

Community Solar Project Interconnection
Community Solar Project System Impact Study Report

Completed for

(“Applicant”)
OCS077

Proposed Point of Interconnection
Circuit 5R55 out of Oak Knoll substation at 12.47 kV
(At approximately 42°10'2.39"N, 122°36'23.5"W)

September 13, 2021

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1.0 DESCRIPTION OF THE COMMUNITY SOLAR PROJECT

(“Applicant”) proposed interconnecting 1.85 MW of new generation to PacifiCorp’s (“Public Utility”) circuit 5R55 out of Oak Knoll substation located in Jackson County, Oregon. The project (“Project”) will consist of ten (10) Delta M125HV inverters (factory limited to 124 kW) and five (5) Delta M125HV inverters (factory limited to 122 kW) for a total requested output of 1.85 MW. The requested commercial operation date is November 30, 2022.

The Public Utility has assigned the Project “OCS077.”

2.0 APPROVAL CRITERIA FOR TIER 4 INTERCONNECTION REVIEW

Pursuant to the Section I(1) of the Public Utility’s CSP Interconnection Procedures, a Public Utility must use the Tier 4 review procedures for an application to interconnect a Community Solar Project that meets the following requirements:

- (a) The Community Solar Project does not qualify for or failed to meet Tier 2 review requirements; and
- (b) The Community Solar Project must have a nameplate capacity of three (3) megawatts or less.

3.0 SCOPE OF THE STUDY

Pursuant to Section I(6)(g) of the CPS Interconnection Procedures, the System Impact Study Report shall consist of: (1) the underlying assumptions of the study; (2) a short circuit analysis; (2) a stability analysis; (3) a power flow analysis; (4) voltage drop and flicker studies; (5) protection and set point coordination studies; (6) grounding reviews; (7) the results of the analyses; and (8) any potential impediments to providing the requested Interconnection Service, including a non-binding informational NRIS portion that addresses the additions, modifications, and upgrades to the Public Utility’s Transmission System that would be required at or beyond the point at which the Interconnection Facilities connect to the Public Utility’s Transmission System to accommodate the interconnection of the CSP Project. In addition, the System Impact Study shall provide a list of facilities that are required as a result of the Community Solar Project request and non-binding good faith estimates of cost responsibility and time to construct.

The information contained in this study report is based on preliminary information and not to be used for construction.

4.0 PROPOSED POINT OF INTERCONNECTION

The Applicant’s proposed Community Solar Project is to be interconnected to the Public Utility’s distribution circuit 5R55 out of Oak Knoll substation via a 12.47 kV primary meter. The proposed Point of Interconnection (“POI”) will be located at approximately 42°10'2.39"N, 122°36'23.5"W located in Jackson County, Oregon. Figure 1 below is a one-line diagram that illustrates the interconnection of the proposed Community Solar Project to the Public Utility’s system.

