March 17, 2015

Advice Letter 4576-E

Meredith Allen  
Senior Director, Regulatory Relations  
Pacific Gas and Electric Company  
77 Beale Street, Mail Code B10C  
P.O. Box 770000  
San Francisco, California 94177

SUBJECT: Smart Grid Detect and Locate Distribution Line Outages and Faulted Circuit Conditions Pilot Project - Phase 1 Status Report, Pursuant to D.13-03-032.

Dear Ms. Allen:

Advice Letter 4576-E is effective as of March 1, 2015.

Sincerely,

Edward Randolph  
Director, Energy Division
January 30, 2015

Advice 4576-E
(Pacific Gas and Electric Company ID U 39 E)

Public Utilities Commission of the State of California

Subject: Smart Grid Detect and Locate Distribution Line Outages and Faulted Circuit Conditions Pilot Project - Phase 1 Status Report, Pursuant to Decision 13-03-032

Purpose

The purpose of this advice letter is to comply with Ordering Paragraph (OP) 9 of Decision (D.) 13-03-032, Decision Granting, in Part, and Denying, in Part, Pacific Gas and Electric Company's Application for Smart Grid Pilot Deployment Project, which directs Pacific Gas and Electric Company (PG&E) to submit a status report via a Tier 2 Advice Letter within 14 days of the completion of each phase of each approved Smart Grid pilot. The Smart Grid Detect and Locate Distribution Line Outages and Faulted Circuit Conditions Pilot Project (Pilot) has completed the key objectives of Phase I as described in Advice Letter 4227-E. Therefore, PG&E submits this status report for review and approval to commence Phase 2 of the Pilot.

Background

On November 21, 2011, PG&E filed Application (A.) 11-11-017 requesting authorization to recover costs for implementing six Smart Grid Deployment Pilot Projects over four years. The Smart Grid Deployment Pilot Projects seek to advance the modernization of PG&E's electric grid consistent with California’s energy policies as described in Senate Bill (SB) 17 and PG&E’s Smart Grid Deployment Plan which was filed on June 30, 2011, and approved on July 25, 2013.

On March 27, 2013, in D.13-03-032, the California Public Utilities Commission (Commission or CPUC) approved four of the Smart Grid Pilot projects proposed by PG&E in its November 2011 application: (1) the Smart Grid Line Sensor Pilot Project, (2) the Smart Grid Voltage and Reactive Power Optimization Pilot Project,

1 PG&E’s Advice Letter 4227-E, Smart Grid Pilot Deployment Projects Implementation Plan, Pursuant to D.13-03-032, submitted for filing on May 22, 2013, and approved effective June 21, 2013, by the CPUC’s Energy Division.
(3) the Smart Grid Detect and Locate Distribution Line Outages and Faulted Circuit Conditions Pilot Project, and (4) the Smart Grid Short Term Demand Forecast Pilot Project. OP 9 of D.13-03-032 states:

“Within 14 days of the completion of each phase of each approved pilot, PG&E shall submit a status report via a Tier 2 Advice Letter to Commission staff. Each status report must include a) details of the activities occurring in the phase; b) a detailed breakdown of the costs of those activities; c) the results of the phase including evaluation and measurements of pre-selected metrics to portray the success or failure of the pilot phase; and d) a recommendation and rationalization of whether the pilot should advance to its next phase. PG&E should ensure that status reports are detailed, both quantitatively and qualitatively. Funding for subsequent phases, although approved in this decision, may not be spent by PG&E until the Advice Letter for the current phase is submitted and approved.”

Discussion

PG&E has achieved its key Pilot Phase 1 goals and objectives, as described below and in Attachment 1, and is ready to proceed to Phase 2. Specifically, PG&E has demonstrated viable calculated fault location (CFL) solutions that are ready for field deployment. PG&E submits this Advice Letter upon completion of the key Phase 1 objectives in order to allow for timely CPUC evaluation of the Phase 1 work and transition of work to Phase 2 to ensure a timely ability to order, deploy, and install the equipment and systems necessary to capture the Pilot Project results beginning in the fall of 2015 when the system experiences higher levels of faults and outages due to seasonal storm events. Based on lab testing, PG&E has determined that it is viable for CFL solutions to enhance grid outage detection, problem isolation, and restoration, as well as enhance grid system safety, monitoring, control, and analysis. PG&E believes that an understanding of the benefits potential for CFL software will be achieved by having the system in place throughout the fall and winter of 2015 in order to create a baseline for future evaluation. During 2016, the pilot will continue to study basic CFL and also explore potential advanced functionality.

