CH2M HILL
2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833
Tel 916-920-0300

DOCKET
09-AFC-3
DATE 9/8/2009
RECD. 9/9/2009

September 8, 2009

Mr. Craig Hoffman
Project Manager
Siting, Transmission and Environmental Protection Division
California Energy Commission
1516 Ninth Street, (MS-15)
Sacramento, CA 95814

Re: DGC KELSO CT (MARIPOSA ENERGY PROJECT) TRANSITION CLUSTER PHASE I INTERCONNECTION STUDY
MARIPOSA ENERGY PROJECT (09-AFC-3)

Dear Craig:

Per your request and on behalf of Mariposa Energy, attached is the DGC Kelso CT Transition Cluster Phase I Interconnection Study prepared by California ISO for the Mariposa Energy Project (MEP). This analysis was prepared for Transition Cluster Group #1, including 12 generation projects totaling approximately 4,700 MW within the Greater Bay Area. Based on direction provided by CAISO to Mariposa Energy, the report appendices contain confidential information that will require a confidential submittal process.

Please contact me at (916) 286-0348 if you have any questions or require additional information.

Sincerely,

Doug Urry
Project Manager

Enclosure

c: Bo Buchynsky, Mariposa Energy
Gregg Wheatland, Ellison, Schneider & Harris L.L.P.

California ISO
Your Link to Power

California Independent
System Operator Corporation

July 28, 2009

Gary Normoyle
Director of Engineering
Diamond Generating Corporation
333 S. Grand Avenue, Suite 1570
Los Angeles, CA 90071

Subject: DGC Kelso CT Transition Cluster Phase I Interconnection Study

Dear Gary Normoyle:

Attached is the Transition Cluster Phase I Interconnection Study Report for the interconnection of the proposed DGC Kelso CT (Project) to the CAISO Controlled Grid. The CAISO and PG&E performed the Phase I Interconnection Study in accordance with the CAISO's LGIP tariff.

Results of the Phase I Interconnection Study establish the maximum cost responsibility for Network Upgrades assigned to the Project in accordance with the CAISO's LGIP tariff. The cost for Network Upgrades assigned to the Project is [redacted]. In addition, the study report provides a non-binding cost estimate of the Interconnection Facilities to interconnect the Project to the CAISO Controlled Grid.

Please review the report and prepare comments and questions for the Results Meeting. The Phase I Interconnection Study Results Meeting will be coordinated and scheduled within 60 calendar days following receipt of this Phase I Interconnection Study report.

Sincerely,

Edward T. Fishback

Edward T. Fishback
Project Manager

Attachment

via e-mail:

Gary Normoyle (g.normoyle@dgc-us.com)
Barbara Madrid (bjm5@pge.com)
Arcy Palomares (ADP5@pge.com)
Nisar Shah (Nshah@caiso.com)
CAISO Regional Transmission North (Regional Transmission – North@caiso.com)
Ed Fishback (efishback@caiso.com)

Transition Cluster Group 1 Phase I Interconnection Study Report

Diamond Generating Corporation

DGC Kelso CT Project

Final Report

California ISO
Your Link to Power

July 28, 2009

This study has been completed in coordination with Pacific Gas & Electric per CAISO Tariff Appendix Y Large Generator Interconnection Procedures (LGIP) for Interconnection Requests in a Queue Cluster Window

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1. Executive Summary

Diamond Generating Corporation, an Interconnection Customer (IC), has submitted a completed Interconnection Request (IR) to the California Independent System Operator Corporation (CAISO) for their proposed DGC Kelso CT Project (Project), interconnecting to the CAISO Controlled Grid. The Project consists of four gas turbines 49.4 MW each with a total rated output of 197.6 MW. With a 4 MW plant auxiliary load, the maximum output to the CAISO Controlled Grid is 193.6 MW. The proposed Commercial Operation Date of the Project is June 1, 2012. The primary point of interconnection (POI) is the 230 kV bus at Pacific Gas & Electric Company's (PG&E) Kelso Substation in Alameda County, California. The IC has selected to loop through either of PG&E's Pittsburg-Tesla 230 kV #1 or #2 Line as an alternative POI.

In accordance with Federal Energy Regulatory Commission (FERC) approved Generation Interconnection Process Reform (GIPR) Large Generator Interconnection Procedures (LGIP), the IC, CAISO, and PG&E have agreed to perform the Transition Cluster Phase 1 Interconnection Study (Phase 1 Study) to determine the impact of the Project on the CAISO Controlled Grid.

Under the new process, Interconnection Requests were processed together in Clusters. Transition Cluster projects are initially grouped for study purposes[1] according to their geographical locations. There were twelve (12) generation projects, including this Project, located in the Greater Bay Area that were assigned to the Transition Cluster Group 1 (Group 1) for the Phase 1 Study. This study report provides the following:

1. Transmission system impacts caused by the addition of the Group 1 projects,

2. System reinforcements necessary to mitigate the adverse impacts of the Group 1 projects under various system conditions,

3. Preliminary evaluation on the feasibility of the Group 1 projects on the CAISO Controlled Grid, and

4. A list of required facilities and a non-binding, good faith estimate of this Project's cost responsibility and time to construct these facilities.

To determine the system impacts caused by the interconnection of the Group 1 projects, the Phase 1 study for Group 1 was performed using the following full-loop base cases:

- 2013 Summer Peak Conditions
- 2013 Summer Off-Peak Conditions

[1] These initial groupings of generation projects were primarily for the purpose of organizing the work to be done by various CAISO and PG&E engineers. Grouping of the generation projects for cost allocation purposes are based on study results. For example, the Groupings for cost allocation of Delivery Network Upgrades are based on the CAISO's Deliverability Assessment Methodologies posted on the CAISO website: http://www.caiso.com/1c44/1c44b5c31cce0.html

The studies performed for the Group 1 projects included:

- Steady State Power Flow Analyses
- System Fault Duty Analyses
- Dynamic Stability Analyses
- Reactive Power Deficiency Analyses
- On-Peak Deliverability Assessment
- System Protection Requirements
- Substation Evaluation
- Transmission Line Evaluation
- Land/Environment Evaluation

The Phase 1 study results have determined that the interconnection of the Group 1 projects to the CAISO Controlled Grid causes new overloads on the following transmission facilities:

Category "A"

- Castro Valley - Newark 230 kV Line
- Cayetano - North Dublin 230 kV Line
- Contra Costa - Brentwood 230 kV Line
- Contra Costa - Delta Pumps 230 kV Line (Contra Costa - Windmaster)
- Contra Costa - Delta Pumps 230 kV Line (Windmaster - Delta Pumps)
- Delta Pumps - Tesla 230 kV Line (Altamont - Delta Pumps)
- Delta Pumps - Tesla 230 kV Line (Altamont - Tesla)
- Kelso - Tesla 230 kV Line (Kelso - USWP RLF)
- Kelso - Tesla 230 kV Line (USWP RLF - Tesla)
- Las Positas - Newark 230 kV Line
- Lonetree - Cayetano 230 kV Line (Lonetree - USWP JRW)
- Lonetree - Cayetano 230 kV Line (USWP JRW - Cayetano)
- Moraga-Castro Valley 230 kV Line
- North Dublin-Vineyard 230 kV Line
- T171 - Tesla 500 kV Line
- Trimble - San Jose B 115 kV Line
- Vineyard - Newark 230 kV Line

