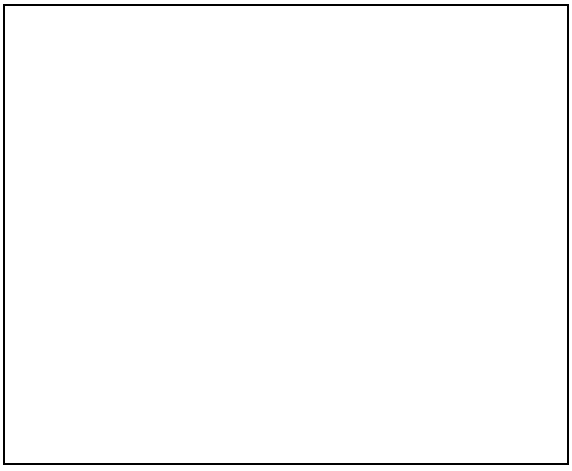
SYSTEM IMPACT STUDY FOR [SPQ/CSQ][####][revision letter, if applicable]

Prepared by

[ENGINEER'S NAME]

Reviewed by

[ENGINEER'S NAME]



Registered Professional Engineer Stamp

SYSTEM IMPACT STUDY (SIS) FOR DISTRIBUTION LINES AND EQUIPMENT

Contents

SYSTEM IMPACT STUDY (SIS) FOR DISTRIBUTION LINES AND EQUIPMENT

INTERCONNECTION INFORMATION

Customer Information

Queue Position	SPQ####
System Impact Study Commitment Date	[date report is completed by Distribution Planning]
Size of Proposed Facility (MW)	
Coordinates or Facility Location	
Inverter Type(s)	
Engineer Performing SIS	[Engineer's name]
Field Work Order (FWO)	

Interconnection Summary

System Impact Study was performed for SPQXXXX on the ___ Substation, feeder ____. The system was simulated and analyzed for voltage, loading, and short circuit violations.

The distribution system improvements needed for this interconnection are:

Note: Provide description of how this interconnection will affect the distribution system if no upgrades are made. This section is to be filled out after studies are complete.

INTERCONNECTION REQUESTS ASSOCIATED WITH THIS SUBSTATION

Queue Pos #	Feeder Name	Xfmr Pos #	GPS Coordinates	Size (MW_{AC})	Status	LL (MW_{AC})	HL (MW_{AC})

Note: The "LL" (Light Load) and "HL" (Heavy Load) columns represent the amount a Small Generator was generating at the time the Feeder Loading Information was measured.

Voltage-Reactive Power Control Settings for SPQXXXX

Voltage-Reactive Power Parameters	Inverter-based DER Default Settings
V_{Ref}	V_N
V_1	0.92 V_{Ref}
V_2	0.98 V_{Ref}
V_3	1.02 V_{Ref}
V_4	1.08 V_{Ref}
Q_1	44% of nameplate apparent power rating, injection
Q_2	0
Q_3	0
Q_4	44% of nameplate apparent power rating, absorption
Open Loop Response Time	5 s

NOTE: All DER shall utilize a fixed reference voltage V_{Ref}, V_N is assumed to be set at DER nominal AC operating voltage of 12.47 kV, and lastly that the DER reactive power capability may be reduced at lower voltage.

SYSTEM IMPACT STUDY (SIS) FOR DISTRIBUTION LINES AND EQUIPMENT

BASE CASE INFORMATION FOR LIGHT LOADING CONDITIONS

Substation Name	
Interconnecting Feeder Name	
Substation Transformer Position # (e.g. WR1, BR1)	

Light Loading Information

Simulated Date	
Simulated Hour	

Feeder Loading Information

Feeder Name	Transformer Position	Loading (KW)	Loading (KVAR)
[Interconnected feeder]			
[Another feeder]			
[Another feeder]			

Feeder Voltage Profile for Light Loading Conditions

Location	VA (120V base)	VB (120V base)	VC (120V base)
Feeder Bus			
Point of Interconnection			

