Appendix T: BATTERY REQUIREMENTS FOR INTERCONNECTION TO PG&E SYSTEM

The purpose of this document is to ensure safety and reliability of Pacific Gas and Electric Company and its customers who will or plan to interconnect to PG&E system. The requirements made here will ensure that the system operates as designed.

It is required on new installations, any protection changes (including like-for-like) or upon request by PG&E that the following documentation be provided to PG&E for review and approval by Substation Project Engineering Department:

1. Type of utility grade Battery (Flooded lead acid or NiCd). Monoblock (multiples cells in a jar) batteries from C&D, EnerSys, BAE, or other approved vendors will be acceptable. Car, deep cycle marine batteries and Sealed Batteries (VRLA) are not acceptable. Battery racks must be designed to withstand loading based on IEEE 693 – High Seismic Zone. UBC Certification is not acceptable. See table on page AT-3 for approved battery make and models.
2. Detailed information of load including continuous and momentary. No minimum load requirement-Smallest flooded acid may be the limitation.
3. Battery sizing calculation based on IEEE Std 485-1997 (IEEE recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations) or IEEE Std 1115-2000 (IEEE Recommended Practice for Sizing Nickel-Cadmium Batteries for Stationary Applications) and minimum 8 hours discharge rate using manufacturer software (to ensure proper discharge curve is used) using aging factor of 1.25 and design margin of 1.1 to be clearly shown on the calculation. Charger sizing calculation based on battery size with recharge time of 12 hours assuming charger will support the continuous load and recharging of the battery at the same time.
4. When battery is installed, proof of discharge testing (3 hour load testing is typical) to ensure battery has the capacity to support the load and trip, per IEEE Std 450-2010 (Voltage measurements should be taken every 15 minutes throughout the testing).
5. Document showing what kind of maintenance will be done (Monthly, Quarterly, Yearly, etc.) Batteries connected to the Bulk Electric System (BES) must meet PRC-005 and TPL-001 requirements. Battery System maintenance shall include the battery and battery charger. Frequencies and depths of maintenance (4 – 36-month intervals) and testing can vary based on chemical composition of the battery, therefore customer should seek NERC PRC-005-2 for guidance. Entities may be required to show proof of compliance upon request.
6. Monitoring of minimum battery low voltage by separate voltage relay or through charger and provide critical alarm to SCADA or monitoring system. An audible and visual alarm is required for 24/7 on-site monitoring.

7. Along with documentation of items 1-6; Form AT-1 (below) must be completed and submitted by the customer to Substation Project Engineering Department for approval.

Because of serious reliability, safety and reduced life concerns with sealed (also called Valve Regulated Lead Acid – VRLA) batteries industry-wide, PG&E has stopped the use of sealed batteries in substation or any switchgear installations or interconnection using these batteries. Flooded lead acid (calcium, antimony) and Nickel-Cadmium (NiCd) are the only batteries acceptable in these installations.

Switchgear compartments typically see very high temperatures, and if sealed batteries are used they will dry out in less than a few years causing safety and reliability concerns along with not having the capability to trip breakers. A side by side comparison of IEEE Std. 450-2002 Section 5.2.3 (IEEE Recommended Practice for Maintenance, Testing and Replacement of Vented lead acid batteries for Stationary applications –also referred as Flooded batteries) and IEEE Std 1188-1996 Section 5.2.2 Subsections a, b & c. (IEEE Recommended Practice for Maintenance, Testing and Replacement of Valve-regulated batteries for Stationary application- also referred as VRLA) clearly demonstrates that VRLA requires Quarterly ohmic resistance testing compared to yearly ohmic testing for flooded batteries. Experience industry wide indicates problem with doing ohmic tests on VRLA because of the design of battery and trying to make connections to the terminals and interconnecting hardware. Even if ohmic resistance reading is not done on flooded battery, the failure modes can be detected by other means whereas with VRLA eliminating this test could cause dryout condition and ultimately catastrophic failure. In hot environment VRLA would require charger compensation as well as monitoring which is expensive and still not proven to be adequate. In the telecommunication industry there are presently trials under way for system wide replacements of VRLA with Flooded or NiCd batteries. PG&E recommends use of NiCd batteries in switchgear cubicle because of better performance under extreme temperatures. Flooded batteries can also be used in switchgear.