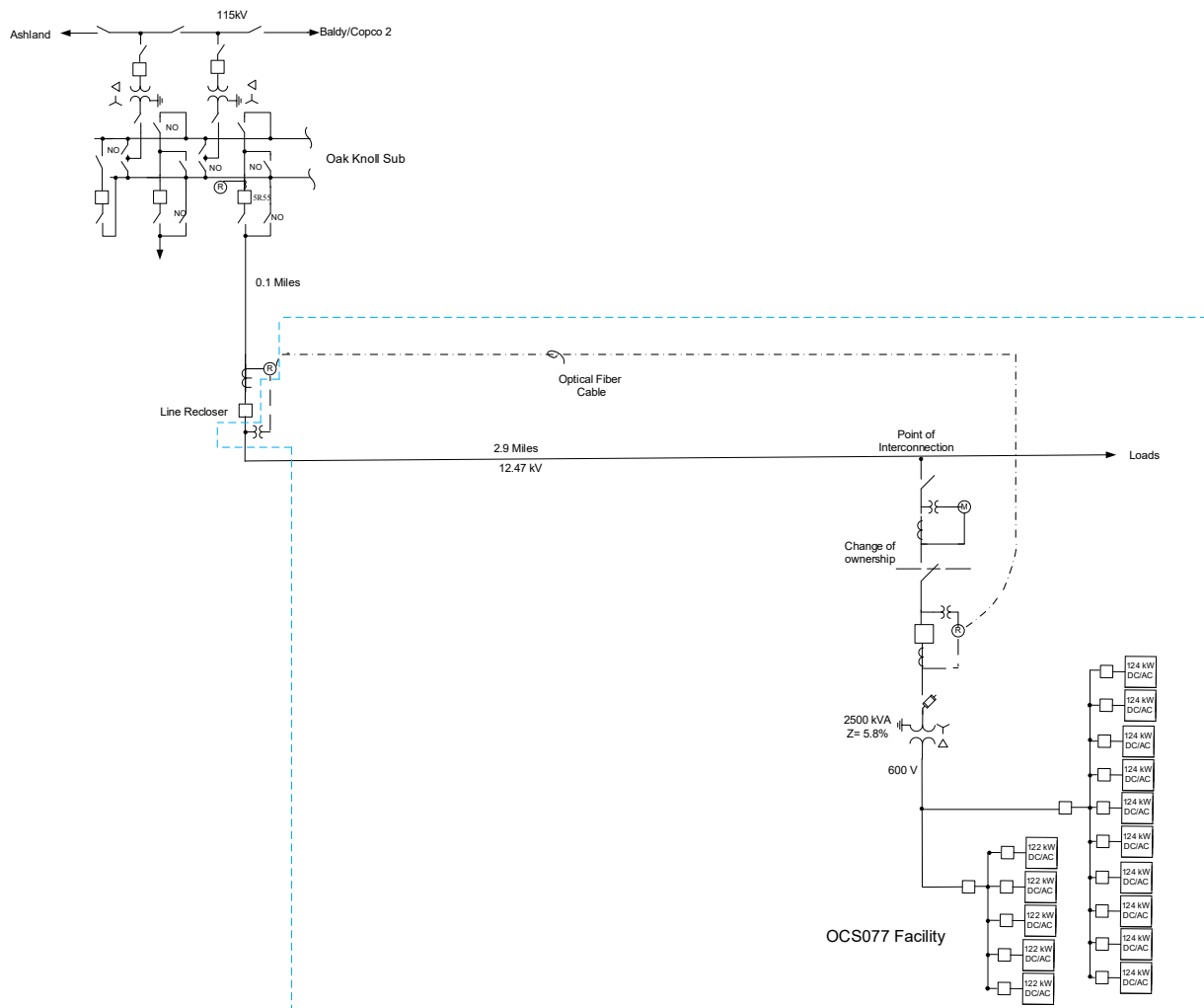


Figure 1: System One Line Diagram

5.0 STUDY ASSUMPTIONS

- All active higher-priority requests for transmission service and/or generator interconnection service (including requests in the traditional interconnection queue and other requests in the Community Solar queue) in the local area of the requested POI will be considered in this study and are listed in Appendix 1. If any of these requests are withdrawn, the Public Utility reserves the right to restudy this request, as the results and conclusions contained within this study could significantly change.
- The Applicant's request for interconnection service in and of itself does not convey transmission service.
- This study assumes the Project will be integrated into Public Utility's system at the agreed upon and/or proposed POI.
- The Applicant will construct and own any facilities required between the POI and the Project unless specifically identified by the Public Utility.

- Line reconductor or fiber underbuild required on existing poles will be assumed to follow the most direct path on the Public Utility's system. If during detailed design the path must be modified it may result in additional cost and timing delays for the Applicant's project.
- Generator tripping may be required for certain outages.
- All facilities will meet or exceed the minimum Western Electricity Coordinating Council ("WECC"), North American Electric Reliability Corporation ("NERC"), and Public Utility performance and design standards.
- The primary meter for this interconnection is assumed to be east of existing facility point 01439002.0207701.
- The interconnection was assumed to operate during daylight hours, 7 days per week, 12 months per year. The assumed export is 1850 kW at unity power factor.
- A daytime minimum load value of 2100 kVA, unity power factor was assumed based on measurements of 5R55.
- A summer peak load value of 5500 kVA at 0.99 power factor was assumed based on measurements of 5R55.
- A winter peak load value of 7815 kVA at unity power factor was assumed based on measurements of 5R55.
- A daytime minimum load value of 765 kW, unity power factor is expected through the field recloser at pole 01439001.0135305.
- For calculation of the forecasted voltage fluctuation, it was assumed that the power flow from the Applicant would change from full generation to no generation during a one minute interval.
- A substation regulator output voltage of 1.021 per unit was assumed during the daytime minimum load case based on existing settings. The study revealed that this magnitude requires reduction to 1.017 per unit. That value was applied to all cases.
- This report is based on information available at the time of the study. It is the Applicant's responsibility to check the Public Utility's web site regularly for transmission system updates (<https://www.oasis.oati.com/ppw>)

6.0 REQUIREMENTS

6.1 COMMUNITY SOLAR PROJECT REQUIREMENTS

The Community Solar Project and Interconnection Equipment owned by the Applicant are required to operate under constant power factor mode with a unity power factor setting unless specifically requested otherwise by the Public Utility. The Community Solar Project is expressly forbidden from actively participating in voltage regulation of the Public Utilities system without written request or authorization from the Public Utility. The Community Solar Project shall have sufficient reactive capacity to enable the delivery of 100 percent of the plant output to the POI at unity power factor measured at 1.0 per unit voltage under steady state conditions.

