TRANSMISSION PLANNING

GENERATION INTERCONNECTION REPORT

2025 TRANSITION CLUSTER STUDY (TCS)

CLUSTER AREA: SOUTH #2, PHASE 1, Revision 0

(25TCS CA-SO2 P1-0)

G0747
G0870
G0871
G0909
G0910
G0912
G1017
G1056

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1 Executive Summary

In 2025, Bonneville Power Administration (BPA) initiated the Transition Cluster Study (TCS) under the new Large Generator Interconnection Transition Process, Attachment R of BPA's Open Access Transmission Tariff (OATT).[1] BPA received 167 Transition Requests that were eligible to participate in the Transition Cluster Study with a total requested Interconnection Service level of approximately 61,100 MW.

This TCS Phase One Cluster Study (TCS PH1) report examines the feasibility and impact of interconnecting the proposed generation projects to BPA's transmission system. Requests in the Cluster Area were studied at the Points of Interconnection (POIs) according to table below. The generation type, requested MW of Interconnection Service level, project location, and requested Commercial Operation Date are also shown.

Cluster Area South 2 (SO2) is comprised of Interconnection Requests (IRs) in Deschutes County and Klamath County of Oregon state. The Cluster Area includes 8 IRs seeking a total combined 2,700 MW of Interconnection Service and 1,700 MW of grid charging.

Table 1.1: Participants in 2025 TCS PH1 CA South Oregon 1

GI #	Gen Type	Studied POI	MW Requested (Generating)	MW Requested (Charging)	Plant Location (County, State)	Requested COD
G0747	Solar, BESS	G0657 POI (La Pine-Chiloquin 230)	200	-200	Klamath, OR	01/01/2027
G0870	Wind	La Pine 500	500	0	Lake, OR	12/01/2028
G0871	Wind	La Pine 500	500	0	Lake, OR	12/01/2028
G0909	Solar, BESS	La Pine 500	200	-200	Deschutes, OR	11/01/2028
G0910	Solar, BESS	La Pine 500	200	-200	Deschutes, OR	11/01/2030
G0912	Solar, BESS	La Pine 500	200	-200	Deschutes, OR	11/01/2033
G1017	Solar, BESS	G657 POI (La Pine-Chiloquin 230)	250	-250	Klamath, OR	06/01/2029
G1056	BESS	La Pine 500	650	-650	Deschutes, OR	11/01/2030

Studied POI locations and requirements for each IR are summarized in Table 1.2.

All IRs will be required to have the necessary communications and controls equipment installed to be available for generator tripping to maintain flexibility and effectiveness of BPA's main grid Remedial Action Schemes (RAS).

[1] Capitalized terms that are not defined in the text of this report refer to defined terms in BPA's OATT.

Table 1.2: 2025 TCS PH1 CA South 2 Requirements

GI #	Studied POI	Total GI Scope	Total Cost	Contingent Facilities
G0870, G0871,	Lapine Annex 500 kV	1x 500 kV gen-tie terminal, New Lapine Annex 500 kV station, 1x LaPine 500/230 kV transformer, New G0657 POI-Captain Jack Annex 500 kV line	$266M	Bonanza 500/230 kV substation Bonanza-La Pine #1 230 kV La Pine-G0657 #2 230 kV Pilot Butte – La Pine #1 230 kV rebuild Mid.OR RAS Algorithm
G0909, G0910, G0912,	Lapine Annex 500 kV	1x 500 kV gen-tie terminal, New Lapine Annex 500 kV station, 1x LaPine 500/230 kV transformer, New G0657 POI-Captain Jack Annex 500 kV line	$215M	Bonanza 500/230 kV substation Bonanza-La Pine #1 230 kV La Pine-G0657 #2 230 kV Pilot Butte – La Pine #1 230 kV rebuild Mid.OR RAS Algorithm
G1056	Lapine Annex 500 kV	1x 500 kV gen-tie terminal, New Lapine Annex 500 kV station, 1x LaPine 500/230 kV transformer, New G0657 POI-Captain Jack Annex 500 kV line	$205M	Bonanza 500/230 kV substation Bonanza-La Pine #1 230 kV La Pine-G0657 #2 230 kV Pilot Butte – La Pine #1 230 kV rebuild Mid.OR RAS Algorithm
G0747	G0657 230 kV station	1x 230 kV gen-tie terminal, New POI 500 kV station, 1x new 500/230 kV transformer, New G0657 POI-Captain Jack Annex 500 kV line	$180M	Bonanza 500/230 kV substation G657 230 kV plan of service Bonanza-La Pine #1 230 kV La Pine-G0657 #2 230 kV Pilot Butte – La Pine #1 230 kV rebuild Mid.OR RAS Algorithm
G1017	G0657 230 kV station	1x 230 kV gen-tie terminal, New POI 500 kV station, 1x new 500/230 kV transformer, New G0657 POI-Captain Jack Annex 500 kV line	$197M	Bonanza 500/230 kV substation G0657 230 kV plan of service Bonanza-La Pine #1 230 kV La Pine-G0657 #2 230 kV Pilot Butte – La Pine #1 230 kV rebuild Mid.OR RAS Algorithm

BPA's construction of equipment and facilities required to interconnect a generator typically takes between 3 and 10 years to complete depending on the scope and scale of the plan of service. The estimated time to construct a plan of service is refined through the subsequent stages of the interconnection process.

2 Purpose

The Bonneville Power Administration (BPA) processes requests to interconnect Large Generating Facilities to the BPA Transmission System under the Large Generator Interconnection Transition Process, Attachment R of BPA's OATT, and the Standard Large Generator Interconnection Procedures (LGIP), Attachment L of BPA's OATT. BPA conducted the TCS PH1 to evaluate the impacts of all eligible Transition Requests in the Transition Cluster on the reliability of BPA's Transmission System. The TCS PH1 evaluates equipment and facilities required to reliably interconnect requests at the requested MW of Interconnection Service. The TCS PH1 consists of short circuit analysis and power flow analysis. The TCS PH1 report preliminarily identifies: (1) equipment where short circuit capability limits or thermal or voltage ratings have been exceeded, and (2) Interconnection Facilities and Network Upgrades expected to be required to address those issues.

BPA performed the TCS PH1 by segmenting and studying the Interconnection Requests according to geographically and electrically relevant areas on BPA's Transmission System; those segments are identified as Cluster Areas. BPA identified plans of service for a subset of Interconnection Requests within a Cluster Area in some instances, identified as Scalable Plan Blocks. Cost and timeframe estimates for plans of service identified in this report are non-binding good faith estimates. Costs are allocated amongst Interconnection Requests as outlined in Section 4.2.3 of the LGIP.

3 Disclaimers

This document contains the technical study results of an evaluation of the impact of all proposed Interconnection Requests in the Cluster Area on the reliability of BPA's Transmission System. The TCS PH1 evaluates providing Interconnection Service, meaning the service provided by BPA to interconnect a Large Generating Facility to BPA's Transmission System to enable BPA's Transmission System to receive energy and capacity from the Large Generation Facility at the Point of Interconnection. The study results reflect evaluation of providing Energy Resource Interconnection Service to all Interconnection Requests, allowing each Large Generating Facility to connect and be eligible to deliver output on an "as available" basis up to the requested MWs of Interconnection Service. The interconnection process for Large Generating Facilities does not evaluate the requirements or potential impediments to providing transmission of the electrical output of a Large Generating Facility beyond the Point of Interconnection. A customer that wishes to obtain the right to deliver or inject energy from a Large Generating Facility beyond the Point of Interconnection must take a separate action to obtain transmission delivery service under BPA's OATT. The provision of Point-to-Point Transmission Service or Network Integration Transmission Service may require the construction of additional transmission equipment and facilities.