Upstream Device Backfeed

Device Type & ID	General Location	Does Backfeed Exist? (Y/N)	Capable of Backfeed? (Y/N/Unknown)
<Sub Reg/LTC>			
<Ex: Recloser>			
<Ex: Line Reg>			

Note: List all reclosers, voltage regulators, and/or substation transformer LTCs upstream of the proposed DG. If a voltage regulator or LTC is expected to experience backfeed and backfeed capability is unknown, flag it in the Summary section to be reviewed at the Facility Study stage. For voltage regulators, include an estimate for tentative replacement. For LTCs, the settings should be checked to ensure they are set to Ignore mode.

Fault Current Profile

Device Type or ID	Distance From Substation (ft.)	Bidirectional? (Y/N)	Continuous Rating (Amps)	Fault Ratings (Symmetrical, Asymmetrical, or Peak Interrupting/ Withstand) in kA	Max Fault Current (Symmetrical/ Asymmetrical/ Peak) In kA
<Feeder breaker>					
***					
***					
***					
***					
***					
<POI>					

Note: List devices between proposed point of interconnection and the feeder breaker. Include feeder regulator(s), feeder breaker, fuses, reclosers, switches, and sectionalizers.

Pertinent Violations[1]

Device Type	General Location	Violation Type	Comments

Note: Only list violations for the feeder with the proposed DG. Violations include Overloads, Under-Voltage, Over-Voltage, or Short Circuit Rating. Only list violations for cable, conductors, and equipment on the primary circuit or in the substation.

SMALL GENERATOR INTERCONNECTION – LIGHT LOADING (Proposed Small Generator is connected and in service)

Small Generator Location

Small Generator Location	
Latitude (DD)	Longitude (DD)

Feeder Voltage Profile for Light Loading Conditions (Small Generator is connected and in service)

Location	VA (120V base)	VB (120V base)	VC (120V base)
Feeder Bus			
Point of Interconnection			

System Backfeed (Record loading at the source side of the proposed Small Generator's feeder breaker, and at the distribution power transformer).

Location	KW	KVAR

[1] **Base case violations are not the responsibility of the interconnection customer.**

Feeder Breaker		
Transformer (115 or 57kV terminals)		
Substation Source Location		

Note: Measured Daytime Minimum Load is utilized to determine System Backfeed values.
Also: Negative kW values indicate backfeed.

Transmission Planning Recommendations (If there is backfeed onto the transmission system)

Note: Provide mitigation strategies and associated costs as proposed by transmission planning engineers. If there is no backfeed onto the transmission system, write "N/A" in the above field.

Contingency Analysis

Protective Device Contingency	Location	Load Loss (KW)	Load Loss (KVAR)	Violations
Contingency #1				
Contingency #2				
Contingency #3				

Note: Feeder single-contingency (N-1) analysis is performed to simulate the loss of a feeder line section due to a fault (where a protective device automatically isolates the faulted area). In the case of a group of fuses serving three-phases, a three-phase fault is assumed. This analysis is used to determine the limitations of distribution equipment (such as conductors and protective devices) since a fault could potentially lead to reduced load and increased reverse power flow on distribution equipment. The protective device contingency scenarios are chosen by the planning engineer based on the heaviest loaded laterals or mainline protective devices disconnected from the feeder while ensuring the proposed Small Generator is not disconnected from service.

Upstream Device Backfeed

Device Type & ID	General Location	Does Backfeed Exist? (Y/N)	Capable of Backfeed? (Y/N/Unknown)
<Sub Reg/LTC>			
<Ex: Recloser>			
<Ex: Line Reg>			

Note: List all reclosers, voltage regulators, and/or substation transformer LTCs upstream of the proposed DG. If a voltage regulator or LTC is expected to experience backfeed and backfeed capability is unknown, flag it in the Summary section to be reviewed at the Facility Study stage. For voltage regulators, include an estimate for tentative replacement. For LTCs, the settings should be checked to ensure they are set to Ignore mode.

