**10,682**	**10,992**	**73,296**
TOTAL PROJECT COST	**NA**	**427**	**8,256**	**3,938**	**236**	**6,846**	**11,450**	**10,088**	**10,381**	**10,682**	**10,992**	**73,296**

Additional Cost Information:
Prior to 2017, cable replacement was not tracked by cable type. As such, no recorded costs are shown for this program for year 2016.

Benefits

- The primary purpose of this program is to provide safe and reliable power, reduce the possibility of equipment damage, and increase customer satisfaction. These benefits are not readily quantifiable.
- Addressing high priority cables that are reaching the end of their useful lives is a proactive means to address potential failures. Through these actions, PG&E plans to improve service reliability, reduce the possibility of equipment damage, and increase customer satisfaction.

Alternatives Considered

1 – Discontinue Future Cable Replacements
This option does not mitigate the service reliability, equipment damage, or customer satisfaction risks associated with the aging cable system infrastructure that is past its useful service life. A higher volume of failed cable replacement would need to be addressed under MAT 56C or emergency program in MWC 17.

2 – Lower Rate of Future Installations
Reduce the total forecast expenditure by 50 percent and defer project completion to 2027 and beyond.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – XLP AND OTHER RELIABILTY
RELATED CABLE REPLACEMENT

- While this alternative would be better than discontinuing replacements, the slower rate of work still poses a significant risk to service reliability and customer satisfaction as a result of increased outages due to deteriorating cable. In addition, this may result in additional customer dissatisfaction due to an increased number of planned outages required to perform the work over a longer period. Furthermore, it is less efficient for PG&E to extend the length of time for the project, which may result in additional project costs.

3 – Increase Rate of Future Installations
Increase the total forecast expenditure

- This option would mitigate the risks associated with decreased service reliability and equipment damage in areas with XLP cables. The increased costs would require reprioritization of other Reliability Related (56A) Cable Replacement projects, which may be of equal or higher priority.

PG&E believes that its current rate of replacement is the best option in terms of addressing the service reliability and customer satisfaction concerns at this location, as well as other locations within the system.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – PILC RELIABILITY RELATED
CABLE REPLACEMENT (EXCLUDING NETWORK)

Project Title: PILC Reliability Related Cable Replacement (Excluding Network)
Major Work Categories: MWC 56, MAT 56A
Planning Order Numbers: Various
Project Start Date: Various
Project Completion Date: Various
Operative Date (only applies to Capital): Operative as installed

Project Description

PG&E plans to proactively replace sections of underground Paper Insulated Lead Cable (PILC) primary distribution cables throughout PG&E's system to improve service reliability and customer satisfaction. This project describes replacements to PILC cable that are not part of PG&E's Network system; cable replacement for the Network system is recorded in MAT 56N and is described in Exhibit 4, Chapter 14.

This program involves PILC cable replacement of approximately 2 miles per year from 2023 to 2026; no work is forecast for 2021 or 2022. Refer to WP 13-23, Line 9 for more details.

Beginning in 2017, the program started tracking the number of miles and types of cables being replaced. While specific projects are identified for current and future years, they may be reprioritized due to escalating reliability concerns in a planned area, new emerging projects, or constructability issues such as moratoriums and delayed permits.

Justification

PILC cable is one of the oldest types of cables in the PG&E system, primarily installed prior to 1960. These cables were installed in both the 600A and 200A systems in rigid ducts. The program also addresses replacement of 35KV gas filled pipe type cables used for serving BART power stations for track power. Currently there are approximately 590 circuit miles of PILC cables in the PG&E system. PILC cable has the highest failure rate of about 6.3 failures per 100 miles.

Replacing underground assets in a proactive manner provides several significant benefits. Proactive cable replacement avoids incurring higher emergency restoration costs including overtime wages, experiencing material delays, incurring fault locating costs, and unplanned customer service interruptions. In addition, replacing facilities in a proactive fashion reduces the possibility of equipment damage which can occur during a failure. Furthermore, proactive replacement supports operational flexibility and improves reliability of the underground system by removing cables that have exceeded their useful operational service lives.