In addition, the technical studies results do not address generator balancing services that may be required to interconnect a Large Generating Facility to BPA's Transmission System.

These studies were conducted using the best available information at the time of the study. Findings and recommendations are based on information and assumptions that could

change. BPA reserves the right to add, delete, or modify any content in this report if new information is provided.

Additional Disclaimers

1) A customer's inclusion of an optional requested POI on a Transition Request does not guarantee that the customer's request was studied for interconnection at that POI. BPA, in its sole discretion, determined the POI for each Large Generating Facility to improve the reliability benefits, cost and/or benefits of the interconnection for the Cluster Area.
2) Energy storage grid charging is defined for this study as importing energy from beyond the POI to the IR storage device. This study evaluates grid charging where elected by each IR, but does not assess all resultant Transmission System requirements beyond the POI. This study presumes that energy storage grid charging connected to BPA's Transmission System will be treated as a generator (not a load) in context of expected transmission curtailments, expected transmission operating limits, or generation tripping RAS.
3) The TCS PH1 does not include the following analyses, which will be provided in the Transition Cluster Study Phase Two Cluster Study or Interconnection Facilities Study:
   a) Provision of Network Resource Interconnection Service (NRIS);
   b) Voltage & Transient Stability studies;
   c) Electromagnetic Transient (EMT) studies; and
   d) Fault Duty studies for detailed equipment sizing.
4) In electing to participate in the TCS, all customers attested that the Generating Facility proposed in a Transition Request would be designed to meet the BPA Transmission Standard *"Technical Requirements for Interconnection to the BPA Transmission Grid"* (STD-N-000001) posted to the BPA Interconnection webpage.
5) Any plan of service identified in this study report that would require access and usage of property associated with the Northwest AC Intertie (NWACI) to construct may require the consent of all owners of NWACI facilities to proceed and be beyond BPA's ability to grant. BPA will continue to study this plan of service but cannot guarantee that the Large Generating Facility may be interconnected under that plan of service.
   i) As noted above, the TCS PH1 does not evaluate requirements or potential impediments to providing transmission delivery service. Any plan of service identified in this study report that would provide electrical connectivity between a Large Generating Facility and a NWACI facility does not provide the customer any right or ability to obtain transmission delivery service on a NWACI facility.

4 Study Assumptions

4.1 General Assumptions

BPA Transmission uses PowerWorld for positive sequence analysis (CTG Tool add-on, ATC Tool add-on, PV/QV Tool add-on, Transient Stability Tool add-on).

For the TCS PH1, "MW injection limit" tests are applied at each POI, to determine IR's MW thresholds at which a steady state system limiter occurs and requires mitigation. Injection limits are also applied in the reverse direction, at POIs that have requested Battery Energy Storage

System (BESS) grid charging. PowerWorld's ATC Tool is used to conduct these injection limit tests.

All analysis presumes Energy Resource Interconnection Service (ERIS) only. BPA Planning presumes IRs are not all dispatched simultaneously. Generally, BPA Planning only presumes IRs are dispatched simultaneously when at most one to two Bulk Electric System (BES) nodes away from the POI under study.

The TCS PH1 assumes all Generating Facilities studied were designed to the standards in STD-N-000001 at the time of publication of this report. Adherence to BPA STD-N-000001 includes many detailed requirements covering but not limited to: minimum BPA communications network transport; BPA control system hardware; participation in BPA RAS; protective relaying; disturbance monitoring; scheduling and metering; voltage control; frequency response; reactive power quality; and more.

4.2 Senior-Queued IRs and non-BPA IRs

The following list of IRs were deemed impactful and senior to the Cluster Area and were assumed to be dispatched online for the TCS PH1. The list includes Interconnection Requests that were not subject to Attachment R of BPA's OATT (Bypass IRs), Late-Stage Projects that elected to proceed serially, and non-BPA queued IRs in adjacent Transmission Provider queues if known.

Table 4.2: Senior Queued IRs Assumed In-Service

Queue #	POI (owner)	MW Generating	MW Grid-Charging	Fuel Type
BPA G0527	Lapine-Fort Rock 115 kV	105	0	Solar
BPA G0570	Lapine-Fort Rock 115 kV	20	0	Solar
BPA G0571	Lapine-Fort Rock 115 kV	20	0	Solar
BPA G0572	La Pine 115 kV	20	0	Solar
BPA G0654	La Pine 230 kV	170	0	Solar
BPA G0655	La Pine 230 kV	200	0	Solar
BPA G0657	La Pine-Chiloquin 230 kV "G657 POI"	500	-500	Solar, BESS
PAC C1-46	La Pine-Chiloquin 230 kV "C1-46 POI" (PAC)	200	-58	Solar, BESS
PAC C3-035	C1-46 POI (PAC)	200	-200	Solar, BESS

Table 4.3: Senior Queued Load IRs Assumed In-Service

Queue #	POI (owner)	MW Amount
BPA L0393	Lapine 115 (BPA)	100
BPA L0513	Thielsen 115 (BPA)	24

4.3 Communications and Control Facilities (C&C)

The TCS PH1 assumed:

1. All POI stations are capable of BPA Main Grid Remedial Action Scheme (RAS)

participation. There is WECC-Class 1 communications (fully redundant, alternately routed) to each generation facility where the Main Grid RAS Generation Dropping (GD) will occur.

2. All POI stations have:
    a. BPA SCADA Control & Indication
    b. Transfer Trip or Current Differential protective relaying on all gen-ties from BPA station to customer station
    c. Control Phasor Measurement Units (CPMUs)
    d. Revenue Metering and telemetry for each IR

5 Study Methodology

5.1 Cluster Area Definition

The following map illustrates the geographic coordinates for the IRs assessed in Cluster Area South 2. IRs with the same coordinates appear as a single point.

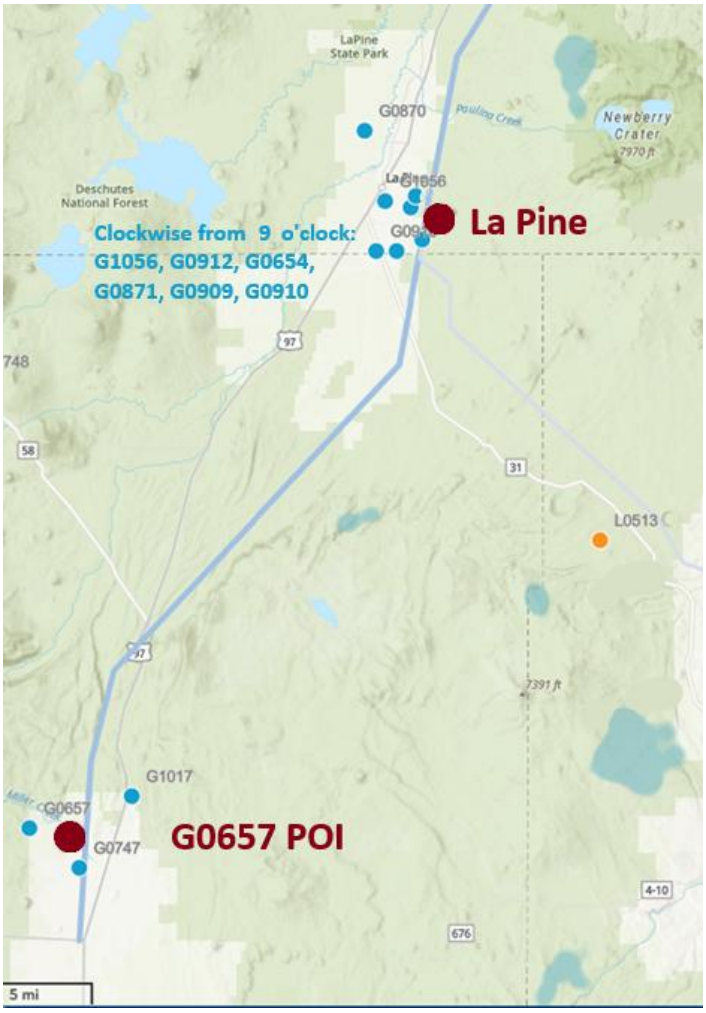

Figure 1 Map of the South 2 Cluster Area. Blue dots are TCS IRs and yellow dots are Line and Load Interconnection Requests in BPA queues. Red dots for Lapine and G657 POI substations.