Overview of the Smart Grid Detect and Locate Distribution Line Outages and Faulted Circuit Conditions Project

Through its Pilot project, PG&E will evaluate the technological capabilities to improve response to events and conditions that lead or could lead to an outage and/or adversely impact public safety, such as detection of open phases and high-impedance faults. The desired outcomes include reducing outage and hazard response time and providing enhanced data to improve the efficiency and operation of the distribution system.
CFL solutions offers two potential direct benefits:

1. Increased System Reliability – CFL would assist in reducing the duration of customer outages by more granularly helping locate outages.

2. Reduced Cost of Outage Response – CFL seeks to reduce costs associated with outage response. It assists in pinpointing outages to a limited number of possible locations on the distribution circuit, therefore reducing overall patrol time. CFL potentially accomplishes outage response more effectively than existing solutions by complementing SmartMeter™ outage data. SmartMeter™ data is effective at scoping the extent of an outage (i.e., customers impacted, and verifies restoration to each customer) but CFL data has the potential to add information on where the fault location is within the outage area. The CFL solution will communicate back to the distribution operations central authority for that distribution circuit to direct the field troubleshooter to a more defined area, reducing overall truck roll time. The field troubleshooter will then be able to locate the problematic equipment sooner, allowing repairs to start, which will reduce hazardous situations and customer outage duration.

In addition to the system reliability and cost benefits, this Pilot may result in public safety benefits:

   Improved Safety - CFL will seek to provide information about previously undetected hazardous conditions. If the Pilot is able to successfully locate downed wire locations, PG&E may be able to respond more quickly in order to keep the public away from potentially hazardous conditions. Additionally, if PG&E is able to detect and locate faults more quickly, power may be more quickly restored to customers, reducing the potentially hazardous secondary impacts of power outages.

Detect and Locate Distribution Line Outages and Faulted Circuit Conditions Pilot Phase 1 – Analysis and Laboratory Test Results

The analysis and laboratory test phase involved: (1) assessing the fault analysis systems available in the industry in production and/or being used by other utilities to identify solutions that will meet PG&E’s needs, (2) analyzing and identifying the technology requirements necessary to support fault analysis system implementation, and (3) in a laboratory environment, testing the selected fault analysis systems and devices and identifying the specific solution and supporting technologies to use for the field trial.

As described in further detail in Attachment 1, PG&E has successfully completed the key objectives of Phase 1 and recommends moving to Phase 2. It is important
that PG&E begin the Phase 2 activities no later than April 1, 2015, to ensure that it can order, deploy, and install the equipment and systems necessary to capture the Pilot Project results beginning in the fall of 2015 when the system experiences higher levels of faults and outages due to seasonal storm events. PG&E believes the authorized Phase 1 activities will be completed in March 2015.

Detect and Locate Distribution Line Outages and Faulted Circuit Conditions Pilot Phase 2 – Field Trial

In Phase 2, PG&E will perform field trials of CFL solutions on distribution feeders on a subset of PG&E’s divisions and proceed to operate, evaluate and demonstrate the project in a field trial. In addition to testing the field capabilities of CFL solutions, PG&E’s Phase 2 deployment will attempt to leverage and complement SmartMeter™ technology.

Protests

Anyone wishing to protest this filing may do so by letter sent via U.S. mail, facsimile or E-mail, no later than February 19, 2015, which is 20 days after the date of this filing. Protests must be submitted to:

CPUC Energy Division
ED Tariff Unit
505 Van Ness Avenue, 4th Floor
San Francisco, California 94102

Facsimile: (415) 703-2200
E-mail: EDTariffUnit@cpuc.ca.gov

Copies of protests also should be mailed to the attention of the Director, Energy Division, Room 4004, at the address shown above.