Fault Current Profile (Proposed Small Generator is connected and in service)

Device Type or ID	Distance From Substation (ft.)	Bidirectional? (Y/N)	Continuous Rating (Amps)	Fault Ratings (Symmetrical, Asymmetrical, or Peak Interrupting/ Withstand) in kA	Max Fault Current (Symmetrical/ Asymmetrical/ Peak) In kA
<Feeder breaker>					
***					
***					
***					
***					
***					
<POI>					

Note: List devices between proposed point of interconnection and the feeder breaker. Include feeder regulator(s), feeder breaker, fuses, reclosers, switches, and sectionalizers.

Pertinent Violations

Device Type	General Location	Violation Type	Comments

Note: Only list new violations for the feeder with the proposed Small Generator. Violations include Overloads, Under-Voltage, Over-Voltage, or Short Circuit Rating. Only list violations for cable, conductors, and equipment on the primary circuit or in the substation.

SYSTEM IMPACT STUDY (SIS) FOR DISTRIBUTION LINES AND EQUIPMENT

BASE CASE INFORMATION FOR HEAVY LOADING CONDITIONS

Heavy Loading Information

Simulated Date	
Simulated Hour	

Feeder Loading Information (All feeders served from associated substation transformer)

Feeder Name	Transformer Position	Loading (KW)	Loading (KVAR)

Note: List feeders served from the associated transformer or bus of the interconnecting device

Feeder Voltage Profile for Heavy Loading Conditions

Location	VA (120V base)	VB (120V base)	VC (120V base)
Feeder Bus			
Point of Interconnection			

Pertinent Violations[2]

Device Type	General Location	Violation Type	Comments

[2] **Base case violations are not the responsibility of the interconnection customer.**

Note: Only list violations for the feeder with the proposed Small Generator. Violations include Overloads, Under-Voltage, Over-Voltage, or Short Circuit Rating. Only list violations for cable, conductors, and equipment on the primary circuit or in the substation.

SMALL GENERATOR INTERCONNECTION – HEAVY LOADING

Feeder Voltage Profile for Heavy Loading Conditions (Proposed Small Generator is connected and in service)

Location	VA (120V base)	VB (120V base)	VC (120V base)
Feeder Bus			
Point of Interconnection			

System Backfeed (Record loading at the source side of the proposed Small Generator's feeder breaker, and at the distribution power transformer).

Location	KW	KVAR
Feeder Breaker		
Transformer (115 or 57kV terminals)		
Substation Source Location		

Note: Negative kW values indicate backfeed.

Pertinent Violations

Device Type	General Location	Violation Type	Comments

SYSTEM IMPACT STUDY (SIS) FOR DISTRIBUTION LINES AND EQUIPMENT

Note: Only list new violations for the feeder with the Small Generator. Violations include Overloads, Under-Voltage, Over-Voltage, or Short Circuit Rating. Only list violations for cable, conductors, and equipment on the primary circuit or in the substation.

SYSTEM IMPACT STUDY (SIS) FOR DISTRIBUTION LINES AND EQUIPMENT

SYSTEM IMPROVEMENT SUMMARY

Note: If no system improvements are needed, write "No additional upgrades are required on the distribution system pertaining to this interconnection request" in the above field.

SYSTEM IMPROVEMENTS – LIGHT LOADING

Feeder Voltage Profile for Light Loading Conditions (Proposed Small Generator is off)

Location	VA (120V base)	VB (120V base)	VC (120V base)
Feeder Bus			
Point of Interconnection			

Contingency Analysis

Protective Device Contingency	Location	Load Loss (KW)	Load Loss (KVAR)	Violations
Contingency #1				
Contingency #2				
Contingency #3				

Note: Feeder single-contingency (N-1) analysis is performed to simulate the loss of a feeder line section due to a fault (where a protective device automatically isolates the faulted area). In the case of a group of fuses serving three-phases, a three-phase fault is assumed. This analysis is used to determine the limitations of distribution equipment (such as conductors and protective devices) since a fault could potentially lead to reduced load and increased reverse power flow on distribution equipment. The

protective device contingency scenarios are chosen by the planning engineer based on the heaviest loaded laterals or mainline protective devices disconnected from the feeder while ensuring the proposed Small Generator is not disconnected from service.