Category "B"

- Birds Landing - Contra Costa 230 kV Line
- Brentwood - Kelso 230 kV Line
- Castro Valley - Newark 230 kV Line
- Cayetano - North Dublin 230 kV Line
- Contra Costa - Brentwood 230 kV Line
- Contra Costa - Contra Costa Sub 230 kV Line

- Contra Costa - Delta Pumps 230 kV Line (Contra Costa - Windmaster)
- Contra Costa - Delta Pumps 230 kV Line (Windmaster - Delta Pumps)
- Contra Costa - Las Positas 230 kV Line
- Cooley Landing - Stanford 60 kV Line (Cooley Landing - SRI)
- Delta Pumps - Tesla 230 kV Line (Altamont - Tesla)
- Delta Pumps - Tesla 230 kV Line (Delta Pumps - Altamont)
- Kelso - Tesla 230 kV Line (Kelso - USWP RLF)
- Kelso - Tesla 230 kV Line (USWP RLF - Tesla)
- Las Positas - Newark 230 kV Line
- Lonetree - Cayetano 230 kV Line (Lonetree - USWP JRW)
- Lonetree - Cayetano 230 kV Line (USWP JRW - Cayetano)
- Moraga - Castro Valley 230 kV Line
- Newark 230/115 kV Bank 11
- North Dublin - Vineyard 230 kV Line
- Oakland C - Oakland L 115 kV Line
- Pittsburg 230/181 kV TBC Bank
- Potrero 115/181 kV TBC Bank
- Sobrante - El Cerrito 115 kV Line No. 1
- Sobrante - El Cerrito 115 kV Line No. 2
- Table Mountain - Tesla 500 kV Line
- Tesla - T171 500 kV Line
- Trimble - San Jose B 115 kV Line
- Vaca Dixon-T171 500 kV Line
- Vaca-Dixon - T275 230 kV Line No. 1
- Vaca-Dixon - T275 230 kV Line No. 2
- Vineyard - Newark 230 kV Line

Category "C"

- Birds Landing - Contra Costa 230 KV Line
- Birds Landing - Contra Costa Sub 230 kV Line
- Brentwood - Kelso 230 kV Line
- Castro Valley - Newark 230 kV Line
- Cayetano - North Dublin 230 kV Line
- Contra Costa - Brentwood 230 kV Line
- Contra Costa - Contra Costa Sub 230 kV Line
- Contra Costa - Delta Pumps 230 kV Line (Contra Costa - Windmaster)
- Contra Costa - Delta Pumps 230 kV Line (Windmaster - Delta Pumps)
- Contra Costa - Las Positas 230 kV Line
- Delta Pumps - Tesla 230 kV Line (Altamont - Tesla)
- Delta Pumps - Tesla 230 kV Line (Delta Pumps - Altamont)
- Eastshore - San Mateo 230 kV Line
- Kelso - Tesla 230 kV Line (Kelso - USWP RLF)
- Kelso - Tesla 230 kV Line (USWP RLF - Tesla)
- Lambie - Birds Landing 230 kV Line
- Las Positas - Newark 230 kV Line
- Lonetree - Cayetano 230 kV Line (Lonetree - USWP JRW)
- Lonetree - Cayetano 230 kV Line (USWP JRW - Cayetano)
- Moraga - Castro Valley 230 kV Line
- Moraga - Claremont 115 kV Line No. 1
- Moraga - Claremont 115 kV Line No. 2
- Newark 230/115 kV Bank 11
- North Dublin - Vineyard 230 kV Line

- Oakland C - Oakland L 115 kV Line
- Oleum - North Tower - Christie 115 kV Line (Christie - Martinez Jct)
- Sobrante - Christie 115 kV Line
- Sobrante - El Cerrito 115 kV Line No. 1 (El Cerrito Jct - Sobrante)
- Sobrante - El Cerrito 115 kV Line No. 2
- T171 - Tesla 500 kV Line
- Table Mountain - Tesla 500 kV Line
- Trimble - San Jose B 115 kV Line
- Vaca-Dixon - T275 230 kV Line No. 1
- Vaca-Dixon - T275 230 kV Line No. 2
- Vineyard - Newark 230 kV Line
- Westley - Los Banos 230 kV Line

The non-binding construction schedule to engineer and construct the facilities is approximately 24-36 months from the signing of the Large Generator Interconnection Agreement (LGIA).

The non-binding cost estimate of Interconnection Facilities[2] to interconnect the Project would be approximately [redacted] exclusive of ITCC[3]. The non-binding cost estimate for the Network Upgrades[4] to interconnect the Project would be approximately [redacted]

2. Project and Interconnection Information

Table 2-1 provides general information about the Project.

Table 2-1: DGC Kelso CT Project General Information

Project Location	14511 Christensen Road, Unincorporated in Alameda County, California 94550
PG&E Planning Area	San Francisco Greater Bay Area
Number and Type of Generators	Four Gas Turbines (each rated for 49.4 MW)
Maximum Generator Output	197.6 MW
Generator Auxiliary Load	4 MW
Maximum Net Output to Grid	193.6 MW
Power Factor Range	0.85
Step-up Transformer	Four 36/48/60/67.2 MVA, 13.8/230 kV Transformers
Description Of Interconnection Configuration	230 kV Bus at Kelso Substation
Connection Voltage	230 kV

[2] The transmission facilities necessary to physically and electrically interconnect the Project to the CAISO Controlled Grid at the point of interconnection.

[3] Income Tax Component of Contribution

[4] The transmission facilities, other than Interconnection Facilities, beyond the point of interconnection necessary to physically and electrically interconnect the Project safely and reliably to the CAISO Controlled Grid

Figure 2-1 provides the map for the Project and the transmission facilities in the vicinity. Figure 2-2 shows the conceptual single line diagram of the Project.