5.2 Studied POIs

The following table 5.2 indicates the studied POI for each request in the Cluster Area.

Table 5.2: Studied POI locations

GI #	Gen Type	Studied POI	MW Generating	MW Grid – charging
G0747	Solar, BESS	La Pine-Chiloquin 230	200	-200
G0870	Wind	La Pine 500	500	0
G0871	Wind	La Pine 500	500	0
G0909	Solar, BESS	La Pine 500	200	-200
G0910	Solar, BESS	La Pine 500	200	-200
G0912	Solar, BESS	La Pine 500	200	-200
G1017	Solar, BESS	La Pine-Chiloquin 230	250	-250
G1056	BESS	La Pine 500	650	-650

5.3 Starting Base Cases

Following WECC Cases were used for SO2.

- 2026HS
- 2034HS

Cases were modified to include applicable senior-queued IR POIs, and their associated plans of service as reported in their associated System Impact or Facility study reports published on host utility's OASIS.

The load in Central Oregon was adjusted by adding 24 MW of L0513 load at Thielsen substation and 100 MW of L0393 load at LaPine substation. These load additions are near G0657 POI substation.

In addition, select planned BPA projects were modeled as senior to the TCS and impactful to the POI performance. Impactful topology additions for SO2 include:

- Bonanza Substation (BPA)
- Bonanza-La Pine 230 kV transmission line operable at 500 kV (BPA)
    - Construction will be to BPA 500 kV conductor and tower design specifications. Initial operation will be 230 kV.
    - Conversion to 500 kV operation will occur once a LaPine 500 kV Annex station is available to re-terminate. For purposes of this study, line is modeled as 500 kV connection between Bonanza and LaPine Annex.
- La Pine Long Range Plan (BPA)
- La Pine-G0657 POI #2 230 kV transmission line (BPA G0657)
- Pilot Butte-La Pine 230 kV rebuild (BPA G0657)

Additional summary of significant projects deemed Contingent Facilities and assumed in-service as base-state for this Cluster Area are specified in section 6.

5.3.1 Load and Resource Scenario Descriptions

Sensitivity studies were performed to ensure the Plan of Service is acceptable under expected North-South and South-North COI flow patterns.

5.3.2 Topology Sensitivity Descriptions

Sensitivity studies with and without Contingent Facilities and proposed interconnection plans of service were performed to confirm those facilities are required.

- With and without the La Pine Long Range Plan (contingent facility)
- With and without the Pilot Butte-La Pine #1 230 kV line rebuild (contingent facility)
- With and without Bonanza-Lapine 230 kV #1 line (contingent facility)
- With and without Lapine-G0657 POI #2 230 kV line (contingent facility)
- With and without G0657 POI-Captain Jack #1 500 kV line (Transition Cluster Phase 1 requirement – Cluster Areas South 1 and South 2)
- With and without Bonanza-NOB all three 500 kV transmission lines
- With and without the PAC Pilot Butte 230/69 kV transformer #4 (to assess impacts on single contingency system performance due to voltage change)

5.4 Phase 1 POI Injection Tests

Steady state Contingency Analysis was conducted at each POI injecting total generating or grid-charging amounts until a reliability limit was reached. The assumed source/sink pairs for these injection tests were as follows:

Table 5.4: **2025 TCS PH1 SO2** ATC Source/Sink Nodes

Mode	Direction	Source	Sink
Generating	N->S	La Pine and G0657 POI generators	Area 30 (PG&E) generation
Grid Charging	N->S	Area 30 (PG&E) generation	La Pine and G0657 POI energy storage systems

Detailed findings of these injection tests can be found in the Results Section.

5.5 Phase 1 POI Short Circuit Ratio Strength Tests

Per BPA STD-N-000001, all LIR POIs shall have Short Circuit Ratio (SCR) of 3 or greater for all critical NERC TPL-001 P1 conditions.

Both La Pine and G0657 POI substation POIs fail the SCR strength test for generation injections larger than 800 MW. Both POIs will require the new network connections towards La Pine and Bonanza (Contingent Facilities, see Section 6) and towards Captain Jack (see section 7) to mitigate the impacts to system instability impacts.

6 Contingent Facilities Assumed In-Service

6.1 La Pine Annex POI Contingent Facilities

The following projects are assumed in-service for the La Pine Annex POI. They are deemed Contingent Facilities for this study and are required to be energized prior to IRs at POI La Pine Annex taking Interconnection Service.

Table 6.1: La Pine Annex POI Contingent Facilities

Project Name	Driver	Estimated Cost	Estimated I/S Date
Bonanza substation	TSEP, LLIRs, Senior IRs	$548M[1]	2033[1]
Bonanza-La Pine #1 transmission line	LLIRs, Senior IRs	$150M[1]	2033[1]
La Pine Long Range Plan[2]	TSEP, LLIRs, senior IRs	$67M	December 2030
Mid-Oregon RAS Algorithm	Senior IRs	Not Available	Not Available
La Pine-G0657 POI #2 transmission line (46mi)	Senior IRs	$300M[3]	2035[4]
Remediate La Pine-Chiloquin #1 line trap	Senior IRs	Not Available	2035[4]
Pilot Butte – La Pine #1 230 kV rebuild	Senior IRs	$83M[3]	2035[4]

1. *Scoping is ongoing for Bonanza and Bonanza-La Pine projects, and their estimates will be refined as scoping continues.*
2. *The La Pine Long Range Plan STATCOM component is not necessary for N0930.*
3. *Estimates driven by the BPA interconnection request G0657 are typical estimates.*
4. *Project design has not initiated. These dates are tentative.*

The Bonanza Substation project is a 500/230 kV substation planned near the existing Ponderosa substation. It is required for many generator and load interconnections as well as transmission service requests in the Central Oregon area. Two 500/230 kV transformers are planned, and the substation will loop in two major 500 kV transmission lines in Central Oregon.

The Bonanza-La Pine #1 transmission line is to be constructed to a 500 kV design specification but operated at 230 kV until the need arises. The line is approximately 50 miles in length. Several previous interconnections, both generation and load, require this project prior to energization.

The La Pine Long Range Plan includes adding bus-sectionalizing breakers and shunt reactive devices to La Pine substation. These upgrades improve voltage performance and reduce the severity of some of the worst contingencies in the local area.

The Mid-Oregon RAS is a local RAS involving generation in the Central Oregon Area.

The La Pine-G0657 POI #2 transmission line is to be constructed to a 500 kV design specification but operated at 230 kV until the need arises. The transmission line will be approximately 46 miles in length.

The remediation of the La Pine-Chiloquin #1 transmission line is to restore the rating of the transmission line to that of the conductor. Currently, the rating is limited by a line trap.