Upstream Device Backfeed

Device Type & ID	General Location	Does Backfeed Exist? (Y/N)	Capable of Backfeed? (Y/N/Unknown)
<Sub Reg/LTC>			
<Ex: Recloser>			
<Ex: Line Reg>			

Note: List all reclosers, voltage regulators, and/or substation transformer LTCs upstream of the proposed DG. If a voltage regulator or LTC is expected to experience backfeed and backfeed capability is unknown, flag it in the Summary section to be reviewed at the Facility Study stage. For voltage regulators, include an estimate for tentative replacement. For LTCs, the settings should be checked to ensure they are set to Ignore mode.

Fault Current Profile

Device Type or ID	Distance From Substation (ft.)	Bidirectional? (Y/N)	Continuous Rating (Amps)	Fault Ratings (Symmetrical, Asymmetrical, or Peak Interrupting/ Withstand) in kA	Max Fault Current (Symmetrical/ Asymmetrical/ Peak) In kA
<Feeder breaker>					
***					
***					
***					
***					
***					
<POI>					

SYSTEM IMPACT STUDY (SIS) FOR DISTRIBUTION LINES AND EQUIPMENT

Note: List devices between proposed point of interconnection and the feeder breaker. Include feeder regulator(s), feeder breaker, fuses, reclosers, switches, and sectionalizers.

Pertinent Violations

Device Type	General Location	Violation Type	Comments

Note: None of these violations should supersede base case violations.

Small Generator Interconnection – Light Loading (Proposed Small Generator is connected and in service)

Feeder Voltage Profile for Light Loading Conditions (Proposed Small Generator is connected and in service)

Location	VA (120V base)	VB (120V base)	VC (120V base)
Feeder Bus			
Point of Interconnection			

System Backfeed (Record loading at the source side of the proposed Small Generator's feeder breaker, and at the distribution power transformer).

Location	KW	KVAR
Feeder Breaker		
Transformer (115 or 57kV terminals)		
Substation Source Location		

Note: Measured Daytime Minimum Load is utilized to determine System Backfeed values.
Also: Negative kW values indicate backfeed.

Contingency Analysis

Protective Device Contingency	Location	Load Loss (KW)	Load Loss (KVAR)	Violations
Contingency #1				
Contingency #2				
Contingency #3				

Note: Feeder single-contingency (N-1) analysis is performed to simulate the loss of a feeder line section due to a fault (where a protective device automatically isolates the faulted area). In the case of a group of fuses serving three-phases, a three-phase fault is assumed. This analysis is used to determine the limitations of distribution equipment (such as conductors and protective devices) since a fault could

potentially lead to reduced load and increased reverse power flow on distribution equipment. The protective device contingency scenarios are chosen by the planning engineer based on the heaviest loaded laterals or mainline protective devices disconnected from the feeder while ensuring the proposed Small Generator is not disconnected from service.

Upstream Device Backfeed

Device Type & ID	General Location	Does Backfeed Exist? (Y/N)	Capable of Backfeed? (Y/N/Unknown)
<Sub Reg/LTC>			
<Ex: Recloser>			
<Ex: Line Reg>			

Note: List all reclosers, voltage regulators, and/or substation transformer LTCs upstream of the proposed DG. If a voltage regulator or LTC is expected to experience backfeed and backfeed capability is unknown, flag it in the Summary section to be reviewed at the Facility Study stage. For voltage regulators, include an estimate for tentative replacement. For LTCs, the settings should be checked to ensure they are set to Ignore mode.