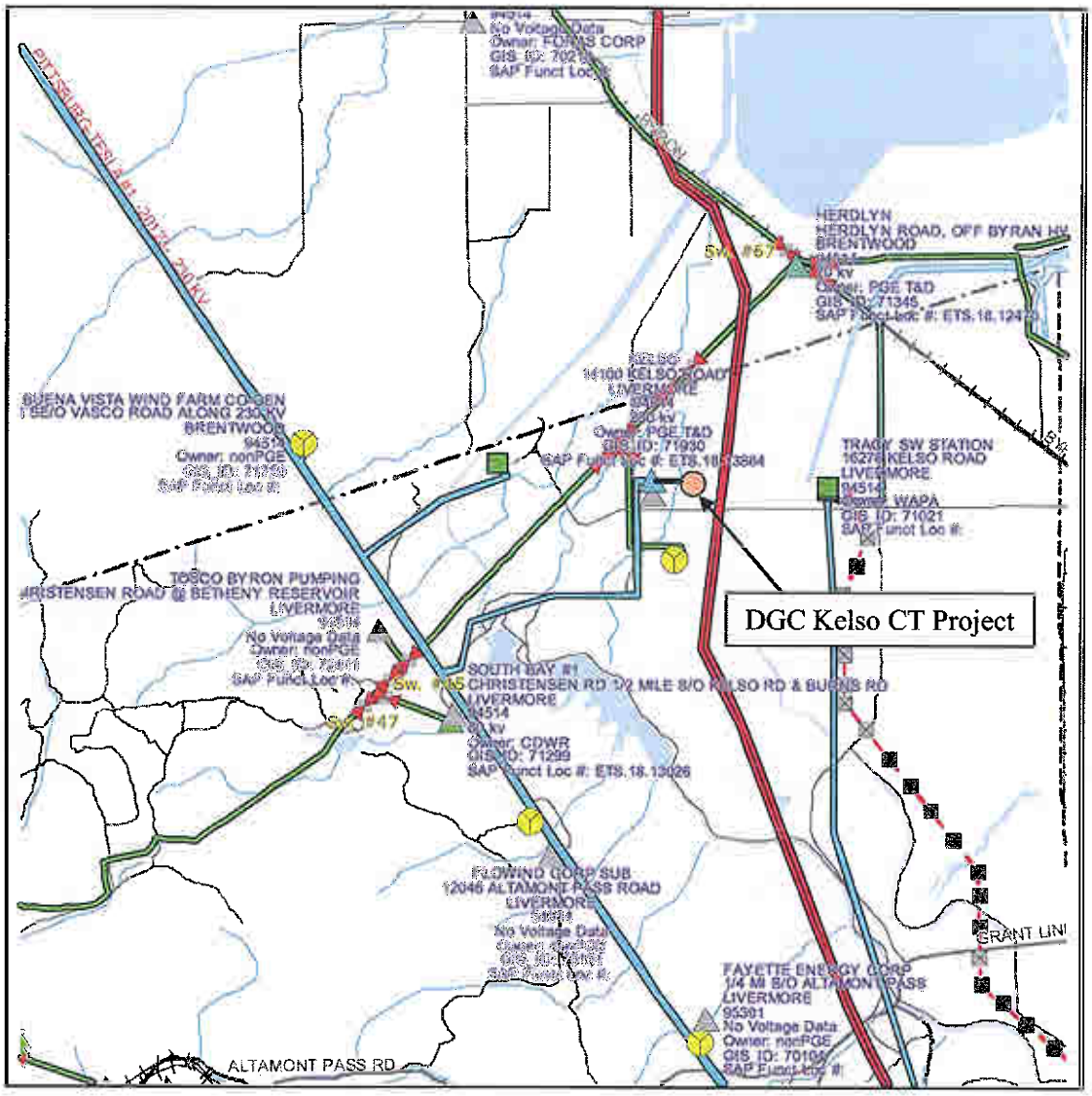

Figure 2-1 : Map of the Project

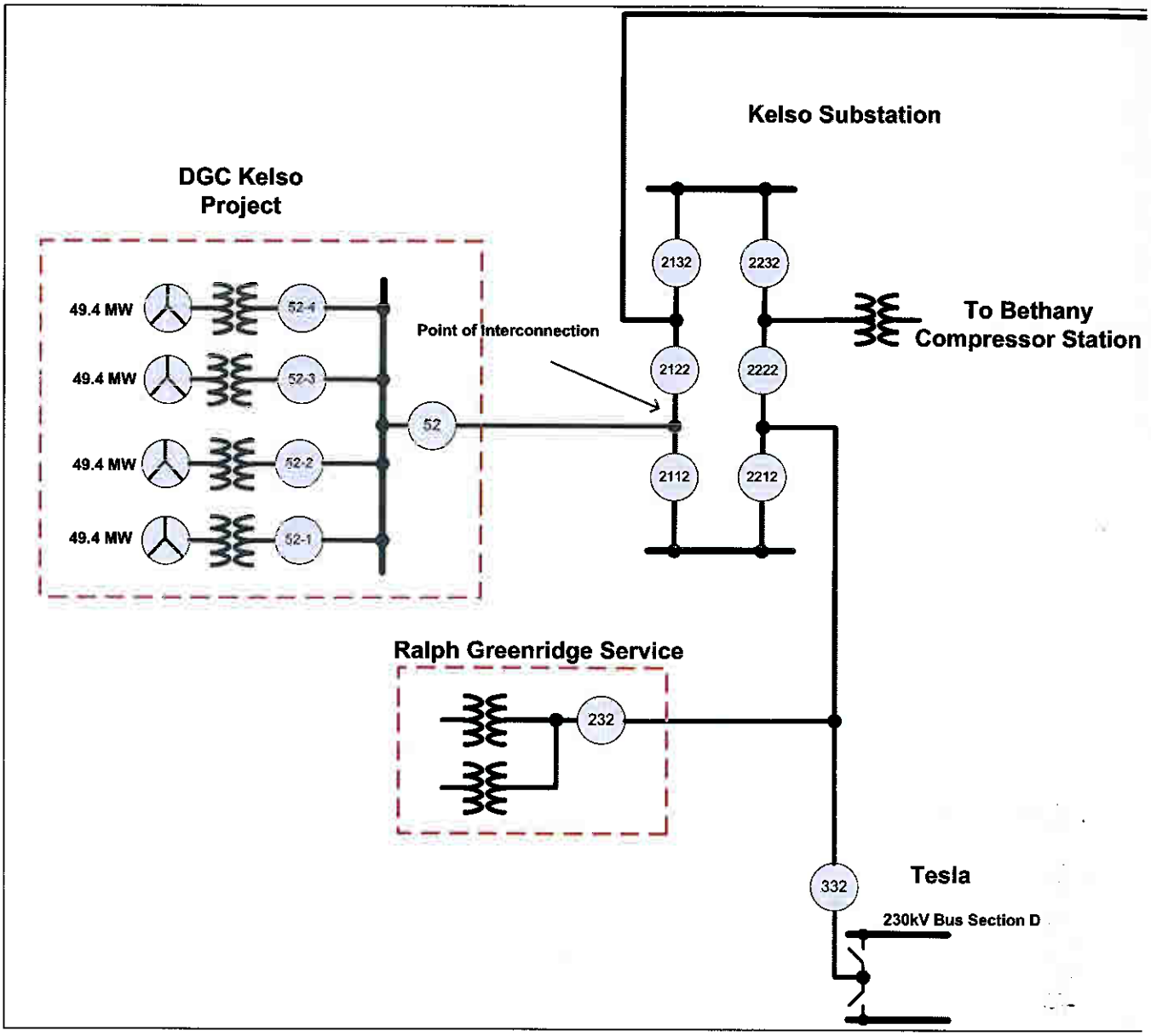

Figure 2-2: Proposed Single Line Diagram

3. Study Assumptions

Under the direction of the CAISO, PG&E conducted the Phase 1 Study using the following assumptions:

1. The Project consists of four gas turbine units 49.4 MW each with a total rated output of 197.6 MW. With 4 MW plant auxiliary load, the maximum output to the CAISO Controlled Grid is 193.6 MW.