Generators shall be capable of operating under Voltage-reactive power mode, Active power-reactive power mode, and Constant reactive power mode as per IEEE Std. 1547-2018. This project shall be capable of activating each of these modes one at a time. The Public Utility reserves the right to specify any mode and settings within the limits of IEEE

Std 1547-2018 needed before or after the Community Solar Project enters service. The Applicant shall be responsible for implementing settings modifications and mode selections as requested by the Public Utility within an acceptable timeframe. The reactive compensation must be designed such that the discreet switching of the reactive device (if required by the Applicant) does not cause step voltage changes greater than $\pm 3\%$ on the Public Utility's system. In all cases the minimum power quality requirements in PacifiCorp's Engineering Handbook section 1C shall be met and are available at <https://www.pacificpower.net/about/power-quality-standards.html>. Requirements specified in the System Impact Study that exceed requirements in the Engineering Handbook section 1C power quality standards shall apply.

All generators must meet applicable WECC low voltage ride-through requirements as specified in the interconnection agreement.

The Applicant's facilities must be operated in a manner so as not to cause objectionable power quality issues to other Public Utility customers. Voltage fluctuations caused by the Community Solar Project are required to meet the Public Utility's Engineering Handbook, Voltage Fluctuation and Flicker, Standard 1C.5.1 which is found at <https://www.pacificpower.net/about/power-quality-standards.html>. Table 1 of Standard 1C.5.1 indicates that for this project the medium voltage planning levels for voltage fluctuation under any condition is a $P_{st} < 0.9$ and a $P_{lt} < 0.7$. It is the Applicant's responsibility to design and construct a system capable of meeting these levels. Specific system information will be provided on request to the Applicant for design purposes. During operation if measured voltage fluctuation levels exceed the limits specified in Standard 1C.5.1 the Applicant is required to cease generation until the condition is mitigated. The requirement for the Applicant's system to meet Standard 1C.5.1 will be incorporated in the interconnection contract. The Public Utility may, at its discretion, disconnect the Applicant's facilities until mitigations to meet these standards are made. The Applicant must also comply with all of the Public Utility's Engineering Handbook standards addressing power quality, including but not limited to Voltage Level, Voltage Balance, Harmonic Distortion, and Voltage Frequency.

The Generation Applicant will be required to install a transformer that will hold the phase to neutral voltages within limits when the Community Solar Project is isolated with the Public Utility's local system until the generation disconnects. The proposed ground wye/delta transformer will accomplish the stabilization of the phase to neutral voltages on the 12.47 kV system. The circuit that the project is connecting to is a four wire multi-grounded circuit with line to neutral connected load.

6.2 TRANSMISSION SYSTEM MODIFICATIONS

- No transmission system modifications are required to accommodate the Applicant's proposed Community Solar Project.

6.3 DISTRIBUTION/TRANSMISSION LINE MODIFICATIONS

This interconnection is planned for line extension from the Oak Knoll 5R55 circuit at facility point 01439002.0207701. Facilities are scoped to extend east of 01439002.0207701 to the POI. This line extension will require a minimum of two new poles. A three-phase, gang-operated, load break disconnect switch is required on the first new pole. A primary metering assembly is required on the second new pole. Note that the Applicant's single line diagram shows a customer owned recloser near the utility meter. The Applicant will be responsible for obtaining all necessary permissions and easements.

With the substation load tap changer set for output of 1.021 per unit based on present settings, an overvoltage of 1.052 per unit accounting for the 2 volt bandwidth was forecasted at the POI in the daytime minimum load case during full generation. The following settings changes are required on the Oak Knoll T-3234 load tap changer:

- Base voltage = 122.0 volts, R Compensation = 0, X Compensation = 0.

These setting changes are applied in all other cases.