The major criteria used to identify reliability-related cable replacement projects are:

1) History of failures in the area or protective zone.
2) Sections that may not meet compliance standards, such as cables with deteriorated concentric neutrals
3) Type and age of cables, some of which are known to that have an increased likelihood of failure

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – PILC RELIABILITY RELATED
CABLE REPLACEMENT (EXCLUDING NETWORK)

Risk – The program helps mitigate the risk of deteriorating service reliability and reduced customer satisfaction.

Compliance – This program does not directly address compliance requirements. However, projects within the Reliability Related (56A) Cable Replacement category do address concentric neutral corrosion in support of GO128 and PG&E standards.

Safety and Reliability – This program is evaluated in terms of safety and reliability to determine the extent of system risk reduced by completion of the proposed work. This program is necessary for reducing safety issues and for reliability, as it has a major impact to a large number of customers.

Cost

The un-escalated unit cost used to forecast the cable replacement is about $3.5 million per circuit mile ($654 per circuit foot). This is based on normalized 2018 to 2020 average costs, and escalated for years 2021 to 2026. Where appropriate, PG&E factors in additional equipment costs related to more costly circuit reconfiguration. The unit cost of PILC cable replacement increased significantly in recent years due to factors such as work performed in more congested downtown areas of Oakland or San Francisco, severely deteriorated or collapsed old conduits requiring open trenching to install new conduits, as well as cases of deteriorated manholes that required installation of new enclosures and other connected equipment. Other associated costs such as repaving costs also increased as a direct result of the new conduit and enclosure installations.

See Workpaper Table 13-23 “56A Reliability Related Cable Replacement Forecast Overview,” for more details.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast							
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	Workpaper Reference
CAPITAL													
MWC 56, MAT 56A	NA	5,690	2,601	14,010	2,332	$ -	$ -	$ 8,546	$ 8,359	$ 8,161	$ 7,950	57,649	WP 13-23, Line 4
Capital Total	**NA**	**5,690**	**2,601**	**14,010**	**2,332**	**-**	**-**	**8,546**	**8,359**	**8,161**	**7,950**	**57,649**	WP 13-23, Line 4
TOTAL PROJECT COST	**NA**	**5,690**	**2,601**	**14,010**	**2,332**	**-**	**-**	**8,546**	**8,359**	**8,161**	**7,950**	**57,649**	WP 13-23, Line 4

Additional Cost Information:
Prior to 2017, cable replacement was not tracked by type. As such, no recorded costs are shown for this program for year 2016.

Benefits

- The primary purpose of this program is to improve service reliability, reduce the possibility of equipment damage, and increase customer satisfaction. These benefits are not readily quantifiable.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – PILC RELIABILITY RELATED
CABLE REPLACEMENT (EXCLUDING NETWORK)

- Addressing high priority cables that are reaching the end of their useful lives is a proactive means to address potential failures. Through these actions, PG&E plans to improve service reliability, reduce the possibility of equipment damage, and increase customer satisfaction.

Alternatives Considered

1 – Discontinue Future Cable Replacements
This option does not mitigate the service reliability, equipment damage, or customer satisfaction risks associated with the aging cable system infrastructure that is past its useful service life. Higher volume of failed cables replacement would need to be addressed under MAT 56C or emergency program in MWC 17.

2 – Lower Rate of Future Installations
Reduce the total forecast expenditure by 50 percent and defer project completion to 2027 and beyond.

- While this alternative is better than discontinuing replacements, the slower rate of work still poses a significant risk to service reliability and customer satisfaction as a result of increased outages due to deteriorating cable. In addition, this may result in additional customer dissatisfaction due to an increased number of planned outages required to perform the work over a longer period. Furthermore, it is less efficient for PG&E to extend the length of time for the project, which may result in additional project costs.