2. The expected Commercial Operation Date of the Project is June 1, 2012.

3. The Project has four three-phase 13.8/230 kV transformers. These transformers are each rated for 36/48/60/67.2 MVA OA/FA/FA @ 55/65 degree C temperature rise with an impedance of 8.3% at 36 MVA base.

4. PG&E will engineer, procure, construct, own, and maintain the conversion of Kelso Substation 230 kV bus into two-bay, six-breaker BAAH configuration.

5. The IC will engineer, procure, construct, own, and maintain its project facility, including a new switchyard.

6. The IC will engineer, procure, construct, own, operate, and maintain the generator tie line from the supporting structure outside of Kelso Substation to the Project facility. The generator tie line is about 0.25 miles long with 795 kcmil ACSR conductor or equivalent.

7. The Phase 1 Study for Transition Cluster Group 1 is based on twelve projects including this Project. Table 3-1 is the list of the projects in this group.

3-1: Transition Cluster Phase I Group 1 Generation Interconnection Projects in the Greater Bay Area

Queue	MW	Point of Interconnection	Online Date
171	500	Vaca-Tesla 500 kV Line	12/31/2011
222	60	Birds Landing Substation 230 kV Bus	12/31/2010
257	575	Loop Ignacio-Sobrante and Lakeville-Sobrante #2 230 kV Lines	6/1/2011
258	520	Contra Costa Substation 230 kV Bus	2/1/2012
269	371.3	Tesla Substation 230 kV Bus	4/15/2012
275	630	Loop Vaca Dixon-Peabody and Vaca-Lambie 230 kV Lines	9/1/2012
305	611	Contra Costa Power Plant 230 kV Switchyard	7/30/2012
320	476	Contra Costa Power Plant 230 kV Switchyard	4/29/2011
322	611	Pittsburg Power Plant 230 kV Switchyard	9/30/2012
334	193.6	Kelso Substation 230 kV Bus	6/1/2012
378	123	Los Esteros Substation 115 kV Bus	6/1/2011

417	36	Pittsburg-Tesla 230 kV Line	9/30/2010

4. Power Flow Study Base cases

Two power flow base cases were used to evaluate the transmission system impacts of the Group 1 projects. While it is impractical to study all combinations of system load and generation levels during all seasons and at all times of the day, these two base cases represented extreme loading and generation conditions for the study area.

The CAISO and PG&E cannot guarantee that the Group 1 projects can operate at maximum rated output 24 hours a day, year round, without adverse system impacts, nor can the CAISO and PG&E guarantee that these projects would not have adverse system impacts during the times and seasons not studied in the Phase 1 Study.

The following power flow base cases were used for the analysis in the Phase 1 Study:

- **2013 Summer Peak Full Loop Base Case:**

  Power flow analysis were performed using PG&E's 2013 summer peak full loop base case (in General Electric Power Flow format). This base case was developed from PG&E's 2008 base case series. It has a 1-in-10 year heat wave load forecast for PG&E's Greater Bay Area.

- **2013 Summer Off-Peak Full Loop Base Case:**

  Power flow analysis were performed using the 2013 summer off peak full loop base case in order to evaluate the potential congestion on transmission facilities during the lightest loading conditions during the year. The summer 2013 off peak loads are about 50% of the summer peak loads.

These base cases modeled all approved PG&E transmission projects that would be operational by 2013. The base cases also modeled all proposed generation projects that would be operational by 2013 along with their associated transmission upgrades required for their interconnection. However, some generation projects that are electrically far from the proposed project were either turned off or modeled with reduced generation to balance the loads and resources in the power flow model. The base case assumptions are provided in Appendix B.

5. Study Criteria Summary

The CAISO Controlled Grid Reliability Criteria, which incorporate the Western Electricity Coordinating Council (WECC) and the North American Electric Reliability

Council (NERC) planning criteria, were used to evaluate the impact of Group 1 on the CAISO Controlled Grid.

5.1 Steady State Study Criteria – Normal Overloads

Normal overloads are those that exceed 100 percent of normal facility ratings. The CAISO Controlled Grid Reliability Criteria requires the loading of all transmission system facilities be within their normal ratings.

5.2 Steady State Study Criteria – Emergency Overloads

Emergency overloads are those that exceed 100 percent of emergency ratings. The emergency overloads refer to overloads that occur during single element contingencies (Category "B") and multiple element contingencies (Category "C").

6. Steady State Power Flow Study and Results

6.1 Contingencies

The Category "B" and "C" contingencies used in this analysis are provided in Appendix C. The single (Category "B") and selected multiple (Category "C") contingencies are summarized in Table 6-1:

Table 6-1: Summary of Planning Standards

Contingencies	Description
CAISO Category "A"	All facilities in service – Normal Conditions
CAISO Category "B"	• B1 - All single generator outages. • B2 - All single transmission circuit outages. • B3 - All single transformer outages. • Selected overlapping single generator and transmission circuit outages for the transmission lines and generators.
CAISO Category "C"	• C1 - SLG Fault, with Normal Clearing: Bus outages (60-230 kV) • C2 - SLG Fault, with Normal Clearing: Breaker failures (excluding bus tie and sectionalizing breakers) at the same bus section above. • C3 - Combination of any two-generator/transmission line/transformer outages. • C4 - Bipolar (dc) Line • C5 - Outages of double circuit tower lines (60-230 kV) • C6 - SLG Fault, with Delayed Clearing: Generator • C7 - SLG Fault, with Delayed Clearing: Transmission Line • C8 - SLG Fault, with Delayed Clearing: Transformer • C9 - SLG Fault, with Delayed Clearing: Bus Section

Although most of the CAISO Category "C" contingencies have been

considered as part of this study, it is impractical to study all the CAISO Category "C" contingencies. For this reason, selected critical Category C contingencies (C1 – C9) were evaluated as part of this study.

6.2 Study Results

The overloads caused by the Transition Cluster Group 1 projects and the overload plots are shown in Appendix D. The worst overloads for each facility under the contingencies studied are summarized in Tables 6-2-1, 6-2-2, and 6-2-3.

6.2.1 Normal Overloads (Category "A")

- Under projected 2013 summer peak conditions, the Group 1 projects caused seventeen (17) new Category "A" normal overloads. Under projected 2013 summer off-peak conditions, the Group 1 projects caused four (4) normal overloads which are already shown in the summer peak conditions. The Category "A" normal overloads are summarized in Table 6-2-1.