The protest shall also be sent to PG&E either via E-mail or U.S. mail (and by facsimile, if possible) at the address shown below on the same date it is mailed or delivered to the Commission:

Meredith Allen
Senior Director, Regulatory Relations
Pacific Gas and Electric Company
77 Beale Street, Mail Code B10C
P.O. Box 770000
San Francisco, California 94177

Facsimile: (415) 973-7226
E-mail: PGETariffs@pge.com
Any person (including individuals, groups, or organizations) may protest or respond to an advice letter (General Order 96-B, Section 7.4). The protest shall contain the following information: specification of the advice letter protested; grounds for the protest; supporting factual information or legal argument; name, telephone number, postal address, and (where appropriate) e-mail address of the protestant; and statement that the protest was sent to the utility no later than the day on which the protest was submitted to the reviewing Industry Division (General Order 96-B, Section 3.11).

**Effective Date**

PG&E requests that this Tier 2 advice filing become effective on regular notice, **March 1, 2015**, which is 30 calendar days after the date of filing.

**Notice**

In accordance with General Order 96-B, Section IV, a copy of this advice letter is being sent electronically and via U.S. mail to parties shown on the attached list and the service list for A.11-11-017. Address changes to the General Order 96-B service list should be directed to PG&E at email address PGETariffs@pge.com. For changes to any other service list, please contact the Commission’s Process Office at (415) 703-2021 or at Process_Office@cpuc.ca.gov. Send all electronic approvals to PGETariffs@pge.com. Advice letter filings can also be accessed electronically at: http://www.pge.com/tariffs

/S/
Meredith Allen
Senior Director, Regulatory Relations

Attachment

cc: Service List A.11-11-017
Company name/CPUC Utility No. Pacific Gas and Electric Company (ID U39 E)

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<tr>
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<th>Contact Person: Shirley Wong</th>
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<tr>
<td>☐ PLC</td>
<td>☐ HEAT</td>
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<tr>
<td>☐ WATER</td>
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<td>E-mail: <a href="mailto:slwb@pge.com">slwb@pge.com</a> and <a href="mailto:PGETariffs@pge.com">PGETariffs@pge.com</a></td>
</tr>
</tbody>
</table>

EXPLANATION OF UTILITY TYPE

ELC = Electric       GAS = Gas       ☐
PLC = Pipeline       HEAT = Heat      WATER = Water

Advice Letter (AL) #: 4576-E Tier: 2
Subject of AL: Smart Grid Detect and Locate Distribution Line Outages and Faulted Circuit Conditions Pilot Project - Phase 1 Status Report, Pursuant to Decision 13-03-032
Keywords (choose from CPUC listing): Compliance
AL filing type: ☐ Monthly ☐ Quarterly ☐ Annual ☑ One-Time ☐ Other _____________________________
If AL filed in compliance with a Commission order, indicate relevant Decision/Resolution #: Decision 13-03-032
Does AL replace a withdrawn or rejected AL? If so, identify the prior AL: No
Summarize differences between the AL and the prior withdrawn or rejected AL:
Is AL requesting confidential treatment? If so, what information is the utility seeking confidential treatment for: No
Confidential information will be made available to those who have executed a nondisclosure agreement: N/A
Name(s) and contact information of the person(s) who will provide the nondisclosure agreement and access to the confidential information: ___________________________________________
Resolution Required? ☐ Yes ☑ No
Requested effective date: March 1, 2015 No. of tariff sheets: N/A
Estimated system annual revenue effect (%): N/A
Estimated system average rate effect (%): N/A
When rates are affected by AL, include attachment in AL showing average rate effects on customer classes (residential, small commercial, large C/I, agricultural, lighting).
Tariff schedules affected: N/A
Service affected and changes proposed: N/A
Protests, dispositions, and all other correspondence regarding this AL are due no later than 20 days after the date of this filing, unless otherwise authorized by the Commission, and shall be sent to:

CPUC, Energy Division
ED Tariff Unit
505 Van Ness Ave., 4th Floor
San Francisco, CA 94102
E-mail: EDTariffUnit@cpuc.ca.gov