The Pilot Butte – La Pine #1 rebuild is a project to rebuild the existing transmission line to the highest capacity available BPA 230 kV standard conductor. The transmission line is approximately 30 miles long.

6.2 G0657 POI Contingent Facilities

The following projects are assumed in-service for the G0657 POI (La Pine-Chiloquin POI). They are deemed Contingent Facilities for this study and are required to be energized prior to IRs at La Pine-Chiloquin POI taking Interconnection Service.

Table 6.2: G0657 POI Contingent Facilities

Project Name	Driver	Estimated Cost	Estimated I/S Date
Bonanza substation	TSEP, LLIRs, Senior IRs	$548M[1]	2033[1]
Bonanza-La Pine #1 transmission line	LLIRs, Senior IRs	$150M[1]	2033[1]
La Pine Long Range Plan[2]	TSEP, LLIRs, senior IRs	$67M	December 2030
Mid-Oregon RAS	Senior IRs	Not Available	Not Available
La Pine-G0657 POI #2 transmission line	Senior IRs	$300M[3]	2035[4]
Remediate La Pine-Chiloquin #1 line trap	Senior IRs	Not Available	2035[4]
Pilot Butte – La Pine #1 230 kV rebuild	Senior IRs	$83M[3]	2035[4]
G0657 POI 230 kV substation	Senior IRs	$150M	2035[4]

1. *Scoping is ongoing for Bonanza and Bonanza-La Pine projects, and their estimates will be refined as scoping continues.*
2. *The La Pine Long Range Plan STATCOM component is not necessary for N0930.*
3. *Estimates driven by the BPA interconnection request G657 are typical estimates.*
4. *Project design has not initiated. These dates are tentative.*

The contingent facilities for G0657 POI IRs are the same as those for the La Pine Annex POI except for the G0657 POI substation. For description of the other contingent facilities, see table 6.1.

The G0657 POI substation is a 230 kV substation required by the senior-queued BPA IR with queue number G0657. Expansion of that substation will be required for interconnection of IRs in this Cluster Study as described in the Interconnection Requirements section of this report.

7 Technical Analysis & Study Results

7.1 La Pine Annex POI Study Results

Table 7.1: Results for La Pine Annex POI

POI MW Threshold	IRs at POI	Limiter (Element or Contingency)	Mitigation
-1250 to 2250	G0870, 0871, G0909, 0910, G0912, 1056	Pilot Butte-LaPine #1 230 kV (TPL-001 P1)	Contingent Facility (Bonanza-La Pine #1 500 kV) Contingent Facility (La Pine-G0657 #2 230 kV) New Lapine Annex 500/230 kV substation New G0657 POI-Captain Jack Annex 500 kV line

La Pine substation cannot be expanded beyond projects already planned. To accommodate generation in this Cluster Study, a "La Pine Annex" substation (name subject to change) must be constructed. The La Pine Annex substation must have 500 kV and 230 kV yards. The La Pine Annex substation will connect to the La Pine substation with two 230 kV transmission lines.

The generation facilities may interconnect at the 500 kV yard of La Pine Annex substation. The 230 kV yard is required to connect La Pine Annex to La Pine substation and thereby, the local load area.

The 500 kV yard is also required to connect the Bonanza-La Pine Annex #1 500 kV transmission line. This future line is a contingent facility, though the contingent facility is planned between Bonanza and La Pine 230 kV. It is already planned to be constructed to a 500 kV design specification. The line is planned to be operated at 230 kV until the need arises. The IRs in this Cluster Study trigger the need to operate at 500 kV. Operating the Bonanza-La Pine line at 500 kV involves re-termination of the transmission line at Bonanza substation and addition of a 500/230 kV transformer at La Pine Annex and re-terminating the La Pine end of that line into La Pine Annex 500 kV yard.

Contingency analysis shows that a single 500 kV line (i.e., Bonanza-La Pine #1 500 kV) is not sufficient to provide adequate transmission system performance with the requested generation injecting at La Pine (Annex) and G0657 POI. One key factor is that Bonanza-La Pine Annex #1 500 kV line could itself be taken out of service by an electrical fault. The construction project to address this inadequate performance must provide an alternate path for generated MW to leave the La Pine area. That involves:

- Another 500 kV line from La Pine to the main grid
- Another 500/230 transformer

A comprehensive approach was considered in choosing the new 500 kV line and 500/230 kV transformer locations. While for the purposes of La Pine GIs another transformer at La Pine Annex is acceptable, G0657 POI IRs require a 500/230 kV transformer at G0657 POI substation and operating the La Pine-G0657 POI #2 line at 500 kV.

This future La Pine-G0657 POI #2 is a contingent facility of this Cluster Study constructed to a 500 kV design specification and operated at 230 kV until the need arises. The IRs in this Cluster Study trigger that need. Operating the La Pine-G0657 POI #2 line at 500 kV involves re-terminating the line at La Pine Annex 500 kV, installing the transformer described above at the G0657 POI substation, and re-terminating the G0657 POI terminal of the line in the G0657 POI 500 kV yard.

The La Pine Annex-G0657 POI 500 kV transmission line upgrade improves generation export from La Pine, but the G0657 POI substation is still weakly connected without another transmission line. Considered holistically, impacts from Cluster Study IRs at La Pine Annex, G0657 POI substation, Bonanza substation, and at the Bonanza-NOB POI substation can all be addressed by continuing the 500 kV transmission corridor from G0657 POI substation to Captain Jack Annex substation. This comprehensive plan economizes planning and material resources and is expected to be cheaper per IR than two projects conceived in isolation. Without this

project, a NERC TPL-001 single-contingency can cause voltage collapse. That is unacceptable performance to grant interconnection service.

7.2 G0657 POI Study Results

Table 7.2: Results for G0657 POI

POI MW Threshold	IRs at POI	Limiter (Element or Contingency)	Mitigation
-450 to 450	G0747 G1017	Pilot Butte-LaPine #1 230 kV (TPL-001 P1)	Contingent Facility (Bonanza-La Pine #1 500 kV) Contingent Facility (La Pine-G0657 #2 230 kV) New Lapine Annex 500/230 kV substation New G0657 POI-Captain Jack Annex 500 kV line

The IRs may be interconnected at the G0657 POI substation 230 kV yard.

Contingency analysis shows that the existing and planned 230 kV transmission lines into the G0657 POI substation do not provide adequate transmission system performance with the addition of the generation requested in this Cluster Study. New 500 kV transmission is needed in the area. The requirements are:

- Two 500 kV lines from La Pine to the main grid
- A 500/230 kV transformer at G0657 POI substation

A holistic approach was used to determine the plan needed to maintain adequate thermal and voltage performance.

The future La Pine-G0657 POI #2 is a contingent facility of this Cluster Study constructed to a 500 kV design specification. However, it is planned to be operated at 230 kV until the need arises. The IRs in this Cluster Study trigger that need. Operating the La Pine-G6057 POI #2 line at 500 kV involves re-terminating that line at La Pine Annex 500 kV, installing the transformer described above at the G0657 POI substation, and re-terminating the G0657 POI terminal of the line in the G6057 POI 500 kV yard.

The La Pine Annex-G0657 POI 500 kV transmission line upgrade improves generation export from La Pine, but a TPL-001 single contingency can remove that transmission line from service. Considered holistically, impacts from Cluster Study IRs at La Pine Annex, G0657 POI substation, Bonanza substation, and the Bonanza-NOB POI substation can all be addressed by continuing the 500 kV transmission corridor from G0657 POI substation to Captain Jack Annex substation. This holistic plan economizes planning and material resources and is expected to be cheaper per IR than two projects conceived in isolation.

