Community Solar Project Interconnection

Community Solar Project System Impact Study Report

Completed for

("Applicant")
OCS047

Proposed Point of Interconnection

Circuit 5L54 out of Lakeport substation at 12.0 kV
(At approximately 42°16'49.7"N, 121°48'44.5'W)

January 4, 2020

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1.0 DESCRIPTION OF THE COMMUNITY SOLAR PROJECT

("Applicant") proposed interconnecting 2.25 MW of new generation to PacifiCorp's ("Public Utility") circuit 5L54 out of Lakeport substation located in Klamath County, Oregon. The project ("Project") will consist of eleven (11) Delta M125HV inverters factory de-rated to 118 kW and eight (8) Delta M125HV inverters factory de-rated to 119 kW for a total requested nameplate output of 2.25 MW. The requested commercial operation date is November 30, 2021.

The Public Utility has assigned the Project "OCS047."

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.

4.0 PROPOSED POINT OF INTERCONNECTION

The Applicant's proposed Community Solar Project is to be interconnected to the Public Utility's distribution circuit 5L54 out of Lakeport substation via a 12.0 kV primary meter. The proposed Point of Interconnection ("POI") will be located at approximately 42°16'49.7"N, 121°48'44.5'W located in Klamath County, Oregon. Figure 1 below is a one line diagram that illustrates the interconnection of the proposed generating facility to the Public Utility's system.