Pacific Gas and Electric Company
Attn: Meredith Allen, Senior Director, Regulatory Relations
77 Beale Street, Mail Code B10C
P.O. Box 770000
San Francisco, CA 94177
E-mail: PGETariffs@pge.com
ATTACHMENT 1

Pacific Gas and Electric Company

Smart Grid Detect and Locate Distribution Line Outages and Faulted Circuit Conditions
Pilot Project
Completion of Phase 1 Key Objectives Report

Advice 4576-E

January 30, 2015
This status report summarizes the completion of Phase 1 Key Objectives of the Smart Grid Detect and Locate Distribution Line Outages and Faulted Circuit Conditions Pilot Project (FDL). As part of Phase 1, PG&E evaluated calculated fault location (CFL) vendors as the technology to fulfill the Pilot Project goals. Details presented in this Report support the conclusion that, based on lab testing, it is viable for CFL solutions to enhance grid outage detection, problem isolation, and restoration, as well as enhance grid system safety, monitoring, control, and analysis.

Therefore, PG&E recommends and requests approval to proceed with the Phase 2 Field Demonstration as described in Advice Letter (AL) 4227-E.
1. Goals and Objectives

The goal of the Pilot Project is to evaluate the technological capabilities to improve response to events and conditions that lead or could lead to an outage and/or adversely impact public safety, such as detection of open phases and high-impedance faults. The desired outcomes include reducing outage and hazard response time and providing enhanced data to improve the efficiency and operation of the distribution system.

PG&E was authorized to perform tasks in Phase 1 to meet these Phase 1 objectives and goals:

- PG&E will assess the fault analysis systems available in the industry in production and/or being used by other utilities to identify solutions that will meet PG&E’s needs.
- PG&E will analyze and identify the technology requirements necessary to support fault analysis system implementation.
- In a laboratory environment, PG&E will test the selected fault analysis systems and devices and identify the specific solution and supporting technologies to use for the field trial.

PG&E has fulfilled the goals and objectives of Phase 1. Based on findings obtained in Phase 1, PG&E requests approval to proceed to Phase 2. In Phase 2, PG&E will perform field trials of CFL solutions on distribution feeders on a subset of PG&E’s divisions and proceed to operate, evaluate and demonstrate the project in a field trial.

In addition to testing the field capabilities of CFL solutions, PG&E’s Phase 2 deployment will attempt to leverage and complement SmartMeter™ technology.

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1 AL 4227-E, Page 25
2. Project Background

The overall Pilot Project objective is to pilot and evaluate fault detection and location solutions using CFL technology. CFL refers to the new technology for locating faults based on measured values, and then calculating how many feet away the fault is from the substation or measurement location. The Pilot will also look at fault anticipation, high impedance faults, and downed wire location. Fault anticipation (FA) is the use of waveform analysis to identify failing equipment and high impedance faults (HZF) which are not the result of broken or downed wires. HZF is the unintended contact between a primary distribution line and a low or non-conducting object. A downed wire location (DWL) is the subset of HZF where a primary wire is broken and may be on the ground.

The objective of this Pilot is similar to the objective of the Line Sensor Pilot (LS), but there are many significant differences between the two pilots. The basic purpose of both pilots is to isolate faults for faster and less costly repairs. The FDL Pilot seeks to achieve this by utilizing a centralized software that provides multiple potential fault location points and can be implemented across circuits with SCADA. The LS Pilot seeks to achieve this by utilizing distributed devices that can locate a fault between two devices, but whose implementation scheme will be limited to selected locations prone to faults and primarily on main lines. These projects are complimentary and have the potential to provide additional benefits when used in parallel. Additionally, this Pilot has potential public safety benefits with the potential advanced capability of detecting High Impedance Faults which were previously undetected.

3. Benchmarking with Other Utilities

PG&E held benchmarking interviews with utilities including Florida Power & Light, Commonwealth Edison, San Diego Gas & Electric, Oklahoma Gas & Electric, and Entergy to understand drivers for implementing CFL solutions, vendor selection processes and outcomes as experienced at other utilities.