3 – Increase Rate of Future Installations
Increase the total forecast expenditure

- This option would mitigate the risks associated with decreased service reliability and equipment damage in areas with PILC cables. The increased costs would require reprioritization of other Reliability Related (56A) Cable Replacement projects, which may be of equal or higher priority.

PG&E believes that its current rate of replacement is the best option in terms of addressing the service reliability and customer satisfaction concerns at this location, as well as other locations within the system.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – LBOR SWITCH REPLACEMENT

Project Title: LBOR Switch Replacement
Major Work Categories: MWC 56, MAT 56S
Planning Order Numbers: Various
Project Start Date: 2013
Project Completion Date: December 31, 2040
Operative Date (only applies to Capital): Operative as installed

Project Description

This program covers proactive replacement of 2,125 Load Break Oil Rotary (LBOR) switch units manufactured prior to 1975 which are installed throughout the PG&E system. As of December 31, 2020, approximately 1,900 of these switches are still on the system. PG&E plans to continue to address these switches on a measured basis with a goal of completing all replacements by December 31, 2040. LBOR switches are 200 Amp rated, subsurface equipment installed in local loop, Underground Residential Developments (URD Systems). These switches make or break load using a solid blade in insulating oil mechanism and provide the operational flexibility to transfer load (customers) from one end of a local distribution loop to the other.

Justification

As PG&E's underground assets age, it is important to have established maintenance programs to ensure the safe and reliable operation of its electrical equipment. As part of this effort, PG&E has developed a proactive replacement program to address non-standard equipment which poses public and employee safety issues.

This program involves proactive replacement of LBOR switches, manually operated, oil-filled underground switches that use solid blade mechanisms immersed in oil to break or make loads. LBOR switches lack oil inspection sight glasses. This poses a greater safety risk than other types of switches because crews cannot visually verify an LBOR switch's oil level and condition before operating it. There were approximately 459 reports of failed LBOR oil switches between 2000 and 2017, some of which were catastrophic failures. About 60 percent of the catastrophic failures were on switches manufactured in the 1970s or 1980s by various manufacturers.

The primary focus of the replacement program is on switches manufactured prior to 1975 with no oil inspection sight glasses, however, PG&E may replace switches manufactured after 1975 when inspection and condition assessments indicate such work is necessary.

Risk – LBOR Switch Replacement helps mitigate safety risks to employees and the public from explosions and fires.

Compliance – This program does not directly address compliance requirements.

Safety and Reliability – This program is evaluated in terms of safety and reliability to determine the extent of system risk reduced by completion of the proposed work. This program is necessary for reducing safety issues and for reliability, as it has a major impact to a large number of customers.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – LBOR SWITCH REPLACEMENT

Cost

The forecast unit cost per switch replacement is approximately $99,500 per unit in 2021. This is based on normalized 2018 to 2020 average costs, escalated for years 2022 to 2026. The scope of work to replace these units often includes replacing the underground vault enclosure, rerouting duct lines, and replacing associated cable.

PG&E completed 165 units from 2016 to 2020, and forecasts 93 units per year in 2021 and 2022, and 77 units per year from 2023 to 2026. This forecast is only for LBOR switch replacements as part of the 56S program; other programs may also replace LBOR switches is the course of their work.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast							
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	Workpaper Reference
CAPITAL													
MWC 56, MAT 56S	4,793	182	1,362	1,556	5,415	9,252	9,493	8,124	8,344	8,569	8,800	65,890	WP 13-27, Line 4
Capital Total	**4,793**	**182**	**1,362**	**1,556**	**5,415**	**9,252**	**9,493**	**8,124**	**8,344**	**8,569**	**8,800**	**65,890**	WP 13-27, Line 4
TOTAL PROJECT COST	**4,793**	**182**	**1,362**	**1,556**	**5,415**	**9,252**	**9,493**	**8,124**	**8,344**	**8,569**	**8,800**	**65,890**	WP 13-27, Line 4

Benefits

The program helps mitigate safety risks to employees and public from explosions and fires.