Fault Current Profile (Proposed Small Generator is connected and in service)

Device Type or ID	Distance From Substation (ft.)	Bidirectional? (Y/N)	Continuous Rating (Amps)	Fault Ratings (Symmetrical, Asymmetrical, or Peak Interrupting/ Withstand) in kA	Max Fault Current (Symmetrical/ Asymmetrical/ Peak) In kA
<Feeder breaker>					
***					
***					
***					
***					
***					
<POI>					

Note: List devices between proposed point of interconnection and the feeder breaker. Include feeder regulator(s), feeder breaker, fuses, reclosers, switches, and sectionalizers.

Pertinent Violations

Device Type	General Location	Violation Type	Comments

Note: None of these violations should supersede base case violations.

SYSTEM IMPROVEMENTS – HEAVY LOADING

Feeder Voltage Profile for Heavy Loading Conditions (Proposed Small Generator is off)

Location	VA (120V base)	VB (120V base)	VC (120V base)
Feeder Bus			
Point of Interconnection			

Pertinent Violations

Device Type	General Location	Violation Type	Comments

Note: None of these violations should supersede base case violations.

Small Generator Interconnection – Heavy Loading (Proposed Small Generator is connected and in service)

Feeder Voltage Profile for Heavy Loading Conditions (Proposed Small Generator is connected and in service)

Location	VA (120V base)	VB (120V base)	VC (120V base)
Feeder Bus			
Point of Interconnection			

System Backfeed (Record loading at the source side of the proposed Small Generator's feeder breaker, and at the distribution power transformer).

Location	KW	KVAR
Feeder Breaker		
Transformer (115 or 57kV terminals)		
Substation Source Location		

Note: Negative kW values indicate backfeed.

Pertinent Violations[3]

Device Type	General Location	Violation Type	Comments

Note: None of these violations should supersede base case violations.

[3] **Base case violations are not the responsibility of the interconnection customer.**

APPENDIX A: EQUIPMENT RATINGS AND STANDARDS

Cutouts

Polymeric Cutout Specifications					
Cutout Usage	PGE Part Number	Cutout Type	kV Rating	Amp Rating	
				Continuous	Asymmetrical Interrupting
General	40102	Open dropout	15	100	16,000
Special application	39478			200	12,000
	90006289	Solid blade		300	—

15-kV Solid Blade Cutout Ratings				
PGE Part Number	Voltage Rating (kV)		Current Rating (amps)	
	Nominal	Maximum	Continuous	Momentary (asymmetrical)
90006289	14.4	15.0	300	12,000

Table 10: 15-kV Solid Blade Cutout Ratings

Gang Operated Switches

15-kV Gang-Operated Switch Fault Ratings				
PGE Part Number	Manufacturer	Peak Withstand (amps, rms, 10 cycles)	Momentary, Symmetrical (amps, rms, three seconds)	Fault Closing (peak amps)[1]
03586	S&C Electric Company Omni-Rupter[2]	65,000	20,000	42,000
	Inertia Engineering LineBOSS	51,000	32,000	30,000
03587	Unassembled S&C Electric Company Alduti-Rupter	40,000	25,000	20,000

Switches

15-kV Disconnect Switch Ratings				
PGE Part Number	Voltage Rating (kV)		Current Rating (amps)	
	Nominal	Maximum	Continuous	Momentary
03582	15	15.5	1200	61,000

Table 9: 15-kV Disconnect Switch Ratings

Reclosers

Types of Reclosers and Corresponding PGE Part Numbers					
PGE Part Number	**Phase**	**Setting**	**Continuous Rating**	**Type**	**Symmetrical Amps**
03398	Single	1A3C	50	L[1]	3000
03399		2A2D			
03401			70		4000
03405			100		
03406			140		
39135			50	V4L	3000
03402			70		4200
39130		1A3C			
03403		2A2D	100		6000
39131		1A3C			
03408		2A2D	140		
39132		1A3C			
03410		2A2D	200		
39133		1A3C			
03411		2A2D	280		
39134		1A3C			
—	Three	Electronic allows a variety of curves	560 and 800 maximum	WE	10,000
03414			800 maximum	VWE	12,000
39756				NOVA	12,500
40242					