PG&E’s benchmarking sessions have identified lessons learned from these peer utilities. Some of the key learnings:

- Pilot should target vendors that are open to using data from multiple different field devices and vendors
- Data quality is critical to successful fault location results
- Due to multiple location results, calculated fault location software should either be augmented with line sensors or utilized as advisement, since the technology cannot pinpoint exact fault locations
- Calculated fault location software is anticipated to capture between 50%-70% of all faults; remaining faults are not captured due to non-zero fault impedance or other valid factors

PG&E is able to incorporate value from this benchmarking on feeders where SCADA communications exist for appropriate substation relays. Part of the Phase 2 analysis will include developing the cost-benefit analysis for upgrading communications on additional feeder devices that could further benefit CFL analysis.
4. Prospective Vendors: Evaluation and Selection

PG&E pursued a two-stage vendor evaluation process: 1) an initial Request for Information (RFI) to clearly understand commercially available CFL solutions and 2) a detailed investigation of vendors shortlisted based on the RFI. The two phases of the evaluation are described in the subsections below.

Request for Information (RFI)
PG&E issued an RFI in December 2013 to evaluate the capabilities of available CFL products. PG&E engaged industry experts to ensure the RFI would provide information relevant for the selection of candidate vendors from whom additional information would be requested. The RFI focused on the following attributes of the vendor technologies:

- Overall CFL Solution Approach
- Solution Functionality
- Reporting, Analytics, and EM&V Capabilities
- System Maintenance and Support Requirements
- Application Architecture
- Network and Communications
- Security
- System Integration
- Existing Installations / Customers
- Total Cost of Ownership

Twelve calculated fault location vendors responded to the RFIs and were evaluated by project stakeholders including PG&E Electric Distribution Operations, Asset Management, and IT organizations. The vendor evaluation was aligned with the PG&E’s sourcing policies and included consideration of supplier diversity, safety, and environmental responsibility, in addition to the technical evaluation of vendor responses. Seven vendor offerings were selected for detailed investigation in the evaluation process.

Detailed Investigation
The detailed investigation included review and assessment of:

- Vendor responses to specific PG&E requests and needs
- Ability to leverage PG&E’s existing and planned infrastructure and systems
- Vendor clients and confirmation of references
- System integration options including interfaces to existing PG&E systems such as SCADA
- Vendor roadmap and future product enhancement potentials
- Vendor specific functionality
- Vendor product communications path options
Vendor Selection Lessons Learned Include:

- The Smart Grid CFL marketplace is relatively small with fewer vendors responding to the RFI than for the other Smart Grid pilots. Distribution Management System (DMS) vendors are offering calculated fault location applications as a new extra feature to their base functionality.

- Available vendors fall into two general categories: 1) “simple” products were more easily integrated but lacked some features, such as detection of high impedance faults or automation and 2) “advanced” products offered a more robust algorithm that present some challenges for integration and require additional data in order for their advanced results.

Conclusion
Two vendors were selected for laboratory testing after passing the RFI product evaluation. These two vendors represent a cross-section of vendor products after passing screening of the RFI review and customer reference due diligence. The products evaluated in the lab included a cross section of “simple” to “advanced” options. The selected vendors (Ventyx and Electrotek) were evaluated in the Phase 1 testing and evaluation at PG&E’s Applied Technology Services (ATS) laboratory in San Ramon.

5. Laboratory Test Environment

PG&E’s ATS laboratory is a multidisciplinary team of 100 engineers, scientists, and technicians committed to delivering practical testing solutions to the electric and gas industry’s challenging problems. The facility houses multiple laboratories supporting comprehensive and often simultaneous testing in power laboratory facilities, environmental chambers, IT and communications laboratories.

6. Laboratory Testing

Laboratory Testing performed at the ATS facility focused on accuracy of vendor solutions and provided information that supports development of design, operating instructions, and training in support of the Phase 2 field pilot.