Non-Cost Benefits

Addressing high priority switches that are reaching the end of their useful lives is a proactive means to mitigate potential failures, including catastrophic failures. LBOR switch failures can pose a significant risk to PG&E employees and the public. Through these actions, PG&E plans to:

- Increase public safety
- Increase employee safety
- Improve service reliability and customer satisfaction
- Reduce the possibility of equipment damage and outages.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – LBOR SWITCH REPLACEMENT

Alternatives Considered

1 – Discontinue Switch Replacements

- This option does not mitigate the public and employee safety risks associated with the catastrophic failure of LBOR switches.

2 – Reduce Rate/Quantity of Proposed Switch Replacements

- While this provides some level of mitigation, it does not adequately address the public and employee safety risks associated with the catastrophic failure of LBOR switches in an appropriate time frame. These switches are at or near the end of their service lives: the youngest LBOR units remaining on the PG&E system are already 43 years old, while the very first units installed are already 50 years old.

3 – Increase Rate of Proposed Switch Replacements to Complete Project by 2025.

- This option would mitigate the public and employee risk associated with the catastrophic failure of these switches but would result in increased costs through 2025. PG&E believes that the cadence it has forecast for the program strikes an appropriate balance between risk reduction and affordability.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – TEMPERATURE ALARM DEVICE INSTALLATION

Project Title: Temperature Alarm Device Installation
Major Work Categories: MWC 56, MAT 56T
Planning Order Numbers: Various
Project Start Date: 2018
Project Completion Date: December 31, 2026
Operative Date (only applies to Capital): Operative as installed

Project Description

PG&E initiated the Temperature Alarm Devices (TAD) program in 2018. The TAD program involves installation of temperature monitors on targeted oil-filled subsurface equipment within the system. A TAD is a battery powered remote sensing unit that uses a thermocouple magnetically attached to the side of tank on subsurface equipment. It continuously captures and analyzes temperature data from oil-filled equipment. The data is sent wirelessly via cellular network to vendor portal for monitoring. When an alarm signal is detected, the vendor will inform PG&E's Distribution department to dispatch a troubleman to deenergize equipment prior to possible failure, followed with replacement of equipment by a crew. PG&E is in the process of migrating the monitoring and dispatching functions from the vendor to internal facilities in 2021.

This program plans to install approximately 16,010 TAD units throughout PG&E system by 2026.

Justification

As PG&E's underground assets age, it is important that the company have a system to monitor the condition of some of its older underground oil-filled equipment, beyond performing visual and infrared inspections. Installing TADs will assist in ensuring to the safe and reliable operation of PG&E's electrical equipment. The strategy behind the implementation of this program is to transition to a data-informed asset replacement approach and to prevent catastrophic equipment failures. Currently TADs are installed on oil-filled equipment installed prior to 1978 in San Francisco, Oakland and San Jose. In addition, TADs are also installed on Self Protected (SP) transformers and other equipment with known manufacturing issues.

Risk – TAD installation helps mitigate safety risks to employees and the public from explosions and fires.

Compliance – This program does not directly address Compliance Requirements.

Safety and Reliability – This program is evaluated in terms of safety and reliability to determine the extent of system risk reduced by completion of the proposed work. This program is necessary for reducing safety issues and for reliability, as it has a major impact to a large number of customers.

Cost

The forecast unit cost per TAD installation is approximately $3,800 per unit in 2021, escalated for years 2022 to 2026. The scope of work is installing a battery-powered remote sensing unit that uses a thermocouple magnetically attached to the side of tank on subsurface equipment.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – TEMPERATURE ALARM DEVICE INSTALLATION

PG&E completed 3,213 units from 2018 to 2020, and forecasts 2,547 units in 2021, 855 units in 2022, and 2,294 units per year in years 2023-2026.