8 Affected System Impacts

The analysis of the proposed interconnections studied in this Cluster Area identified potential adverse system impacts on the Affected Systems identified below. The results of this study report will be shared with the Affected System Operator/s of those Affected System/s. The Affected System Operator/s identified below may determine a study is required and that actions are required on that Affected System to mitigate the impacts of the proposed interconnection on BPA's Transmission System. **Plans of service identified in this report may be modified or revised in response to an affected utility system study result.**

Any plans of service identified to interconnect a request, including plans of service identified in an affected system study, that require access and usage of real property associated with the Northwest AC Intertie (NWACI) to construct or impact the rights of an owner of a NWACI facility may require the consent of all owners to proceed and be beyond BPA's ability to grant. BPA cannot guarantee that the Large Generating Facility can be interconnected under that plan of service.

PacifiCorp is also identified as an Affected System because IRs in this report connect near PacifiCorp-owned facilities south of La Pine substation.

Affected System	Elements Impacted	POIs
PAC	Chiloquin – C1-46 POI substation, Captain Jack Annex 500 kV	La Pine 500 kV, G0657 POI
PGE	Captain Jack Annex 500 kV	La Pine 500 kV, G0657 POI

9 Interconnection Facility Requirements

9.1 La Pine Annex POI Interconnection Facility Requirements

Table 9.1: POI La Pine Annex Facility requirements

G#	BPA Station Work	BPA Non-Station Work
G0870, G0871,	La Pine Annex 500 kV station, 1x shared 500 kV gen-tie Terminal	POI 500/230 kV transformer New G0657 POI-Captain Jack Annex 500 kV line
G0909, G0910, G0912,	La Pine Annex 500 kV station, 1x shared 500 kV gen-tie Terminal	
G1056	La Pine Annex 500 kV station, 1x 500 kV gen-tie Terminal	

1. Develop a 500 kV, three bay breaker-and-half bus substation at the POI. This includes development of a new substation, 9 power circuit breakers, 18 motorized disconnect switches and associated control, relaying, and communications equipment.
2. Develop a 230 kV, two bay breaker-and-a-half bus yard next to the 500 kV substation in (1). This includes 5 power circuit breakers, 10 disconnect switches, and associated control, relaying, and communications equipment.
3. Install a 500/230 kV three-phase transformer with terminals in (1) and (2). The normal MVA rating shall be 1300 MVA. The transformer shall have 9 taps with the ability to change taps under load.
4. All generating facilities are terminated in the 500 kV yard of (1).
5. Construct a new, 500 kV transmission line between G0657 POI substation and Captain Jack Annex substation approximately 86 miles long. This requirement is shared with G0657 POI substation IRs and others in CA South 1.
6. Construct 3 series capacitors and connected them into the Bonanza-La Pine Annex #1 (contingent facility), La Pine Annex-G0657 POI #2 (contingent facility), and G0657 POI-Captain Jack Annex #1 transmission lines. Location and specifications to be determined. This requirement is shared with G0657 POI substation IRs and others in CA South 1.

7. Construct two, 230 kV transmission lines between La Pine Annex and La Pine substation. The transmission lines are expected to be less than 5 miles in length each. Construct the transmission lines to the highest capacity available BPA standard 230 kV construction.
8. Operate the Bonanza-La Pine 230 kV transmission line at 500 kV
    a. Re-terminate the Bonanza-La Pine #1 transmission line from Bonanza 230 kV to Bonanza 500 kV.
    b. Re-terminate the Bonanza-La Pine #1 transmission line from La Pine 230 kV to La Pine Annex 500 kV.
9. Operate the La Pine-G0657 POI transmission line at 500 kV
    a. Re-terminate the La Pine-G0657 POI #2 transmission line from La Pine 230 kV to La Pine Annex 500 kV.
    b. Re-terminate the La Pine-G0657 POI #2 transmission line from the G0657 POI 230 kV yard to the G0657 POI 500 kV yard.
10. Installation of BPA-required C&C equipment at each customer's collector site (RAS, Meters, relays, Control House space)
11. Moderate development of C&C hardware at BPA's POI substation.
12. All generating facilities must have all necessary hardware to participate in BPA Main Grid RAS.
13. All generating facility tie lines must coordinate transfer trip protection schemes with BPA.

The customers will construct 500 kV lines from the BPA POI stations to their generation facilities. The customers must provide protection of the generating facility tie-lines including transfer trips. Protection must be coordinated with BPA. The customer must construct its generating facility and collector substation.

9.2 G0657 POI Interconnection Facility Requirements

Table 8.2: POI La Pine Annex Facility requirements

G#	BPA Station Work	BPA Non-Station Work
G0747	New 500 kV yard, 3x 500 kV terminals, 1x 230 kV Terminal,	new POI 500/230 kV transformer New G0657 POI-Captain Jack Annex 500 kV line
G1017	New 500 kV yard, 3x 500 kV terminals, 1x 230 kV Terminal	New 500 kV yard, POI 500/230 kV transformer New G0657 POI-Captain Jack Annex 500 kV line

1. Develop a 500 kV, two bay breaker-and-a-half bus yard at the POI substation. This includes 5 power circuit breakers, 10 motorized disconnect switches and associated control, relaying, and communications equipment.
2. Install a 500/230 kV three-phase transformer with terminals in (1) and the 230 kV yard of the POI substation. The normal MVA rating shall be 1300 MVA. The transformer shall have 9 taps with the ability to change taps under load.
3. Both generating facilities are terminated in the 230 kV yard of the POI substation.
4. Operate the Bonanza-La Pine 230 kV transmission line at 500 kV
    a. Re-terminate the Bonanza-La Pine #1 transmission line from Bonanza 230 kV to Bonanza 500 kV.

   b. Re-terminate the Bonanza-La Pine #1 transmission line from La Pine 230 kV to La Pine Annex 500 kV.
5. Operate the La Pine-G0657 POI transmission line at 500 kV
   a. Re-terminate the La Pine-G0657 POI #2 transmission line from La Pine 230 kV to La Pine Annex 500 kV.
   b. Re-terminate the La Pine-G0657 POI #2 transmission line from the G0657 POI 230 kV yard to the G0657 POI 500 kV yard.
6. Construct a new, 500 kV transmission line between G0657 POI substation and Captain Jack Annex substation approximately 86 miles long. This requirement is shared with G0657 POI substation IRs and others outside this report.
7. Construct 3 series capacitors and connected them into the Bonanza-La Pine Annex #1, La Pine Annex-G0657 POI #1, and G0657 POI-Captain Jack Annex #1 transmission lines. Location and specifications to be determined. This requirement is shared with G0657 POI substation IRs and others outside this report.
8. Installation of BPA-required C&C equipment at each customer's collector site (RAS, Meters, relays, Control House space)
9. Major development of C&C hardware at BPA's POI substation.
10. All generating facilities must have all necessary hardware to participate in BPA Main Grid RAS.
11. All generating facility tie lines must coordinate transfer trip protection schemes with BPA.

The customers will construct 230 kV lines from the BPA POI stations to their generation facilities. The customers must provide protection of the generating facility tie-lines including transfer trips. Protection must be coordinated with BPA. The customer must construct its generating facility and collector substation.