The lab testing has been conducted using actual field data (actual faults with known locations) which is post processed using the vendor solutions to calculate estimated fault locations. The field data represents a mix of feeder topologies and fault types based on where actual faults occurred during the testing. Fault event waveforms, which show the electrical patterns that occur during a fault, were captured by substation relays and fed into vendor solutions and compared to actual fault locations obtained from PG&E records.
7. Analysis and Laboratory Test Results

Product Requirements:

PG&E System Integration
Production user interface (UI) shall be cost-efficient to integrate into the existing tools used by Distribution Operators (e.g., ‘As Operated Model’, SCADA, PI).

Detection
The CFL solution shall accurately detect, analyze and identify various types of events, such as line-to-ground faults, double-line-to-ground faults, line-to-line faults, three-line-to-ground faults, high-impedance faults, open phases, and conditions that may lead to an outage. Also, the CFL shall accurately locate and appropriately communicate/display system fault locations.

Fault Location Accuracy
The CFL solution shall provide accurate fault location projections, based on the assumption that all required fault related data is correct, including system impedance/connectivity model. Furthermore, the fault location solution should not be highly sensitive to system topology.

User Interface and Result Presentation
The CFL solution should provide functional and user-friendly interface to PG&E staff.

Conclusions
The extensive laboratory testing of vendor products indicate both of the tested vendor products have the necessary features and functions to demonstrate capabilities of calculated fault detection.

Significant Knowledge Gained:
PG&E has developed significant knowledge surrounding the two different approaches to calculating fault location. Major areas of knowledge improvement surrounding these approaches include:

Overall CFL advanced potentials
- Potential opportunities for improving the accuracy of CFL include higher accuracy in fault current measurements, higher accuracy of circuit connectivity and impedances, and additional analytics.
- Possibility of line sensors, voltage measurements, or added SmartMeter™ functions to improve location reliability and eliminate the return of multiple locations from CFL.
- Availability of developments in synchrophaser and other advanced technologies as a means for improving CFL performance. PG&E will track industry developments by participating events such as academic workshops, IEEE Power and Energy Society meetings, vendor focus groups, and other industry events.
Root Mean Squared (RMS) current based approach
The RMS current approach provided by Ventyx is an extension of PG&E’s present DMS system, which minimizes integration needs for field deployment. This system also only needs a fault current value communicated from a protective relay or other measuring device. The current value represents a very small amount of data and can be transported over existing PG&E SCADA communications channels. PG&E proposes to promote this product to field deployment in Phase 2.

Waveform Analysis (WA) based approach
The WA approach under evaluation provided by Electrotek would require significant integration work in order to support a production deployment, which includes requiring interfaces to obtain and maintain the as-switched network model and to provide data to DMS. This approach also requires transport of waveforms, which for full-scale production would need to be provided in real time. Initial lab testing did not demonstrate sufficient improved performance to justify the much higher cost and effort for real time field testing of this application. However, continued production level testing and evaluation is required to determine:

- If applied in a very large number of cases a clear performance advantage is demonstrated.
- If use of waveform analysis does provide a potential for successful high impedance fault detection and location.

During Phase 2, PG&E will obtain waveform data as available and as practical from relays across the system after fault events. These will be processed post event and the resultant location results will be compared with the real time RMS method results and a determination made if any additional benefits such as reduced patrol time would have resulted. Gathering this waveform data will also support further investigation of high impedance fault detection and the potential for “fault prediction.”

8. Recommendations for Pilot Program Refinements
PG&E believes that funding is sufficient to make the following refinements to certain items mentioned in AL 4227-E:

- PG&E proposes exploring the possibility of installing one of the vendor solutions on additional feeders. PG&E selected these vendors in part because their technology deployment could scale cost effectively, thus allowing PG&E to potentially scale the pilot testing without exceeding the overall budget. PG&E proposes installing the Ventyx solution on potentially all feeders where fault current detection is possible, which represents approximately an estimated half of all PG&E feeders. Additionally, PG&E proposes testing the Electrotek solution on all feeders where waveform detection is practical.
• PG&E proposes continuing to monitor the vendor product industry. If a significant product is introduced or modified, PG&E would be able to perform lab testing and promote it to the field if necessary testing is confirmed.