The winter peak load case with no generation results in undervoltage conditions on four different branches of the circuit. These conditions were a result of operating the load tap changer at a reduced voltage output than the present settings. The load flow model indicates that the following construction is required to restore the voltage to ANSI Range A levels:

To correct predicted undervoltage at 01439002.0324005, the following four phase swaps are required to improve load balance and increase the voltage:

- At 01440002.0280001, swap A-phase to B-phase.
- At 01440002.0163900, swap A-phase to B-phase.
- At 01439002.0324201, swap B-phase to C-phase.
- At 01439002.0319502, swap B-phase to C-phase.

To correct predicted undervoltage at 01439001.0254201 along Timberlake Drive, a new pole should be installed east of existing pole 01439002.0301201. One new 100-amp, 7200-volt line to neutral regulator should be installed on this new pole.

To correct predicted undervoltage at the east end of Dead Indian Memorial Road, two new 100-amp, 7200-volt line to neutral regulators should be installed near pole 01439002.0066602.

To correct predicted undervoltage southeast of the new POI, three new 100-amp, 7200-volt line to neutral regulators should be installed near pole 1439002.207700.

The calculated voltage fluctuation from full generation to no generation in the winter peak load case was 2.4%.

6.4 EXISTING BREAKER MODIFICATIONS – SHORT-CIRCUIT

The increase in the fault duty on the system as the result of the addition of the Community Solar Project with photovoltaic arrays fed through 10 – 124 kW inverters & 5 – 122 kW inverters connected to 1 – 2500 kVA 12.5kV – 600 V transformer with 5.8 % impedance will not push the fault duty above the interrupting rating of any of the existing fault interrupting equipment.

6.5 PROTECTION REQUIREMENTS

The OCS077 Community Solar Project will need to disconnect from the network in a high-speed manner for faults on the 12.47 kV line on circuit 5R55 out of Oak Knoll substation. The minimum daytime load on circuit 5R55 is well above the maximum potential power output of the proposed OCS077 Community Solar Project. For this reason, the imbalance condition of the load and generation can be relied upon to cause the high-speed disconnection of the Community Solar Project for faults on the distribution system.

The Community Solar Project is planned to be connected beyond an existing line recloser. During some daytime periods the load beyond the recloser can be as low as 765 kW which is less than the potential generation from the proposed Community Solar Project. Since the unbalance between the generation and load cannot be relied upon to cause the timely disconnection of the Community Solar Project for faults on the 12.47 kV circuit beyond the recloser a transfer trip circuit will be required between the line recloser and the OCS077 POI recloser at the POI for the Community Solar Project. A deadline checking control circuit will be required for the line recloser to delay the automatic reclose if the generation at the Community Solar Project is not disconnected due to a failure of the relay circuitry. Communications will need to be established between the line recloser and the OCS077 POI recloser to carry the transfer trip signal.

The line recloser is equipped with SEL-651R to communicate with remote relays for the transfer trip or provide the deadline checking.

The 12.5 kV circuit recloser planned to be installed at the OCS077 Project will need to be equipped Schweitzer Engineering Laboratories (SEL) 651R relay/controller and voltage instrument transformers mounted on the utility side of the circuit recloser. The 651R will perform the following protection functions:

1. Detect faults on the 12.5 kV equipment at the Community Solar Project
2. Detect faults on the 12.5 kV line to Oak Knoll Substation
3. Monitor the voltage and react to under or over frequency, and /or magnitude of the voltage
4. Receive transfer trip from line recloser

6.6 DATA REQUIREMENTS (RTU)

This size of the proposed Community Solar Project does not require an RTU.

6.7 COMMUNICATION REQUIREMENTS

Install approximately three miles of 48-fiber, single-mode, ADSS cable on the distribution line between the Public Utility's line recloser and the POI for transfer-trip communications. Install fiber storage brackets at both ends. Terminate the fiber in wall-mount patch panels in cabinets. Install fiber-optic jumpers between the patch panels and the relays' fiber-optic transceiver.

6.8 SUBSTATION REQUIREMENTS

No substation modifications have been identified.

6.9 METERING REQUIREMENTSInterchange Metering

The metering will be located on the high side of the customer generator step up transformer at the POI. The metering transformers will be installed overhead on a pole per distribution DM construction standards. The meter itself will be installed on the pole near the ground. The Public Utility will procure, install, test, and own all revenue metering equipment. The metering will be bi-directional to measure KWH and KVARH quantities for both generation received and back feed retail load delivered. There will be no additional station service metering for supplying generation load. The metering generation and billing data will be remotely interrogated via the Public Utility's MV90 data acquisition system.