1. The L-type recloser is no longer purchased by PGE; it is here for reference only.

PGE Part Number	Phase	Setting	Continuous Rating	Type	Symmetrical Amps (Interrupting)	Asymmetrical Amps (Withstand)
	Three	Electronically programmable	1000	VIPER-ST	16,000	25,600

Switchgear

Switchgear Design Ratings	
Design	**Rating**
Maximum voltage	15.5 kV
Power frequency	60 Hz
Lightning impulse withstand voltage	95 kV
Power frequency withstand voltage	35 kV
Continuous current	1200 A
Momentary asymmetrical current	40 kA
Fault-closing asymmetrical current	40 kA

Table 1: Switchgear Design Ratings

600-A, Pad-Mounted Switchgear Configurations				
PGE Part Number	**Number of Switch Ways**	**Number of Fused Ways**	**Switchgear Momentary Fault Rating (kA, asymmetrical)**	**Unit Momentary Fault Rating (kA, symmetrical)**
39686	3	1	40	14
39687	2	2		

Table 5: 600-A, Pad-Mounted Switchgear Configurations

900-A, Pad-Mounted Switchgear Configurations					
PGE Part Number	**Number of Switch Ways**	**Number of Fault Interrupter Ways**	**Switch Way Continuous Rating (amp)**	**Fault Interrupter Way Continuous Rating (amp)**	**Unit Fault Rating (kA, symmetrical)**
90008072	2	2	900	600	25
90008073	3	1			
90008074	4	—		—	

Table 7: 900-A, Pad-Mounted Switchgear Configurations

1200-A, Pad-Mounted Switchgear Configurations				
PGE Part Number	Number of Switch Ways	Number of Fused Ways	Switchgear Momentary Fault Rating (kA, asymmetrical)	Unit Momentary Fault Rating (kA, symmetrical)
01433	4	—	40	25
01434	2	2		14
01435	3	1		
40050[1]	4	—	61	35
40051[1]	3	1		

1. This style is currently only used for Intel sites that require a higher fault rating.

Table 3: 1200-A, Pad-Mounted Switchgear Configurations

600-A, Submersible Switchgear Ratings						
PGE Part Number	Number of Switch Ways	Number of Fault Interrupter Ways	Unit Continuous Rating (amp)	Switchgear Continuous Rating (amp)	Fault Interrupter Continuous Rating (amp)	Unit Fault Rating (kA, symmetrical)
01425	2	2	600	600	200	12.5
01427	3					
01428		3				

Table 10: 600-A, Submersible Switchgear Ratings

900-A, Submersible Switchgear Dimensions					
Unit Fault Rating (kA, symmetrical)	Total Number of Ways	Tank Width[1] (inch)	Tank Depth[2] (inch)	Bushing Height (inch)	Total Height (inch)
12.5	4	65.4375	40.0625	17.5	26.625
25			40.25	28.75	33
12.5	5	80.4375	40.0625	17.5	26.625
25			40.25	28.75	33
12.5	6	95.4375	40.0625	17.5	26.625
25			40.25	28.75	33

1. Termination side of tank.
2. Depth includes controller enclosure but not bushings.

Table 12: 900-A, Submersible Switchgear Dimensions

IEEE Voltage Range/Clearing Times Table

Voltage range (% of base voltage[a])	Clearing time(s)[b]
V< 50	0.16
50 ≤ V< 88	2.00
110 < V < 120	1.00
V ≥ 120	0.16

[a]Base voltages are the nominal system voltages stated in ANSI C84.1-1995, Table 1.
[b]DR ≤ 30 kW, maximum clearing times; DR > 30kW, default clearing times.

The voltage deviation when the Small Generator is offline or in service must be within Voltage Guideline limits from 88% to 110% of the nominal voltage at the point of interconnection and the substation bus. The voltage guideline set by IEEE-1547 requires Small Generators to disconnect from the grid or clear at the set time shown.