PG&E will only fund and undertake activities to the extent there is funding available within the existing approvals.

9. Selection of Feeders for Phase 2 Field Trials

PG&E believes that without exceeding the overall budget, CFL capabilities can be turned on in significantly more locations than just the 15 feeders that were originally proposed. Because faults occur unpredictably at unknown locations and unknown times, wider coverage will allow the project to access data and results from significantly more faults. As part of Phase 1, PG&E identified feeder location selection criteria and rationale for the Phase 2 field pilot. In planning for Phase 2, project stakeholders are being consulted about feeder selection to ensure that piloting CFL technology would not adversely impact PG&E’s ability to deliver safe, reliable, and affordable electrical service to customers served by the pilot feeders. The primary limiting factor for deploying the RMS vendor solution through the PG&E system is the product need for SCADA communications availability to either the substation or line reclosers. PG&E intends to deploy CFL capability to both overhead and underground locations where there is adequate SCADA communications. If feasible, this deployment coverage would represent approximately half of all feeders in the PG&E system, which will allow the effectiveness and potential of the solution to be well analyzed.

10. Benefits Assessment

High level benefits estimates were provided in AL 4227-E. Phase 1 testing and analysis did not uncover material new issues, relevant to costs or benefits, for the core value applications of improved reliability and optimized operation of distribution lines. CFL technology continues to offer the following potential direct benefits to customers:

• Increased System Reliability – CFL would assist in reducing the duration of customer outages by more granularly helping locate outages.

• Reduced Cost of Outage Response – CFL seeks to reduce costs associated with outage response. It assists in pinpointing outages to a limited number of possible locations on the distribution circuit, therefore reducing overall patrol time. CFL potentially accomplishes outage response more effectively than existing solutions by complementing SmartMeter™ outage data. SmartMeter™ data is effective at scoping the extent of an outage (i.e., customers impacted, and verifies restoration to each customer) but CFL data has the potential to add information on where the fault location is within the outage area. The CFL solution will communicate back to the distribution operations central authority for that distribution circuit to direct the field troubleshooter to a more defined area, reducing overall truck roll time. The field troubleshooter will then be
able to locate the problematic equipment sooner, allowing repairs to start, which will reduce hazardous situations and customer outage duration.

In addition to the system reliability and cost benefits, this Pilot may result in public safety benefits:

- **Improved Safety** - CFL will seek to provide information about previously undetected hazardous conditions. If the Pilot is able to successfully locate downed wire locations, PG&E may be able to respond more quickly in order to keep the public away from potentially hazardous conditions. Additionally, if PG&E is able to detect and locate faults more quickly, power may be more quickly restored to customers, reducing the potentially hazardous secondary impacts of power outages.

Based on engineering analysis performed in the lab during Phase 1, PG&E has prepared demonstrations that confirm that CFL has the potential to offer these System Reliability and Outage Response benefits. As a lab study in Phase 1, the benefits can only be estimated by simulation of real events. Phase 2 pilot deployments will provide real operational data and inform PG&E regarding all targeted benefit elements. Cost and benefit models will be enhanced during the deployment and operation stages to capture a higher detail of cost and benefit elements.

### 11. Pilot Project Milestones and Timeline by Phases

Table 1 provides updated project phases milestones and expected timelines for the Detect and Locate Distribution Line Outages and Faulted Circuit Conditions Pilot. The forecasted timeline for Phase 2 is 2014 through 2016 with the major milestones and duration as shown in Table 1:

**Table 1: Project Milestones by Phase**

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<th>Description of the Phases and Key Milestones/Deliverables</th>
<th>Start Date</th>
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<td><strong>Phase 1: July 2013 – January 2015</strong></td>
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<tr>
<td>• <strong>Plan/Analyze</strong>: benchmark CFL implementations, assess and select vendors for testing, negotiate testing contract</td>
<td>8/13/2013</td>
<td>8/30/2014</td>
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<td>• <strong>Critical solution testing</strong>: setup and test critical features two CFL solutions at PG&amp;E’s ATS facility. Phase 1 critical solution testing has verified that vendor solutions are ready to proceed to Phase 2</td>
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• **Continued analysis and testing of additional CFL functionality:** Additional non-critical Phase 1 analysis of vendor products and Phase 2 planning
  
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Phase 1 costs were previously forecast to be approximately $2.3 million. Therefore, PG&E is presently forecasting to exceed that estimate by approximately $0.4 million. This variance is largely due to higher than expected costs and delays associated with acquiring real fault event data from PG&E’s system for use as the testing data set.
Despite the Phase 1 forecast variance, PG&E anticipates that all project objectives will be achieved without exceeding the authorized budget of $12.6M.

