



Powering The Center of What's Possible

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DISTRIBUTED GENERATION PROTECTION

REQUIREMENTS

December 2019

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SUMMARY

The purpose of this utility bulletin is to list protection requirements for Silicon Valley Power (SVP) customers being served at 12kV or 480V, connecting new inverter based distributed generation (DG). This document acts as a supplement to SVP standard - Engineering & Operating Requirements for the Interconnection of Generating Facilities - SD1631.

AFFECTED DOCUMENT

Engineering & Operating Requirements for the Interconnection of Generating Facilities - SD1631.

DEFINITIONS

Distributed Energy Resource (DER) / Distributed Generation (DG): A source of electric power that is not directly connected to a bulk power system. DER/DG includes both generators and energy storage technologies capable of exporting active power to an Electric Power System (EPS) [Ref 1].

Point of Common Coupling (PCC): The point of connection between the Area EPS and the Local EPS [Ref 1].

Point of Distributed Energy Resources Connection (point of DER connection–PoC): The point where a DER unit is electrically connected in a Local EPS [Ref 1].

Certified Inverter: An inverter that has been “Certified” per UL 1741 or UL 1741 SA, which shall trip in 2.0 seconds or less than 2.0 seconds upon formation of an unintended island.



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PROTECTION EVALUATION

The protection requirements are subject to the following:

1. Silicon Valley Power will determine any additional protection requirements on a case-by-case basis.
2. Necessary additional protective equipment (relays, switchgear, transformers, etc.) or reinforcements to Silicon Valley Power's system due to new generation interconnection shall be provided by the customer or by Silicon Valley Power at the customer's expense.
3. Silicon Valley Power has the right, but not the obligation, to review the design of the customer's generating and interconnection facilities and to inspect the customer's generating and interconnection facilities prior to the commencement of parallel operation with the Electric Utility's system. Silicon Valley Power may require customer installing new generation interconnection to make modifications, as necessary, to comply with the requirements prior to commencement of operation.
4. Silicon Valley Power requires the customer to ensure the relays have at least 4 hour DC UPS back up.
5. Indefinite event retention – Silicon Valley Power expects all sequence of event lists and reports captured by the protection systems for any disturbance or fault will be indefinitely retained to assist in any investigation study.
6. Silicon Valley Power requires the customer to maintain updated drawings and records for switchgear, relays and systems connected to the utility and may be requested to support outage investigations.
7. Silicon Valley Power requires the customer to provide commissioning plans and test reports for all the required protective elements for Silicon Valley Power's approval, prior to commencement of operation.
8. Silicon Valley Power is open to reviewing potential design changes and new methods for providing system protection including alternative methods for ground fault sensing. All changes must be approved by the Principal Engineer - Operations & Maintenance.



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The following table will be used in place of Table 2 (Page 15) and Table 3 (Page 16) of SVP standard – SD1631 [Ref 2] , only for inverter based distributed generation interconnections. Please refer to SVP standard – SD1631 [Ref 2] for additional requirements and information.

DG Protection System Requirements	ANSI Device Number	40 kW or less	40 kW to less than 1000 kW	1000 kW and larger
Phase and ground Overcurrent	50/51 and 51N/50N	X ₁	X ₁	X ₁
Overvoltage	59	X	X	X
Undervoltage	27	X	X	X
Overfrequency	81O	X	X	X
Underfrequency	81U	X	X	X
Ground Fault Sensing Scheme	59G/59N		X ₂	X ₂
Reverse Power Relay/ Under power relay	32/37	X ₃	X ₃	X ₃

Note:

1. Phase and ground overcurrent for the customer’s line relays will be coordinated with the upstream utility protection devices based on the fault overcurrent values observed at the PCC.
2. Redundant relaying is required at the utility connection point in the customer’s switchgear or PCC for ground fault detection. For certified inverters aggregating less than 40kW, ground fault detection is not required. Ground fault detection is required for certified inverters aggregating 1000kW or larger capacity. For certified inverters aggregating more than 40 kW but less than 1000KW, requirement of ground fault detection will be determined case-by-case basis, including but not limited to some of the factors listed below:
 - Short circuit current contribution ratio.
 - Ratio of aggregated DG to minimum load.
 - Presence of different types of DG such as certified/non-certified inverters, presence of induction or synchronous machine etc.
 - Minimum export allowed for the interconnection.
 - Non-certified inverters require ground fault sensing scheme.
3. Redundant protection is required to detect reverse power flow or export of power to the utility. Reverse power flow or under power flow protection will trip and disconnect only the distributed generation and not impact the load, when the power export to SVP exceeds pre-determined values.
4. Direct Transfer Trip may be required for interconnections depending on SVP circuit configurations and loading, as determined by SVP.



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GROUND FAULT SENSING SCHEME

The ground fault sensing scheme detects SVP system ground faults and trips the generator breaker or the Generating Facility’s main circuit breaker, thus preventing the Generating Entity’s generator from continuously contributing to a ground fault. This scheme must be able to detect faults between PCC and the end of SVP’s line, including the SVP substation circuit breaker(s) serving the Generating Facility’s interconnection. Type of ground fault detection scheme is influenced by the configuration of the system and step-up interconnection transformer configuration.

Protection Requirement Reference Table:

Protection function	ANSI Device Number	Purpose	Location	Minimum Tripping requirement
Phase time overcurrent and phase instantaneous overcurrent	51/50	To detect phase overcurrent	PCC	Customer's main breaker
Ground time overcurrent and ground instantaneous overcurrent	51N/50N	To detect ground overcurrent	PCC	Customer's main breaker
Phase Overvoltage	59	To detect voltage disturbances	PoC	DER
Phase Undervoltage	27	To detect voltage disturbances	PoC	DER
Overfrequency	81O	To detect frequency disturbances	PoC	DER
Underfrequency	81U	To detect frequency disturbances	PoC	DER
Ground fault sensing (sequence overvoltage elements)	59G/59N	To detect single line to ground faults in an ungrounded zone	PCC	DER
Reverse power flow / Under power flow	32/37	To detect the power export to SVP	Customer’s Relay in switchgear / PoC	DER only
Reverse power flow	32	To detect the power export to SVP	*Vacuum Disconnect Switch	*SVP Vacuum Switch
* If Vacuum disconnect switches are installed and protective devices are installed at Vacuum disconnect switches.				



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REFERENCES

- [1] IEEE Standard for protection requirements:
- IEEE Std 1547.2™, IEEE Application Guide for IEEE Std 1547™, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems;
 - 1547-2018 - IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces;
 - 1547-2003 - IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems.
- [2] Silicon Valley Power Generation interconnection standard: Engineering & Operating Requirements for the Interconnection of Generating Facilities SD 1631
- [3] J. Blackburn, T. Domin, Protective Relaying Principles and Applications, 3rd ed. Boca Raton, FL: CRC Press, 2007
- [4] Rule 21 Interconnection

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