10 Project One-Line Drawings

10.1 LaPine 500 kV Annex

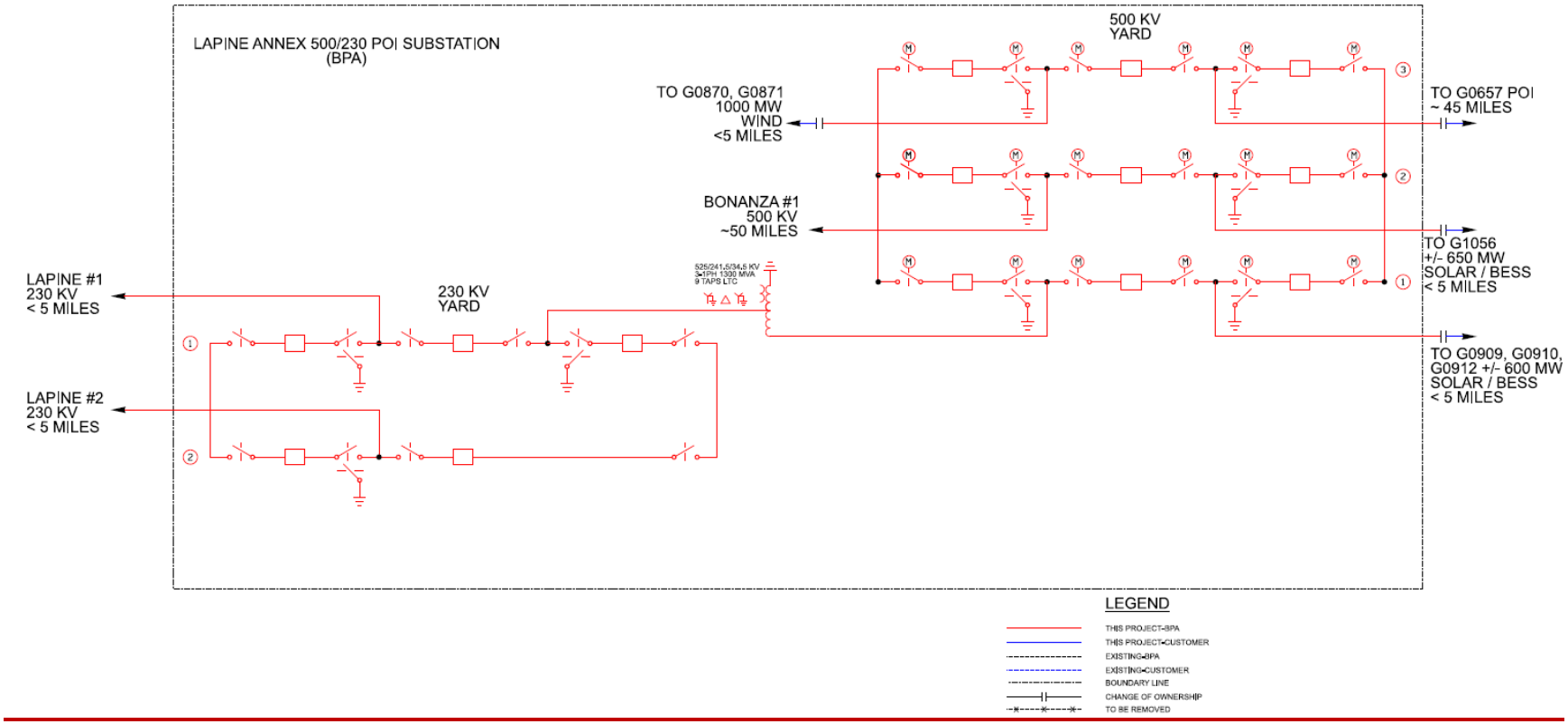

Figure 2 La Pine Annex POI one line. Note that the existing La Pine substation is full, so a new substation is required. The name "La Pine Annex" is subject to change.

10.2 G0657 POI Station

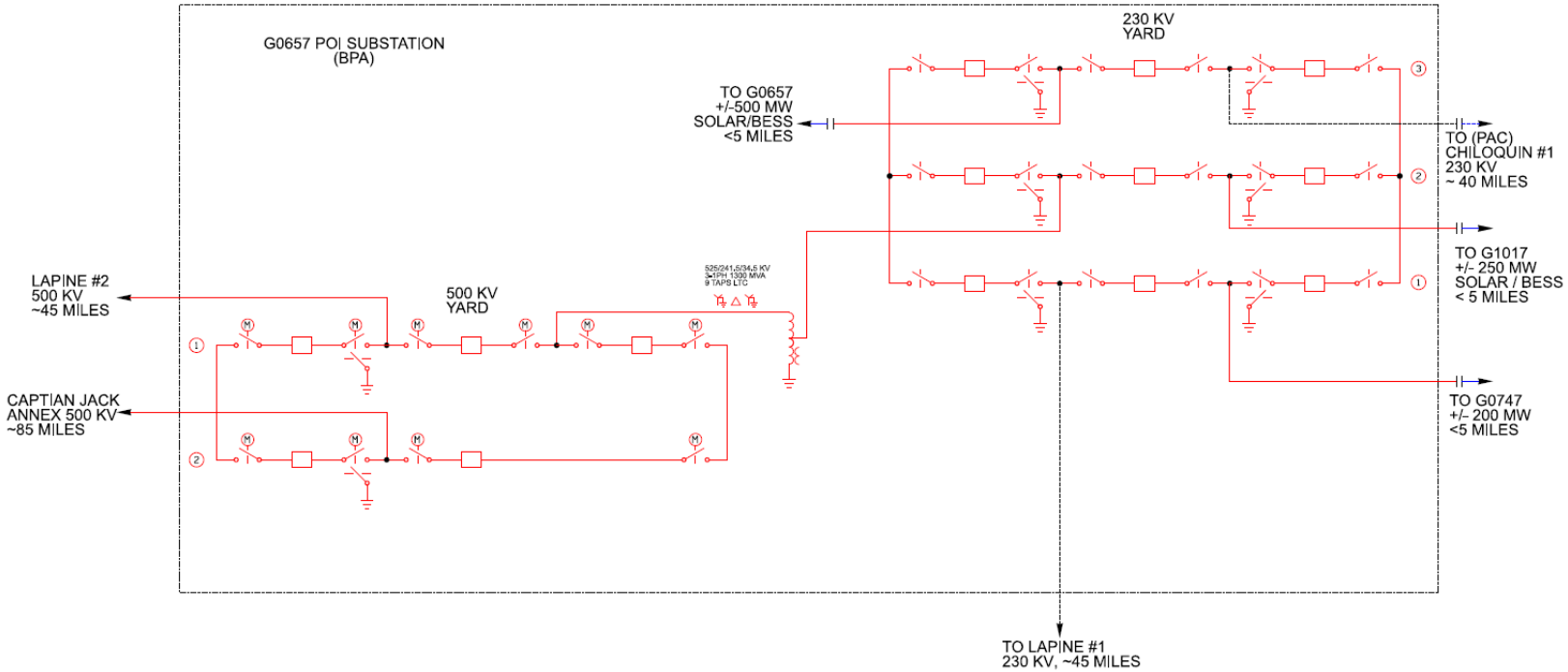

Figure 3 G657 POI Substation, also referred to in this report as "La Pine-Chiloquin POI". Note that part of the 230 kV yard is a contingent facility of this Cluster Study and Cluster Study Plan of Service costs reflect that.