Major Project Spending Estimates
(Thousands of Nominal Dollars)

	Recorded					Forecast							
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	Workpaper Reference
CAPITAL													
MWC 56, MAT 56S			1,519	2,661	8,162	9,589	3,303	9,099	9,345	9,597	9,856	63,132	WP 13-28, Line 4
Capital Total	**-**	**-**	**1,519**	**2,661**	**8,162**	**9,589**	**3,303**	**9,099**	**9,345**	**9,597**	**9,856**	**63,132**	WP 13-28, Line 4
TOTAL PROJECT COST	**-**	**-**	**1,519**	**2,661**	**8,162**	**9,589**	**3,303**	**9,099**	**9,345**	**9,597**	**9,856**	**63,132**	WP 13-28, Line 4

Benefits

The program helps mitigate safety risks to employees and public from explosions and fires.

Non-Cost Benefits

Addressing underground oil-filled equipment that is reaching the end of its useful life is a proactive means to mitigate potential failures, including catastrophic failures. Underground oil-filled equipment failures can pose a significant risk to PG&E employees and the public. Through these actions, PG&E plans to:

- Increase public safety
- Increase employee safety
- Improve service reliability and customer satisfaction
- Reduce the possibility of equipment damage and outages.

PACIFIC GAS AND ELECTRIC COMPANY
EXHIBIT (PG&E-4), CHAPTER 13, OVERHEAD AND UNDERGROUND ASSET MANAGEMENT
PROJECT SUMMARY – TEMPERATURE ALARM DEVICE INSTALLATION

Alternatives Considered

1 – Discontinue TAD installations

- This option does not mitigate the public and employee safety risks associated with the catastrophic failure of underground oil filled equipment.

2 – Reduce Rate/Quantity of Proposed TAD installations

- While this provides some level of mitigation, it does not adequately address the public and employee safety risks associated with the catastrophic failure of underground oil filled equipment.

3 – Increase Rate of Proposed Switch Replacements to Complete Project by 2023.

- This option would mitigate the public and employee risk associated with the catastrophic failure of these equipment but would result in increased costs through 2023. PG&E believes that the cadence it has forecast for the program strikes an appropriate balance between risk reduction and affordability.

PACIFIC GAS AND ELECTRIC COMPANY
2023 GENERAL RATE CASE

Testimony: ☐ **Workpapers:** ☒ **SOQ:** ☐

Exhibit Number: 4 **Chapter Number:** 13

Chapter Title: Overhead and Underground Asset Management And Reliability

Witness Name: Mark Esguerra

Page No.	Line No.	Item	As Filed	As Corrected
Errata as of November 5, 2021				
WP 13-27	2	Number of units 2016-2019	2016: 77 2017; 8 2018; 24 2019; 13	2016; 72 2017; 7 2018; 23 2019; 12
WP 13-27	3	Unit costs 2016-2019	2016; $ 62.3 2017; $ 22.7 2018; $ 56.8 2019; $ 119.7	2016; $ 66.6 2017; $ 26.0 2018; $ 59.2 2019; $ 129.7
WP 13-50	2nd paragraph	Units completed	PG&E completed 173 units from 2016 to 2020	PG&E completed 165 units from 2016 to 2020
Errata as of February 25, 2022				
WP 13-28	2	Number of TAD units installed	2018: 11 2019: 870 2020: 2,551	2018: 13 2019: 757 2020: 2,443
WP 13-28	3	Cost Per Unit	2018 $138.1 2019 $3.1 2020 $3.2	2018 $116.9 2019 $3.5 2020 $3.3
WP 13-53	1	Number of TAD units installed	PG&E completed 3,432 units from 2018 to 2020	PG&E completed 3,213 units from 2018 to 2020