Table 6-2-1: Summer Peak and Off-Peak Study Category "A" Normal Violations

Over Loaded Component	Rating (Amps)	Pre- Project Loading(Amps |%Rating)		Post- Project Loading(Amps |%Rating)		% Change from Pre-Project Loading	Mitigation
Category A Normal Overloads – 2013 Summer Peak Greater Bay Area Transition Cluster							
Castro Valley - Newark 230 kV Line	743	503	67%	781	105%	38%	Reconductor with 795 ACSS or equivalent (23 miles)
Cayetano - North Dublin 230 kV Line	1004	707	70%	1023	102%	32%	Install 230 kV Switching Station. Loop Lonetree-Cayetano, Contra Costa-Las Positas, and North Dublin Vineyard 230 kV Lines. No reconductor.
Contra Costa - Brentwood 230 kV Line	826	718	87%	1108	134%	47%	Reconductor with 954 ACSS or equivalent (10 miles)
Contra Costa - Delta Pumps 230 kV Line (Contra Costa - Windmaster)	826	637	77%	1287	156%	79%	Reconductor with 1113 ACSS or equivalent (17 miles)
Contra Costa - Delta Pumps 230 kV Line (Windmaster - Delta Pumps)	826	634	77%	1285	156%	79%	Reconductor with 1113 ACSS or equivalent (1.4 miles)
Delta Pumps - Tesla 230 kV Line (Altamont - Delta Pumps)	996	631	63%	1282	129%	66%	Reconductor with 1113 ACSS or equivalent (4.7 miles)
Delta Pumps - Tesla 230 kV Line (Altamont - Tesla)	996	631	63%	1281	129%	66%	Reconductor with 1113 ACSS or equivalent (3 miles)

Kelso - Tesla 230 kV Line (Kelso - USWP RLF)	997	399	40%	1261	127%	87%	Reconductor with 1113 ACSS or equivalent (3.3 miles)
Kelso - Tesla 230 kV Line (USWP RLF - Tesla)	997	412	41%	1277	128%	87%	Reconductor with 1113 ACSS or equivalent (4.7 miles)
Las Positas - Newark 230 kV Line	743	743	83%	999	134%	51%	Reconductor with 954 ACSS or equivalent (21 miles)
Lonetree - Cayetano 230 kV Line (Lonetree - USWP JRW)	886	767	87%	1083	122%	35%	Install 230 kV Switching Station. Loop Lonetree-Cayetano, Contra Costa-Las Positas, and North Dublin Vineyard 230 kV Lines. Reconductor with 954 ACSS (12 miles)
Lonetree - Cayetano 230 kV Line (USWP JRW - Cayetano)	886	764	86%	1081	122%	36%	Install 230 kV Switching Station. Loop Lonetree-Cayetano, Contra Costa-Las Positas, and North Dublin Vineyard 230 kV Lines. Reconductor with 954 ACSS (3 miles)
Moraga - Castro Valley 230 kV Line	911	688	76%	965	106%	30%	Reconductor with 795 ACSS or equivalent (15 miles)
North Dublin - Vineyard 230 kV Line	886	654	74%	969	109%	35%	Install 230 kV Switching Station. Loop Lonetree-Cayetano, Contra Costa-Las Positas, and North Dublin Vineyard 230 kV Lines. Reconductor with 954 ACSS (10 miles)
T171 - Tesla 500 kV Line	2430	1821	75%	2636	108%	33%	Congestion Management
Trimble - San Jose B 115 kV Line	703	427	61%	728	104%	43%	Reconductor with 477 ACSS or equivalent (1.1 miles)
Vineyard - Newark 230 kV Line	743	440	59%	749	101%	42%	Install 230 kV Switching Station. Loop North Dublin-Vineyard, Cayetano, Las Positas-Newark, and Vineyard-Newark 230 kV Lines. Reconductor with 954 ACSS (14 miles)
Category A Normal Overloads – 2013 Summer Off Peak Greater Bay Area Transition Cluster							
Contra Costa - Delta Pumps 230 kV Line (Contra Costa - Windmaster)	826	86	10%	1187	144%	134%	Reconductor with 1113 ACSS or equivalent (17 miles)
Contra Costa - Delta Pumps 230 kV Line (Windmaster - Delta Pumps	826	169	21%	1279	155%	134%	Reconductor with 1113 ACSS or equivalent (1.4 miles)

Kelso - Tesla 230 kV Line (Kelso - USWP RLF)	997	81	8%	1178	118%	110%	Reconductor with 1113 ACSS or equivalent (3.3 miles)
Kelso - Tesla 230 kV Line (USWP RLF - Tesla)	997	74	7%	1200	120%	113%	Reconductor with 1113 ACSS or equivalent (4.7 miles)

6.2.2 Emergency Overloads (Category "B")

Under projected 2013 summer peak conditions, the Group 1 projects caused thirty five (35) new Category "B" emergency overloads. Under projected 2013 summer off-peak conditions, the Group 1 projects caused nine (9) new Category "B" emergency overloads which also showed up in the summer peak conditions. The Category "B" emergency overloads are summarized in Table 6-2-2.

Table 6-2-2: Summer Peak and Off Peak Study, Category "B" Emergency Overloads

Over Loaded Component	Contingency	Rating (Amps)	Pre- Project Loading (Amps)	%Rating)	Post-Project Loading (Amps)	%Rating)	% Change from Pre-Project Loading	Mitigations
Worst Category B Emergency Overloads - 2013 Summer Peak Greater Bay Area Transition Cluster								
Birds Landing-Contra Costa 230 kV Line	Contra Costa - Contra Costa Sub 230 kV Line and Gateway PP	1893	1713	90%	2597	137%	47%	Loop Contra Costa-Moraga No. 1 230 kV Line into Contra Costa Sub.
Brentwood - Kelso 230 kV Line	Contra Costa - Delta Pumps 230 kV Line	1129	584	52%	1136	101%	49%	Congestion Management
Castro Valley - Newark 230 kV Line	T171 - Tesla 500 kV Line	851	636	75%	1022	120%	45%	Reconductor with 795 ACSS or equivalent (23 miles)
Castro Valley - Newark 230 kV Line	Contra Costa - Las Positas 230 kV Line and RCEC STG1	851	652	77%	977	115%	38%	Reconductor with 795 ACSS or equivalent (23 miles)
Cayetano - North Dublin 230 kV Line	Contra Costa - Las Positas 230 kV Line and RCEC STG1	1004	875	87%	1249	124%	37%	Install 230 kV Switching Station. Loop Lonetree-Cayetano, Contra Costa-Las Positas, and North Dublin Vineyard 230 kV Lines. No reconductor.
Contra Costa - Brentwood 230 kV Line	Delta Pumps - Tesla 230 kV Line	1130	876	78%	1434	127%	49%	Reconductor with 954 ACSS or equivalent (10 miles)
Contra Costa - Contra Costa Sub 230 kV Line	Birds Landing - Contra Costa 230 kV Line and Gateway PP	1893	1599	84%	2786	147%	63%	Loop Contra Costa-Moraga No. 1 230 kV Line into Contra Costa Sub.
Contra Costa - Delta Pumps 230 kV Line (Contra Costa - Windmaster)	Kelso - Tesla 230 kV Line	1130	754	67%	1667	148%	81%	Reconductor with 1113 ACSS or equivalent (17 miles)
Contra Costa - Delta Pumps 230 kV Line (Windmaster - Delta Pumps)	Kelso - Tesla 230 kV Line	1130	752	67%	1665	147%	80%	Reconductor with 1113 ACSS or equivalent (1.4 miles)