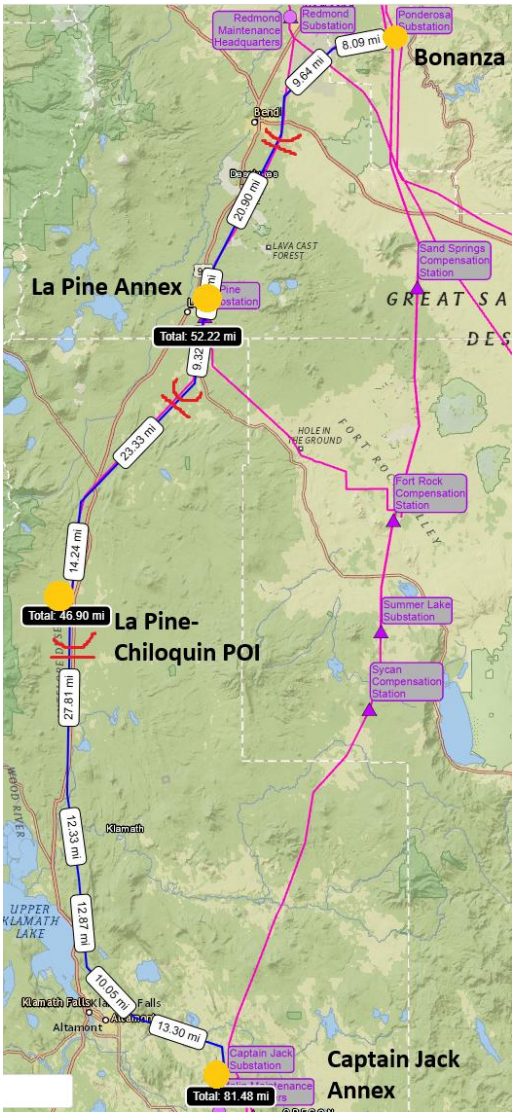

Figure 4 Sketch of the Bonanza-La Pine Annex #1, La Pine Annex-G657 POI #1, and G657 POI - Captain Jack Annex #1 transmission lines required by these facilities. Details including final routing and location of series capacitors are to be determined in later study phases.

11 Cost Estimates and Schedules

11.1 Estimated Schedule

The schedule is dependent on,

1) The acquisition of long lead time equipment,
2) BPA's ability to fit the project into its construction work plan, and
3) The customer's ability to obtain any necessary permits for the project and progress through the interconnection process in a timely manner.

A non-binding good faith estimated time to construct is 3-5 years for substation equipment and 7-10 years for transmission line upgrades after design activities begin. The estimated time to construct a plan of service is refined through the subsequent stages of the interconnection process.

BPA will not begin construction of a plan of service required for interconnection until the Interconnection customer has executed a Standard Large Generator Interconnection Agreement (LGIA). BPA's decision to offer an LGIA is dependent on the completion of an environmental compliance decision under the National Environmental Policy Act (NEPA). BPA's environmental compliance decision under NEPA requires the Interconnection customer to have obtained required permitting, certification, and environmental approvals for any facilities that BPA will not own.

11.2 Cost Estimates and Cost Allocations

The following are non-binding good faith estimates of cost based on previous estimates for similar projects. They represent only scopes of work that will be performed by BPA. Costs for any work being performed by the customer are not included. These costs include overhead rates for BPA labor & materials, and for contract labor & materials. The costs also include a 40% contingency. Not included in these estimates are costs for land acquisition, permitting and environmental mitigations. More accurate estimates based on scoping for the project will be available at the completion of the Interconnection Facilities Study.

Detailed Communications and Control (C&C) equipment required for each generation facility and interconnection into the BPA transmission system at the BPA-TS POI substation will be determined in an Interconnection Facilities Study. The TCS PH1 estimates C&C equipment scope and costs based on whether required upgrades fall into the following categories:

1) customer Station ($5M): for BPA-required C&C equipment at customer's collector site (RAS, Meters, relays, Control House space)
2) Low ($5M): BES additions to an existing BPA station
3) Medium ($10M): BES creation of a new BPA substation near existing C&C infrastructure, or significant expansion of an existing BPA substation
4) High ($15M): BES creation of BPA substation very remote from any existing C&C infrastructure.

When multiple projects owned by affiliated entities interconnected at the same POI, BPA assumed the IRs to be sharing a tie line where applicable. These IRs were treated as a single customer for per capita cost allocation of station equipment Network Upgrades as outlined in Section 4.2.3(a) of the LGIP. In the below cost estimate tables, this treatment is identified by the senior-queued IR being allocated the full per capita cost share and the junior-queued IR being allocated 0% of costs for station equipment Network Upgrades. IRs assumed to be sharing a tie line are identified in the one-line drawings provided in section 10 of this report.

11.3 POI 1: La Pine Annex

Table 11.1 POI 1 – La Pine Annex Station Cost Estimate

Estimate Summary									
Estimate #	Description		Quantity	Contract		BPA		Misc.	Total
				Labor	Material	Labor	Material		
	La Pine Annex POI		-	-	-	-	-	-	-
ST-070-133-7	500kV New POI: 4x PCB, 3pos, 2x bay BAAH,		1	$44,512,000	$46,842,000	$5,690,000	$816,000	$0	$97,860,000
ST-070-65-10	500kV Add: 1x bay 2pos BAAH		2	$23,416,000	$19,228,000	$3,620,000	$0	$116,000	$46,380,000
ST-070-39-12	230kV New POI: 3x PCB, 3pos, 2x bay BAAH		1	$18,348,000	$12,624,000	$4,830,000	$0	$118,000	$35,920,000
C&C:Customer Site	C&C Placeholder per collector site		6	$0	$0	$0	$0	$30,000,000	$30,000,000
C&C: Med.BPA Site	C&C Placeholder at BPA station		1	$0	$0	$0	$0	$10,000,000	$10,000,000
Contingency %	40%		Subtotal:	$86,276,000	$78,694,000	$14,140,000	$816,000	$40,234,000	$220,160,000
Overhead %	Labor	Materials & Turnkey	Contingency:	$34,510,400	$31,477,600	$5,656,000	$326,400	$16,093,600	$88,064,000
	26%	9%	Overhead:	$10,870,776	$9,915,444	$5,146,960	$102,816	$14,645,176	$40,681,172
Grand Total:	*(rounded to two significant figures)*			**$132,000,000**	**$120,000,000**	**$25,000,000**	**$1,250,000**	**$71,000,000**	**$350,000,000**

Table 11.2 POI 1 – La Pine Annex Non-Station Cost Estimate

Estimate Summary									
Estimate #	Description		Quantity	Contract		BPA		Misc.	Total
				Labor	Material	Labor	Material		
	La Pine Annex POI		-	-	-	-	-	-	-
LT-040-19-10	230kV: 1 mi, 1-Jefferson, SC all new towers		10	$11,060,000	$5,440,000	$1,940,000	$0	$0	$18,440,000
ST-070-141-6	500kV: 1x 525/241 433 MVA bank (1ph)		3	$24,306,000	$28,137,000	$4,176,000	$6,384,000	$0	$63,003,000
Contingency %	40%		Subtotal:	$35,366,000	$33,577,000	$6,116,000	$6,384,000	$0	$81,443,000
Overhead %	Labor	Materials	Contingency:	$14,146,400	$13,430,800	$2,446,400	$2,553,600	$0	$32,577,200
	26%	9%	Overhead:	$4,456,116	$4,230,702	$2,226,224	$804,384	$0	$11,717,426
Grand Total:	*(rounded to two significant figures)*			**$54,000,000**	**$51,000,000**	**$10,800,000**	**$9,700,000**	**$0**	**$126,000,000**