Additional reasoning for not using VRLA in substation as pointed out by IEEE Battery working group Chairman in the recent paper published in IEEE. “Summarizing the issue for VRLA batteries”, there is a considerable risk involved in installing a single VRLA string in a substation. If parallel strings are installed, to operate reliably, they must be redundant, either by design or by a sufficient degree of conservatism in the sizing calculation. In building in redundancy, however, the main aim of reducing battery costs is compromised. Despite the early claims of maintenance-free operation, VRLA batteries require considerable surveillance and testing to maintain a high degree of reliability, IEEE Std 1188-1996 [2] recommends quarterly internal ohmic measurements and annual discharge testing of VRLA. These measures are largely ignored by the telephone operating companies because of their low loads and use of parallel strings, as detailed above. In substation operation, however, these practices are doubly important because of the higher currents involved”.

PG&E Approved Interconnection Batteries[1,2]		
Type	Manufacturer	Model Line
Vented or Flooded Lead Acid (VLA)	C&D	DCU
		DJ
		JC
		KCR
		LCY
		LCR
	Alcad	LSe
		SGL/SGH
		SD/SDH
	BAE	OGi
		OPzS
	Enersys	OPzS
		Powersafe CC
		Powersafe EC
		Powersafe FC
		Powersafe GC
		Powersafe Plante’
	SBS	STT
		SR
	Hoppecke	GrOE
		OSP
		OPzS
	GNB	MCX/MCT/H1T
		NCX/NCN/NCT
		PDQ/ T-Bloc
Nickel Cadmium (Ni-Cad)	Alcad	LE
		M
		H
	SBS	KP
	Enersys	RH
		RM
		RL
		VGM
		VGL

[1] **List is not exclusive**, other battery manufactures and model lines must be submitted for review

[2] Multiple cells per jar or block types of any models above are acceptable

FORM AT-1, Third Party Interconnection Battery Information Sheet and Acceptance Document

Section 1: To be completed by Customer while providing all pertinent information and documentation for review based on Appendix T of the TIH or PG&E document TD-2999B.

Project Name: _____ Site: _____ Date: _____

Type of Interconnection/project and Voltage Class: _____
(Transmission, Distribution, Primary Service, Relay Replacement, etc.)

1A) - Battery

Is Battery Flooded type or Sealed Type	
Battery Manufacturer	
Battery Size.	
Battery Model No.	

1B) Charger

Charger Size	
Charger Model No.	

1C) Rack

Is Rack Certified for IEEE 693, High Seismic Zone (UBC Certification is not accepted) –	
Rack Manufacturer and Model No.	

2- List of DC Loads

Is list and quantity of DC Loads included with the Submittal?	

3-Battery Sizing Calculation

Is Battery sizing sheet based on IEEE 485-1997 or IEEE 1115-2000 included with the Submittal.	

4 –Proof of Discharge Testing

Is proof of Discharge Testing included with this Submittal	

5 –Maintenance

Are maintenance schedule and procedure included with this Submittal	

6 – Battery Low Voltage Monitoring

Are details included with this submittal for 24/7 monitoring of Low DC Voltage. – Please specify Yes or No Remote monitoring is required for unmanned Sites	

Section 2: To be completed by PG&E Substation Engineering Department

FORM AT-1, Third Party Interconnection Battery Acceptance Document

Date: XX/XX/XXXX

Name of Customer:
JO#:
Distribution engineer or PM:
Reviewed by:

Item 1: Type of Utility Grade Battery –
Battery Type:
Rack Type:
Charger Type:

Item 2. Detailed Load Information –

Item 3. Battery & Charger Sizing Calculations –

Item 4. Proof of 3hr-Discharge Testing –

Item 5. Maintenance Procedures –

Item 6. Monitoring of Minimum Battery Voltage –
(Ensure battery DC low voltage is monitored as this will be verified during the Pre-Parallel inspection).

Thank you,

(Engineer who reviewed Info)
Substation Project Engineering