Over Loaded Component	Contingency	Rating (Amps)	Pre- Project Loading (Amps)	%Rating)	Post-Project Loading (Amps)	%Rating)	% Change from Pre-Project Loading	Mitigations
Contra Costa - Las Positas 230 kV Line	Contra Costa - Lonetree 230 kV Line and DEC	1714	1186	69%	1650	96%	27%	None (Corrected rating)
Cooley Landing-Stanford 60 kV Line (Cooley Landing-SRI)	Cardinal Units #1 and #2	600	553	92%	622	104%	12%	PG&E project will replace limiting 600A switches to utilize conductor emergency rating of 703A.
Delta Pumps - Tesla 230 kV Line (Altamont - Tesla)	Kelso - Tesla 230 kV Line	1130	748	66%	1662	147%	81%	Reconductor with 1113 ACSS or equivalent (3 miles)
Delta Pumps - Tesla 230 kV Line (Delta Pumps - Altamont)	Kelso - Tesla 230 kV Line	1130	748	66%	1663	147%	81%	Reconductor with 1113 ACSS or equivalent (4.7 miles)
Kelso- Tesla 230 kV Line (Kelso - USWP RLF)	Contra Costa - Delta Pumps 230 kV Line	1129	557	49%	1599	140%	91%	Reconductor with 1113 ACSS or equivalent (3.3 miles)
Kelso - Tesla 230 kV Line (USWP RLF - Tesla)	Contra Costa - Delta Pumps 230 kV Line	1129	571	51%	1599	140%	89%	Reconductor with 1113 ACSS or equivalent (4.7 miles)
Las Positas - Newark 230 kV Line	Contra Costa - Lonetree 230 kV Line	851	788	93%	1228	144%	51%	Reconductor with 954 ACSS or equivalent (21 miles)
Lonetree - Cayetano 230 kV Line (Lonetree - USWP JRW)	Contra Costa - Las Positas 230 kV Line and RCEC STG1	1005	934	93%	1310	130%	37%	Install 230 kV Switching Station. Loop Lonetree-Cayetano, Contra Costa-Las Positas, and North Dublin Vineyard 230 kV Lines. Reconductor with 954 ACSS (12 miles)
Lonetree - Cayetano 230 kV Line (USWP JRW - Cayetano)	Contra Costa - Las Positas 230 kV Line and RCEC STG1	1005	932	93%	1307	130%	37%	Install 230 kV Switching Station. Loop Lonetree-Cayetano, Contra Costa-Las Positas, and North Dublin Vineyard 230 kV Lines. Reconductor with 954 ACSS (3 miles)
Moraga - Castro Valley 230 kV Line	T171 - Tesla 500 kV Line	1021	823	81%	1210	119%	38%	Reconductor with 795 ACSS or equivalent (15 miles)
Moraga - Castro Valley 230 kV Line	Contra Costa - Las Positas 230 kV Line and RCEC STG1	1021	837	82%	1163	114%	32%	Reconductor with 795 ACSS or equivalent (15 miles)
Newark 230/115 kV Bank 11	Newark 230/115 kV Bank 7	462 MVA	443 MVA	96%	502 MVA	109%	13%	Congestion Management

Over Loaded Component	Contingency	Rating (Amps)	Pre-Project Loading (Amps)	Pre-Project Loading (%Rating)	Post-Project Loading (Amps)	Post-Project Loading (%Rating)	% Change from Pre-Project Loading	Mitigations
North Dublin - Vineyard 230 kV Line	Contra Costa - Las Positas 230 kV Line and RCEC STG1	1005	822	82%	1196	119%	37%	Install 230 kV Switching Station. Loop Lonetree-Cayetano, Contra Costa-Las Positas, and North Dublin Vineyard 230 kV Lines. Reconductor with 954 ACSS (10 miles)
Oakland C - Oakland L 115 kV Line	Moraga - San Ramon 230 kV Line and DEC	790	772	98%	828	105%	7%	Congestion Management
Pittsburg 230/181 kV TBC Bank	Pittsburg - San Mateo 230 kV Line and DEC	450 MVA	427 MVA	95%	462 MVA	103%	8%	Congestion Management
Potrero 115/181 kV TBC Bank	Moraga - San Ramon 230 kV Line	450 MVA	408 MVA	94%	456 MVA	101%	7%	Congestion Management
Sobrante - El Cerrito #1 115 kV Line	Sobrante - El Cerrito #2 115 kV Line	600	570	95%	619	103%	8%	Replace 600A disconnect switches to use full line capability of 802A emergency rating.
Sobrante - El Cerrito #2 115 kV Line	Sobrante - El Cerrito #1 115 kV Line	600	571	95%	620	103%	8%	Replace 600A disconnect switches to use full line capability of 802A emergency rating.
Table Mountain - Tesla 500 kV Line	T171- Tesla 500 kV Line	2964	2501	84%	3071	104%	20%	Congestion Management
Tesla - T171 500 kV Line	Olinda - Tracy 500 kV Line	2816	2663	95%	3559	126%	31%	Congestion Management
Trimble - San Jose B 115 kV Line	Tesla - Metcalf 500 kV Line	924	614	67%	1071	116%	49%	Reconductor with 477 ACSS or equivalent (1.1 miles) Rerate underground section to match rating of overhead conductors.
Vaca-Dixon - T171 500 kV Line	Olinda - Tracy 500 kV Line	2816	2663	95%	3007	107%	12%	Congestion Management
Vaca-Dixon - T275 #1 230 kV Line	Vaca-Dixon - T275 #2 230 kV Line	1893	657	35%	2269	120%	85%	Reconductor with 2-795 ACSS (5 Miles)
Vaca-Dixon - T275 #2 230 kV Line	Vaca-Dixon - T275 #1 230 kV Line	1893	349	19%	2269	120%	101%	Reconductor with 2-795 ACSS (5 Miles)
Vineyard - Newark 230 kV Line	Contra Costa - Las Positas 230 kV Line and RCEC STG1	851	607	71%	975	115%	44%	Install 230 kV Switching Station. Loop North Dublin-Vineyard, Cayetano, Las Positas-Newark, and Vineyard-Newark 230 kV Lines. Reconductor with 954 ACSS (14 miles)
Category B Emergency Overloads - 2013 Summer Off Peak Greater Bay Area Transition Cluster								
Contra Costa - Delta Pumps 230 kV Line (Contra Costa - Windmaster)	Kelso - Tesla 230 kV Line	1130	81	7%	1542	136%	129%	Reconductor with 1113 ACSS or equivalent (17 miles)