Station Service/Construction Power

The Applicant must arrange distribution voltage retail meter service for electricity consumed by the project when not generating. Temporary construction power metering shall conform to the Six State Electric Service Requirements manual. Applicant must call the PCCC Solution Center 1-800-640-2212 to arrange this service. Approval for back feed is contingent upon obtaining station service.

7.0 COST ESTIMATE

The following estimate represents only scopes of work that will be performed by the Public Utility. Costs for any work being performed by the Applicant are not included.

Project Administration <i>Project management, administrative support</i>	\$17,000
Relay Setting Development <i>P&C Engineer and Relay Technician</i>	\$15,000
Distribution <i>Line extension, regulators, poles, bypass switches, phase swaps & settings</i>	\$236,000
Metering <i>Metering equipment</i>	\$11,000
Communications	\$204,000

Communications at POI and recloser, install fiber

Other Costs \$111,000
Capital surcharge & contingency

Total **\$594,000**

*Any distribution line modifications identified in this report will require a field visit analysis in order to obtain a more thorough understanding of the specific requirements. The estimate provided above for this work could change substantially based on the results of this analysis. Until this field analysis is performed the Public Utility must develop the Project schedule using conservative assumptions. The Applicant may request that the Public Utility perform this field analysis, at the Applicant's expense, prior to the execution of an Interconnection Agreement in order to obtain more cost and schedule certainty.

Note: Costs for any excavation, duct installation and easements shall be borne by the Applicant and are not included in this estimate. This estimate is as accurate as possibly given the level of detailed study that has been completed to date and approximates the costs incurred by Public Utility to interconnect this Community Solar Project to Public Utility's electrical distribution or transmission system. An estimate, based on finer detail, will be calculated during the Facilities Study. The Applicant will be responsible for all actual costs, regardless of the estimated costs communicated to or approved by the Applicant.

8.0 SCHEDULE

The Public Utility estimates it will require approximately 15-18 months to design, procure and construct the facilities described in this report following the execution of an Interconnection Agreement. The schedule will be further developed and optimized during the Facilities Study.

Please note, the time required to perform the scope of work identified in this report appears to result in a timeframe that does not support the Applicant's requested commercial operation date of November 30, 2022.

9.0 PARTICIPATION BY AFFECTED SYSTEMS

Public Utility has identified the following Affected Systems: None

10.0 APPENDICES

Appendix 1: Higher Priority Requests

Appendix 2: Informational Network Resource Interconnection Service Assessment

Appendix 3: Property Requirements

10.1 APPENDIX 1: HIGHER PRIORITY REQUESTS

All active higher priority transmission service and/or generator interconnection and Community Solar Project requests will be considered in this study and are identified below. If any of these requests are withdrawn, the Public Utility reserves the right to restudy this request, as the results and conclusions contained within this study could significantly change.

Transmission/Generation Interconnection/Community Solar Queue Requests considered:

GI Queue	Size (MW)	GI Queue	Size (MW)
721	55	OCS046	2.25
741	40	OCS047	2.25
849	100	OCS048	1.50
905	50	OCS049	2.99
971	2.7	OCS050	1.00
1055	4.2	OCS051	1.50
OCS003	0.8	OCS054	0.90
OCS004	0.8	OCS055	1.35
OCS019	0.88	OCS058	1.25
OCS020	0.17	OCS059	0.63
OCS025	2.80	OCS065	1.25
OCS034	0.98	OCS066	1.13
OCS036	1.13	OCS067	1.00
OCS037	1.50	OCS068	1.00
OCS039	2.25	OCS070	2.00
OCS042	0.13	OCS072	1.00
OCS044	0.36	C1-15	2.30
		OCS074	0.36

10.2 APPENDIX 2: INFORMATIONAL NETWORK RESOURCE INTERCONNECTION SERVICE ASSESSMENT

The study results described above reflect an energy resource interconnection service (“ERIS”) evaluation, modified in the CSP program rules to examine only generation and load conditions local to the requested CSP project’s interconnection point (sometimes referred to as the “zoomed in view”). The “zoomed in view” functions to: (1) study the project’s proposed interconnection without considering certain existing or higher-queued requests outside of the local area; and (2) to inform whether the CSP facility must cap its project to mitigate, although not eliminate, the risk of potential deliverability-related network upgrades to accommodate the proposed CSP generator.