Table 11.3 POI 1 – La Pine Annex Cost Allocation

Queue #	Requested MW	Station Equipment	Station Equipment Allocation (Per Capita)	Station Equipment Cost	Non-Station Equipment (1)	Non-Station Equipment (1) Allocation (Per MW)	Non-Station Equipment (1) Cost	Non-Station Equipment (2)	Non-Station Equipment (2) Allocation (Per MW)	Non-Station Equipment (2) Cost	Non-Network Direct Assigned	Direct Assigned Cost	Cost Assignment
G0870	500	New La Pine Annex 500kV Substation, w/ New Comms	33.33%	$296M	G657 - Captain Jack 500kV Line	5.49%	$850M	New 500/230kV Transformer	22.222%	$126M	Collector Station C&C and RAS	$9M	$182M
G0871	500		0.00%			5.49%			22.222%		Collector Station C&C and RAS	$9M	$84M
G0909	200		33.33%			2.20%			8.889%		Collector Station C&C and RAS	$9M	$138M
G0910	200		0.00%			2.20%			8.889%		Collector Station C&C and RAS	$9M	$39M
G0912	200		0.00%			2.20%			8.889%		Collector Station C&C and RAS	$9M	$39M
G1056	650		33.33%			7.14%			28.889%		Collector Station C&C and RAS	$9M	$205M

11.4 POI 2: G657 POI

Table 11.4 POI 2 –G657 Station Cost Estimate

Estimate Summary									
Estimate #	Description		Quantity	Contract		BPA		Misc.	Total
				Labor	Material	Labor	Material		
	G0657 POI (La Pine-Chiloquin)		-	-	-	-	-	-	-
ST-070-133-7	500kV New POI: 4x PCB, 3pos, 2x bay BAAH, w/		1	$44,512,000	$46,842,000	$5,690,000	$816,000	$0	$97,860,000
ST-070-124-6	230kV Add: 1x bay 2pos BAAH		1.5	$12,345,000	$7,542,000	$1,728,000	$0	$27,000	$21,642,000
C&C:Customer Site	C&C Placeholder per collector site		2	$0	$0	$0	$0	$10,000,000	$10,000,000
C&C: Large. BPA Site	C&C Placeholder at BPA station		1	$0	$0	$0	$0	$15,000,000	$15,000,000
Contingency %	40%		Subtotal:	$56,857,000	$54,384,000	$7,418,000	$816,000	$25,027,000	$144,502,000
Overhead %	Labor	Materials & Turnkey	Contingency:	$22,742,800	$21,753,600	$2,967,200	$326,400	$10,010,800	$57,800,800
	26%	9%	Overhead:	$7,163,982	$6,852,384	$2,700,152	$102,816	$9,109,828	$25,929,162
Grand Total:	*(rounded to two significant figures)*			**$87,000,000**	**$83,000,000**	**$13,000,000**	**$1,250,000**	**$44,000,000**	**$230,000,000**

Table 11.5 POI 2 –G657 Non-Station Cost Estimate

Estimate Summary									
Estimate #	Description		Quantity	Contract		BPA		Misc.	Total
				Labor	Material	Labor	Material		
	G0657 POI (La Pine-Chiloquin)		-	-	-	-	-	-	-
ST-070-124-6	230kV Add: 1x bay 2pos BAAH		0.5	$4,115,000	$2,514,000	$576,000	$0	$9,000	$7,214,000
ST-070-141-6	500kV: 1x 525/241 433 MVA bank (1ph)		3	$24,306,000	$28,137,000	$4,176,000	$6,384,000	$0	$63,003,000
Contingency %	40%		Subtotal:	$28,421,000	$30,651,000	$4,752,000	$6,384,000	$9,000	$70,217,000
Overhead %	Labor	Materials & Turnkey	Contingency:	$9,722,400	$11,254,800	$1,670,400	$2,553,600	$0	$25,201,200
	26%	9%	Overhead:	$3,432,906	$3,771,522	$1,669,824	$804,384	$2,340	$9,680,976
Grand Total:	*(rounded to two significant figures)*			**$42,000,000**	**$46,000,000**	**$8,100,000**	**$9,700,000**	**$11,000**	**$105,000,000**

Table 11.6 POI 2 – G657 POI Cost Allocation

Queue #	Requested MW	Station Equipment	Station Equipment Allocation (Per Capita)	Station Equipment Cost	Non-Station Equipment (1)	Non-Station Equipment (1) Allocation (Per MW)	Non-Station Equipment (1) Cost	Non-Station Equipment (2)	Non-Station Equipment (2) Allocation (Per MW)	Non-Station Equipment (2) Cost	Non-Network Direct Assigned	Direct Assigned Cost	Cost Assignment
G0747	200	G0657 POI 230kV Substation Expansion w/ Expanded	50.00%	$212M	G657 - Captain Jack 500kV Line	2.20%	$850M	New 500/230kV Transformer	44.444%	$105M	Collector Station C&C and RAS	$9M	$180M
G1017	250		50.00%			2.75%			55.556%		Collector Station C&C and RAS	$9M	$197M

11.5 SPB1: G657-Captain Jack Annex 500 kV Line

Table 11.7 SPB1 – G657-Captain Jack Annex 500 kV Line Cost Estimate

Estimate Summary									
Estimate #	Description		Quantity	Contract		BPA		Misc.	Total
				Labor	Material	Labor	Material		
	G657-CPJK 500 kV line		-	-	-	-	-	-	-
LT-040-54-8	500kV: 1 mi, 3-Deschutes, SC all new towers		85	$154,530,000	$126,820,000	$82,450,000	$0	$0	$363,800,000
SB-8071-1-0	500kV: series capacitor		3	$49,155,000	$8,136,000	$13,350,000	$73,830,000	$93,000	$144,564,000
ST-070-65-10	500kV Add: 1x bay 2pos BAAH		1	$11,708,000	$9,614,000	$1,810,000	$0	$58,000	$23,190,000
C&C	C&C Placeholder (new fiber)		1	$0	$0	$0	$0	$11,800,000	$11,800,000
Contingency %	40%		Subtotal:	$215,393,000	$144,570,000	$97,610,000	$73,830,000	$11,951,000	$543,354,000
Overhead %	Labor	Materials & Turnkey	Contingency:	$86,157,200	$57,828,000	$39,044,000	$29,532,000	$4,780,400	$217,341,600
	26%	9%	Overhead:	$27,139,518	$18,215,820	$35,530,040	$9,302,580	$3,107,260	$93,295,218
Grand Total:	*(rounded to two significant figures)*			**$330,000,000**	**$220,000,000**	**$170,000,000**	**$113,000,000**	**$20,000,000**	**$850,000,000**

**G657-CPJK Project Costs to be allocated with IRs in Cluster Area South 1 report POIs (BONZ-NOB and BONZ)*

Table 11.8 SPB1 – G657-Captain Jack Annex 500 kV Line Cost Allocation

Queue #	Enabled MW	Percent Allocation	Cost Allocation
G0695*	900	9.89%	$ 84,065,934
G0702*	600	6.59%	$ 56,043,956
G0747	200	2.20%	$ 18,681,319
G0758*	600	6.59%	$ 56,043,956
G0861*	500	5.49%	$ 46,703,297
G0870	500	5.49%	$ 46,703,297
G0871	500	5.49%	$ 46,703,297
G0887*	200	2.20%	$ 18,681,319
G0888*	200	2.20%	$ 18,681,319
G0900*	200	2.20%	$ 18,681,319
G0901*	200	2.20%	$ 18,681,319
G0909	200	2.20%	$ 18,681,319
G0910	200	2.20%	$ 18,681,319
G0912	200	2.20%	$ 18,681,319
G1017	250	2.75%	$ 23,351,648
G1051*	630	6.92%	$ 58,846,154
G1052*	1300	14.29%	$ 121,428,571
G1053*	1070	11.76%	$ 99,945,055
G1056	650	7.14%	$ 60,714,286
Total:	9100	100%	$ 850,000,000

** Requests were studied in Cluster Area South 1 (SO1), beyond SO2*