Over Loaded Component	Contingency	Rating (Amps)	Pre- Project Loading (Amps)	%Rating	Post-Project Loading (Amps)	%Rating	% Change from Pre-Project Loading	Mitigations
Contra Costa - Delta Pumps 230 kV Line (Windmaster - Delta Pumps)	Kelso - Tesla 230 kV Line	1130	155	14%	1633	145%	131%	Reconductor with 1113 ACSS or equivalent (1.4 miles)
Contra Costa Sub - Contra Costa 230 kV Line	Birds Landing - Contra Costa 230 kV Line	1893	1360	72%	2025	107%	35%	Loop Contra Costa-Moraga No. 1 230 kV Line into Contra Costa Sub.
Delta Pumps - Tesla 230 kV Line (Altamont - Tesla)	Kelso - Tesla 230 kV Line	1130	261	23%	1266	112%	89%	Reconductor with 1113 ACSS or equivalent (3 miles)
Delta Pumps - Tesla 230 kV Line (Delta Pumps - Altamont)	Kelso - Tesla 230 kV Line	1130	260	23%	1267	112%	89%	Reconductor with 1113 ACSS or equivalent (4.7 miles)
Kelso - Tesla 230 kV Line (Kelso - USWP RLF)	Contra Costa - Delta Pumps 230 kV Line	1129	74	7%	1480	131%	124%	Reconductor with 1113 ACSS or equivalent (3.3 miles)
Kelso - Tesla 230 kV Line (USWP RLF - Tesla)	Contra Costa - Delta Pumps 230 kV Line	1129	73	7%	1503	133%	126%	Reconductor with 1113 ACSS or equivalent (4.7 miles)
Vaca-Dixon - T275 #1 230 kV Line	Vaca-Dixon - T275 #2 230 kV Line	1893	484	26%	2747	145%	119%	Reconductor with 2-795 ACSS (5 Miles)
Vaca-Dixon - T275 #2 230 kV Line	Vaca-Dixon - T275 #1 230 kV Line	1893	338	18%	2747	145%	127%	Reconductor with 2-795 ACSS (5 Miles)

6.2.3 Emergency Overloads (Category "C")

Under projected 2013 summer peak conditions, the Group 1 projects caused thirty nine (39) new Category "C" emergency overloads. Under projected 2013 summer off peak conditions, the Group 1 projects caused fourteen (14) Category "C" emergency overloads which also showed up in the summer peak conditions. The Category "C" emergency overloads are summarized in Table 6-2-3. .

Table 6-2-3: Summer Peak and Off-Peak Study, Category "C" Overloads

Over Loaded Component	Contingency	Rating (Amps)	Pre- Project Loading (Amps)	%Rating	Post-Project Loading (Amps)	%Rating	% Change from Pre-Project Loading	Mitigations
Worst Category C Emergency Overloads - 2013 Summer Peak Greater Bay Area Transition Cluster								
Birds Landing - Contra Costa 230 KV Line	Contra Costa Sub 230 kV Bus Section 2	1893	1465	77%	2370	125%	48%	Install SPS to drop generation.
Birds Landing - Contra Costa Sub 230 kV Line	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1893	1340	71%	1992	105%	34%	Install SPS to drop generation.
Brentwood - Kelso 230 kV Line	Contra Costa 230 kV Bus Section 2F	1129	515	46%	1289	114%	68%	Congestion Management
Castro Valley - Newark 230 kV Line	Contra Costa - Las Positas and Contra Costa - Lonetree 230 kV Lines	851	812	95%	1198	141%	46%	Reconductor with 795 ACSS or equivalent (23 miles)

Over Loaded Component	Contingency	Rating (Amps)	Pre- Project Loading (Amps)	%Rating	Post-Project Loading (Amps)	%Rating	% Change from Pre-Project Loading	Mitigations
Cayetano - North Dublin 230 kV Line	Contra Costa - Brentwood and Contra Costa - Delta Pumps 230 kV Lines	1004	873	87%	1323	132%	45%	Install 230 kV Switching Station. Loop Lonetree-Cayetano, Contra Costa-Las Positas, and North Dublin Vineyard 230 kV Lines. No reconductor.
Contra Costa - Brentwood 230 kV Line	Contra Costa 230 kV Bus Section 2F	1130	803	71%	1590	141%	70%	Reconductor with 954 ACSS or equivalent (10 miles)
Contra Costa - Contra Costa Sub 230 kV Line	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1893	1265	67%	2973	157%	90%	Loop Contra Costa-Moraga No. 1 230 kV Line into Contra Costa Sub.
Contra Costa - Delta Pumps 230 kV Line (Contra Costa - Windmaster)	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1130	802	71%	1858	164%	93%	Reconductor with 1113 ACSS or equivalent (17 miles)
Contra Costa - Delta Pumps 230 kV Line (Windmaster - Delta Pumps)	Table Mountain-Tesla & T171-Tesla 500 kV DLO	1130	987	87%	1870	166%	79%	Reconductor with 1113 ACSS or equivalent (1.4 miles)
Contra Costa - Delta Pumps 230 kV Line (Windmaster - Delta Pumps)	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1130	799	71%	1856	164%	93%	Reconductor with 1113 ACSS or equivalent (1.4 miles)
Contra Costa - Las Positas 230 kV Line	Contra Costa - Brentwood and Contra Costa - Delta Pumps 230 kV Lines	1714	1207	70%	1786	104%	34%	Install SPS to drop generation.
Contra Costa - Lonetree 230 kV Line	Contra Costa - Brentwood and Contra Costa - Delta Pumps 230 kV Lines	1714	1106	65%	1563	91%	26%	None. Corrected rating.
Delta Pumps - Tesla 230 kV Line (Altamont - Tesla)	Table Mountain-Tesla & T171-Tesla 500 kV DLO	1130	986	87%	1869	165%	78%	Reconductor with 1113 ACSS or equivalent (3 miles)
Delta Pumps - Tesla 230 kV Line (Altamont - Tesla)	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1130	795	70%	1852	164%	94%	Reconductor with 1113 ACSS or equivalent (3 miles)
Delta Pumps - Tesla 230 kV Line (Delta Pumps - Altamont)	Table Mountain-Tesla & T171-Tesla 500 kV DLO	1130	986	87%	1869	166%	79%	Reconductor with 1113 ACSS or equivalent (4.7 miles)
Delta Pumps - Tesla 230 kV Line (Delta Pumps - Altamont)	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1130	796	70%	1853	164%	94%	Reconductor with 1113 ACSS or equivalent (4.7 miles)
East Shore - San Mateo 230 kV Line	Newark - Ravenswood and Tesla - Ravenswood 230 kV Lines	1742	1715	98%	1776	102%	4%	Install SPS to drop generation.
Kelso - Tesla 230 kV Line (Kelso - USWP RLF)	Contra Costa 230 kV Bus Section 2F	1129	489	43%	1735	154%	111%	Reconductor with 1113 ACSS or equivalent (3.3 miles)
Kelso - Tesla 230 kV Line (USWP RLF - Tesla)	Contra Costa 230 kV Bus Section 2F	1129	501	44%	1751	155%	111%	Reconductor with 1113 ACSS or equivalent (4.7 miles)