By contrast, the following informational section provides a network resource interconnection service (“NRIS”) evaluation performed with traditional assumptions, i.e., not modified to examine only local generation and load conditions, but rather one that assumes that all existing interconnections, higher-queued requests for interconnection service (in both the traditional and CSP queue), and generators with executed contracts beyond the local area are in-service. Depending on the severity of the conditions created when absorbing additional generation (capped or not capped) in that broader, “zoomed out” area, the local area-focused generator size cap developed in the “zoomed in” examination may not be sufficient to mitigate the need for deliverability-related network upgrades. Regardless of this report’s informational NRIS results, the deliverability-related network upgrades ultimately necessary to accommodate the proposed CSP generator will depend on conditions present when the future transmission service study is performed, as well as whether network upgrade alternatives are available at that time.

Considering existing generation and higher-queued requests to interconnect in the Southern Oregon/Northern California area where the CSP generator proposes to interconnect, 1.85 MW of additional generation can be absorbed. As a result, the Public Utility determines that no additional network upgrades would be required for the aggregate of generation in the local area to be delivered to the aggregate of load on the Public Utility’s transmission system (the NRIS study scope).

10.3 APPENDIX 3: PROPERTY REQUIREMENTS

Requirements for rights of way easements

Rights of way easements will be acquired by the Applicant in the Public Utility's name for the construction, reconstruction, operation, maintenance, repair, replacement and removal of Public Utility's Interconnection Facilities that will be owned and operated by PacifiCorp. Applicant will acquire all necessary permits for the project and will obtain rights of way easements for the project on Public Utility's easement form.

Real Property Requirements for Point of Interconnection Substation

Real property for a POI substation will be acquired by an Applicant to accommodate the Applicant's project. The real property must be acceptable to Public Utility. Applicant will acquire fee ownership for interconnection substation unless Public Utility determines that other than fee ownership is acceptable; however, the form and instrument of such rights will be at Public Utility's sole discretion. Any land rights that Applicant is planning to retain as part of a fee property conveyance will be identified in advance to Public Utility and are subject to the Public Utility's approval.

The Applicant must obtain all permits required by all relevant jurisdictions for the planned use including but not limited to conditional use permits, Certificates of Public Convenience and Necessity, California Environmental Quality Act, as well as all construction permits for the project.

Applicant will not be reimbursed through network upgrades for more than the market value of the property.

As a minimum, real property must be environmentally, physically, and operationally acceptable to Public Utility. The real property shall be a permitted or able to be permitted use in all zoning districts. The Applicant shall provide Public Utility with a title report and shall transfer property without any material defects of title or other encumbrances that are not acceptable to Public Utility. Property lines shall be surveyed and show all encumbrances, encroachments, and roads.

Examples of potentially unacceptable environmental, physical, or operational conditions could include but are not limited to:

- Environmental: known contamination of site; evidence of environmental contamination by any dangerous, hazardous or toxic materials as defined by any governmental agency; violation of building, health, safety, environmental, fire, land use, zoning or other such regulation; violation of ordinances or statutes of any governmental entities having jurisdiction over the property; underground or above ground storage tanks in area; known remediation sites on property; ongoing mitigation activities or monitoring activities; asbestos; lead-based paint, etc. A phase I environmental study is required for land being acquired in fee by the Public Utility unless waived by Public Utility.

- Physical: inadequate site drainage; proximity to flood zone; erosion issues; wetland overlays; threatened and endangered species; archeological or culturally sensitive areas; inadequate sub-surface elements, etc. Public Utility may require Applicant to procure various studies and surveys as determined necessary by Public Utility.
- Operational: inadequate access for Public Utility's equipment and vehicles; existing structures on land that require removal prior to building of substation; ongoing maintenance for landscaping or extensive landscape requirements; ongoing homeowner's or other requirements or restrictions (e.g., Covenants, Codes and Restrictions, deed restrictions, etc.) on property which are not acceptable to the Public Utility.

10.4 APPENDIX 4: TRANSMISSION/DISTRIBUTION STUDY RESULTS

Three base cases were developed and studied in power flow simulation at the transmission level covering summer peak load, winter peak load and daytime minimum load conditions.

The results of the transmission study show that the proposed OCS077 project does not result in negative impacts to the Public Utility's transmission system. Power flow simulation indicates that steady state and post transient voltages are projected to remain within acceptable limits and loading on transmission facilities is projected to remain within facility ratings.

There are no contingent facilities identified for this interconnection request at the transmission level.

Six cases were assembled and studied at the 12.47 kV distribution voltage level.

- Daytime minimum load, no generation.
- Daytime minimum load, full generation.
- Summer peak, no generation.
- Summer peak, full generation.
- Winter peak, no generation.
- Winter peak, full generation.