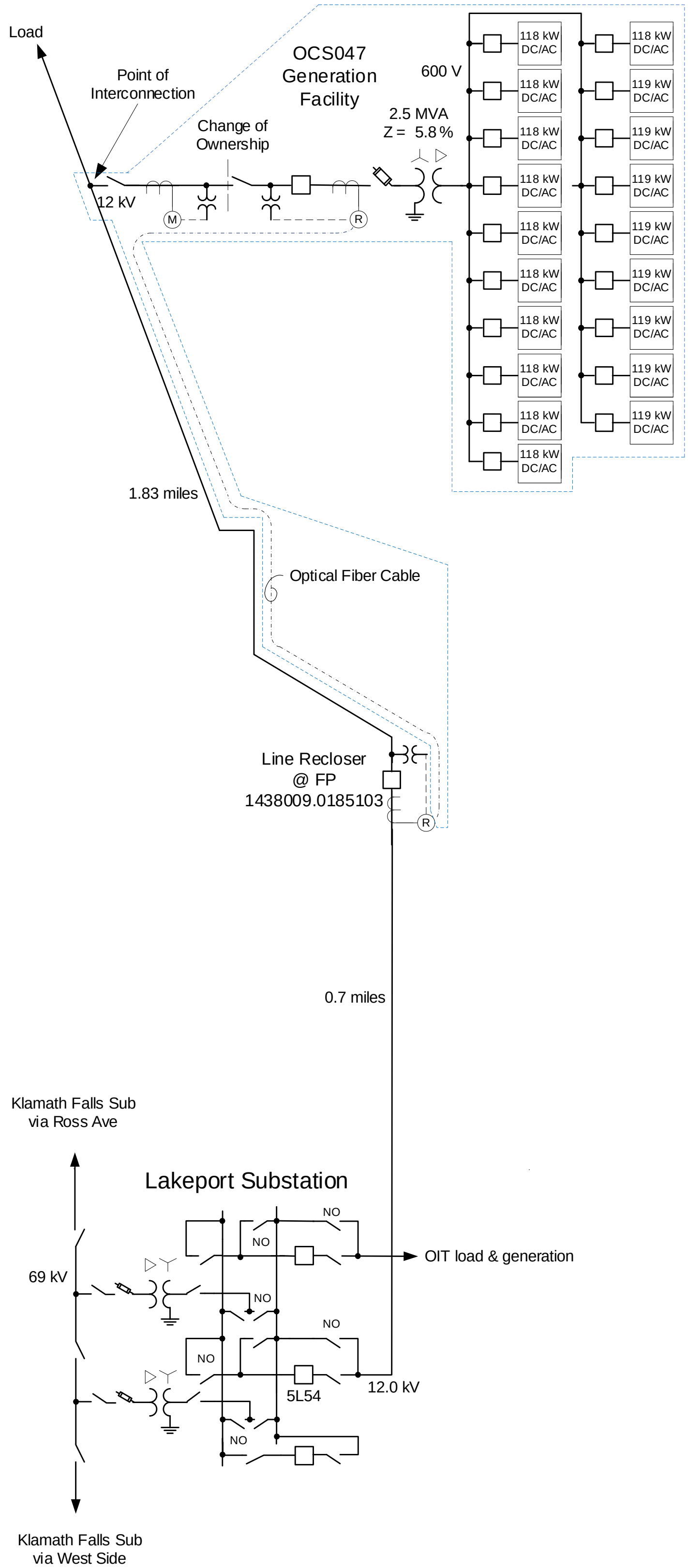

Figure 1: System One Line Diagram

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 PacifiCorp distribution facility point closest to the POI is 01438009.0-071500 on Highway 97 south of Cove Point Road.
- Distribution load flows were performed at peak and light load and full and no generation with summer and winter loading conditions
- 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 automatic power factor control with the power factor sensed electrically at the POI. The required power factor is 0.95 per unit leading (absorbing reactive) at the POI.

In general, the Community Solar Project and Interconnection Equipment should be operated so as to maintain the voltage at the POI between 1.01 pu to 1.04 pu. At the Public Utility's discretion, these values might be adjusted depending on the operating conditions.

The minimum power quality requirements are in PacifiCorp's Engineering Handbook and are available at https://www.pacificpower.net/about/power-quality-standards.html. Requirements in the System Impact Study that exceed requirements in the Engineering Handbook power quality standards shall apply.

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

As per NERC standard VAR-001-1, the Public Utility is required to specify voltage or reactive power schedule at the POI. Under normal conditions, the Public Utility's system should not supply reactive power to the Community Solar Project.

6.2 Transmission System Modifications

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

6.3 Distribution Modifications

The following are required to the Public Utility's distribution system in order to facilitate the interconnection of the Applicant's Community Solar Project.

- Extend #2 AAAC phase and neutral from Highway 97 at or near facility point 01438009.0-071500 to the POI. The line extension includes a pole for primary metering and a pole with a 600 amp group operated switch.
- Program the SEL-651R recloser control at facility point 01438009.0-185103 with dead-line check and transfer trip to the POI recloser.
- Relocate the 900 kVAR fixed capacitor bank from 01437009.0-301500 to 01438009.0-196902. Remove the 450 kVAR capacitor bank installed at 01438009.0-182602.
- Replace the 65T fuses with solid blades and faulted circuit indicators at 01438009.0-183906. Install 65T fuses at 01438009.0-071200 and 65T fuses at or near 01438009.0-071501 north of the POI tap.

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 11– 118 kW inverters and 8 – 119 kW inverters connected to 1 – 2.5 MVA 12 kV – 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 OCS047 Community Solar Project will need to disconnect from the network in a high-speed manner for faults on the 12 kV line on circuit 5L54 out of Lakeport substation. The minimum daytime load on circuit 5L54 is 2.5 MW which is above the maximum potential power output of the proposed OCS047 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 generating facilityfor faults on the distribution system.

The Community Solar Project is planned to be connected beyond an existing line recloser at facility point 01438009.0185103. During some daytime periods the load beyond the recloser will be 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 kV circuit beyond the recloser a transfer trip circuit will be required between the line recloser and the OCS047 POI recloser at 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.

With the addition of the OCS047 Community Solar Project there will be a potential for the Community Solar Project to contribute more fault current for phase to ground faults between line recloser at facility point 01438009.0185103 and Lakeport substation to be above the pickup value for the ground overcurrent element in the recloser. With the current configuration of the recloser this will cause it to trip for these type faults. This will down grade the service to the existing retail customers and will not be acceptable. The recloser has the capabilities needed for the OCS047 project so new settings will be required.