13. Summary and Recommendation to Proceed to Phase 2

In summary, Phase 1 testing has demonstrated viable calculated fault location solutions that are ready for pilot field deployment. Therefore, PG&E recommends the Detect and Locate Distribution Line Outages and Faulted Circuit Conditions Pilot Project move into Phase 2.

The plan as described in PG&E’s AL 4227-E has been completed for Phase 1 testing and analysis as follows:

- Completed benchmarking with major Investor-Owned Utilities
- Assessed CFL products available in the market
- Reviewed associated visualization and analysis software relative to function, cyber security, standards and telecommunications
- Laboratory tested CFL software at the San Ramon test facilities
- Analyzed that CFL software will be effective in improving reliability and reducing patrol time when deployed
- Tested and evaluated measurement accuracies, software and system performance
- Documented test results in PG&E standard test reports

PG&E believes that an understanding of the benefits potential for CFL software will be achieved by having the system in place throughout the fall and winter of 2015 in order to create a baseline for future evaluation. During 2016, the pilot will continue to study basic CFL and also explore potential advanced functionality. It is critical that PG&E begin the Phase 2 activities no later than April 1, 2015, to ensure that it can order, deploy, and install the equipment and systems necessary to capture the Pilot Project results beginning in the fall of 2015 when the system experiences higher levels of faults and outages due to seasonal storm events.
AT&T
Albion Power Company
Alcantar & Kahl LLP
Anderson & Poole
BART
Barkovich & Yap, Inc.
Bartle Wells Associates
Braun Blasing McLaughlin, P.C.

CENERGY POWER
California Cotton Ginters & Growers Assn
California Energy Commission
California Public Utilities Commission
California State Association of Counties
Calpine
Casner, Steve
Center for Biological Diversity
City of Palo Alto
City of San Jose
Clean Power
Coast Economic Consulting
Commercial Energy
Cool Earth Solar, Inc.
County of Tehama - Department of Public Works
Crossborder Energy
Davis Wright Tremaine LLP
Day Carter Murphy
Defense Energy Support Center
Dept of General Services

Division of Ratepayer Advocates
Douglas & Liddell
Downey & Brand
Ellison Schneider & Harris LLP
G. A. Krause & Assoc.
GenOn Energy Inc.
GenOn Energy, Inc.
Goodin, MacBride, Squeri, Schlotz & Ritchie
Green Power Institute
Hanna & Morton
In House Energy
International Power Technology
Intestate Gas Services, Inc.
K&L Gates LLP
Kelly Group
Linde
Los Angeles County Integrated Waste Management Task Force
Los Angeles Dept of Water & Power
MRW & Associates
Manatt Phelps Phillips
Marin Energy Authority
McKenna Long & Aldridge LLP
McKenzie & Associates
Modesto Irrigation District
Morgan Stanley
NLine Energy, Inc.
NRG Solar
Nexant, Inc.

Occidental Energy Marketing, Inc.
OnGrid Solar
Pacific Gas and Electric Company
Praxair
Regulatory & Cogeneration Service, Inc.
SCD Energy Solutions
SCE
SDG&E and SoCalGas
SPURR
Seattle City Light
Sempra Utilities
SoCalGas
Southern California Edison Company
Spark Energy
Sun Light & Power
Sunshine Design
Tecogen, Inc.
Tiger Natural Gas, Inc.
TransCanada
Utility Cost Management
Utility Power Solutions
Utility Specialists
Verizon
Water and Energy Consulting
Wellhead Electric Company
Western Manufactured Housing
Communities Association (WMA)
YEP Energy