The 12 kV circuit recloser planned to be installed at the OCS047 project will need to 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 kV equipment at the solar-electric Community Solar Project
2. Detect faults on the 12 kV line to Lakeport Substation
3. Monitor the voltage and react to under or over frequency, and/or magnitude of the voltage
4. Communicate with line recloser at facility point 01438009.0185103 to receive transfer trip from the line recloser

6.6 Data Requirements (RTU)

Due to the power size of the solar-electric Community Solar Project no real time monitoring will be required by the Public Utility for the operation of the transmission network so no RTU will be required.

6.7 Communication Requirements

48-fiber, single-mode, ADSS cable will be installed along the distribution line between the line recloser at facility point 01438009.0185103 and the OCS047 POI recloser for transfer trip. The fiber will be terminated in patch panels mounted in cabinets. Fiber optic jumpers will connect the patch panels to the relays' fiber optic transceivers.

6.8 Substation Requirements

No substation requirements.

6.9 Metering Requirements

<u>Interchange Metering</u>

The metering will be located on the high side of the Applicant 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 at the base of the pole. 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.

OCS047 Collector Station *Install metering and communications equipment, develop relay settings.*	$76,000
Line Recloser *Install communications equipment and update relay settings.*	$30,000
Distribution *Line extension, relocate capacitor bank and install fuses.*	$55,000
Communications *Install ~1.8 miles of fiber underbuild.*	$63,000
Total	**$224,000**

*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 12-15 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 does not support the Applicant's requested commercial operation date of November 30, 2021.

9.0 PARTICIPATION BY AFFECTED SYSTEMS

Public Utility has identified the following Affected Systems: None

Copies of this report will be shared with each Affected System.

10.0 APPENDICES

Appendix 1: Higher Priority Requests
Appendix 2: Informational Network Resource Interconnection Service Assessment
Appendix 3: Property Requirements
Appendix 4: Transmission/Distribution Study Results

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:

Queue #	Size (MW)
721	55
741	40
849	100
905	50
971	2.7
1120	3
1126	8
1147	2.999
1160	70
OCS003	0.8
OCS004	0.8
OCS019	0.882
OCS020	0.594
OCS025	2.8
OCS034	0.978
OCS036	1.125
OCS037	1.5
OCS039	2.25
OCS040	1.64
OCS042	0.13
OCS044	0.447
OCS046	2.25

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, 2.25 MW of additional generation can be absorbed. As a result, the transmission provider 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 transmission provider'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

Transmission:

Three base cases were developed to represent heavy summer, heavy winter and light spring load conditions. A Power flow analysis was performed on each case for three system configurations.

1. Normal transmission configuration: Lakeport substation fed radial out of Klamath Falls at 69 kV on Line 18-7 with normally open switch 3L118 near Ross Ave. Tap.
2. Contingency transmission configuration: 69kV line section between Lakeport and Westside plant out of service. Lakeport transferred to alternate feed using switch 3L118 near Ross Ave.
3. Contingency transmission configuration: 69kV line section between Klamath Falls and Westside out of service. Switch 3L33 at Westside planet closed feeding Lakeport radially using line 18-6.

Each Power flow analysis was conducted pre and post OCS047. The study focused on the 69 kV system in the Klamath Falls area and distribution voltages at Lakeport substation. Voltage and thermal limitation of surrounding substation buses and lines were monitored.

The results for the transmission study concluded that steady state and post transient voltages are within acceptable limits. No thermal violations were identified. The proposed OCS047 project does not result in additional deficiencies to the Public Utility's transmission system.

There are no contingent facilities identified for this interconnection request.

Distribution:

- The modeled voltage at the POI is 1.061 per unit during light load and full generation and OCS047 generating at 1.0 per unit power factor.
- The modeled current on the 65T fuses at 01438009.0-183906 is 103 amps, 158% of rating, during full generation.
- The modeled load flow on the line recloser at 01438009.0-185103 is 1616 kW reverse power flow during light load and full generation.
- The modeled load flow at breaker 5L54 is 278 kW forward power flow during light load and full generation.