Over Loaded Component	Contingency	Rating (Amps)	Pre- Project Loading (Amps)	(%Rating)	Post-Project Loading (Amps)	(%Rating)	% Change from Pre-Project Loading	Mitigations
Lambie - Birds Landing 230 kV Line	Contra Costa Sub - Contra Costa and Birds Landing - Contra Costa 230 kV Lines	1893	1182	63%	2077	110%	47%	Install SPS to drop generation.
Las Positas - Newark 230 kV Line	Contra Costa - Brentwood and Contra Costa - Delta Pumps 230 kV Lines	851	818	96%	1359	160%	64%	Reconductor with 954 ACSS or equivalent (21 miles)
Lonetree - Cayetano 230 kV Line (Lonetree - USWP JRW)	Contra Costa - Brentwood and Contra Costa - Delta Pumps 230 kV Lines	1005	933	93%	1382	137%	44%	Install 230 kV Switching Station. Loop Lonetree-Cayetano, Contra Costa-Las Positas, and North Dublin Vineyard 230 kV Lines. Reconductor with 954 ACSS (12 miles)
Lonetree - Cayetano 230 kV Line (USWP JRW - Cayetano)	Contra Costa - Brentwood and Contra Costa - Delta Pumps 230 kV Lines	1005	930	93%	1380	137%	44%	Install 230 kV Switching Station. Loop Lonetree-Cayetano, Contra Costa-Las Positas, and North Dublin Vineyard 230 kV Lines. Reconductor with 954 ACSS (3 miles)
Moraga - Castro Valley 230 kV Line	Contra Costa - Las Positas and Contra Costa - Lonetree 230 kV Lines	1021	997	98%	1383	135%	37%	Reconductor with 795 ACSS or equivalent (15 miles)
Moraga - Claremont #1 115 kV Line	Oakland C 115 kV Bus Section E	472	456	97%	490	104%	7%	Rerate with 4 fps wind speed.
Moraga - Claremont #2 115 kV Line	Oakland C 115 kV Bus Section E	472	456	97%	490	104%	7%	Rerate with 4 fps wind speed.
Newark 230/115 kV Bank 11	Newark 230 kV Bus Section 1D	462 MVA	450 MVA	97%	507 MVA	110%	13%	Congestion Management.
North Dublin - Vineyard 230 kV Line	Contra Costa - Brentwood and Contra Costa - Delta Pumps 230 kV Lines	1005	820	82%	1268	126%	44%	Install 230 kV Switching Station. Loop Lonetree-Cayetano, Contra Costa-Las Positas, and North Dublin Vineyard 230 kV Lines. Reconductor with 954 ACSS (10 miles)
Oakland C-Oakland L 115 kV Line	Sobrante 115 kV Bus Section 2	790	847	107%	883	112%	5%	Congestion Management
Oleum - North Tower - Christie 115 kV Line (Christie - Martinez Jct)	Sobrante - El Cerrito #1 and #2 115 kV Lines	522	460	88%	536	103%	15%	Rerate with 4 fps wind speed.
Sobrante - Christie 115 kV Line	Sobrante - El Cerrito #1 and #2 115 kV Lines	523	532	102%	596	114%	12%	Rerate with 4 fps wind speed.
Sobrante - El Cerrito #1 115 kV Line (El Cerrito Jct - Sobrante)	El Cerrito 115 kV Bus Section E	600	581	97%	619	103%	6%	Replace 600A disconnect switches to use full line capability of 802A emergency rating.

Over Loaded Component	Contingency	Rating (Amps)	Pre- Project Loading (Amps)	%Rating	Post-Project Loading (Amps)	%Rating	% Change from Pre-Project Loading	Mitigations
Sobrante - El Cerrito #2 115 kV Line	Sobrante 115 kV Bus Section 1	600	694	116%	794	132%	16%	Replace 600A disconnect switches to use full line capability of 802A emergency rating.
T171 - Tesla 500 kV Line	Contra Costa Sub - Contra Costa and Birds Landing - Contra Costa 230 kV Lines	2816	2151	76%	3205	114%	38%	Congestion Management
Table Mountain - Tesla 500 kV Line	T171 - Tesla 500 kV and Peabody - Birds Landing 230 kV Lines	2763	2411	81%	3041	103%	22%	Congestion Management
Trimble - San Jose B 115 kV Line	Metcalf - El Patio #1 and #2 115 kV Lines	924	957	104%	1160	126%	22%	Rerate new 477 ACSS with 4 fps wind speed. Rerate underground section to match rating of the overhead conductors.
Vaca-Dixon - T275 #1 230 kV Line	Contra Costa Sub - Contra Costa and Birds Landing - Contra Costa 230 kV Lines	1893	1529	81%	2616	138%	57%	Reconductor with 2-795 ACSS (5 Miles)
Vaca-Dixon - T275 #2 230 kV Line	Contra Costa Sub - Contra Costa and Birds Landing - Contra Costa 230 kV Lines	1893	778	41%	2616	138%	97%	Reconductor with 2-795 ACSS (5 Miles)
Vineyard - Newark 230 kV Line	Contra Costa - Brentwood and Contra Costa - Delta Pumps 230 kV Lines	851	604	71%	1047	123%	52%	Install 230 kV Switching Station. Loop North Dublin-Vineyard, Cayetano, Las Positas-Newark, and Vineyard-Newark 230 kV Lines. Reconductor with 954 ACSS (14 miles)
Westley - Los Banos 230 kV Line	Tesla-Los Banos & Tracy-Los Banos 500 kV DLO	1700	888	52%	2220	131%	79%	Install SPS to drop generation.
Category C Emergency Overloads - 2013 Summer Off Peak Greater Bay Area Transition Cluster								
Birds Landing - Contra Costa 230 KV Line	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1893	1214	64%	2218	117%	53%	Install SPS to drop generation.
Brentwood - Kelso 230 kV Line	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1129	94	8%	1252	111%	103%	Congestion Management
Contra Costa - Brentwood 230 kV Line	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1130	172	15%	1349	119%	104%	Reconductor with 954 ACSS or equivalent (10 miles)
Contra Costa - Delta Pumps 230 kV Line (Contra Costa - Windmaster)	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1130	217	19%	1870	166%	147%	Reconductor with 1113 ACSS or equivalent (17 miles)
Contra Costa - Delta Pumps 230 kV Line (Windmaster - Delta Pumps)	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1130	305	27%	1963	174%	147%	Reconductor with 1113 ACSS or equivalent (1.4 miles)
Contra Costa Sub - Contra Costa 230 kV Line	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1893	1040	55%	3037	160%	105%	Loop Contra Costa-Moraga No. 1 230 kV Line into Contra Costa Sub.

Over Loaded Component	Contingency	Rating (Amps)	Pre- Project Loading (Amps)	%Rating	Post-Project Loading (Amps)	%Rating	% Change from Pre-Project Loading	Mitigations
Delta Pumps - Tesla 230 kV Line (Altamont - Tesla)	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1130	144	13%	1591	141%	128%	Reconductor with 1113 ACSS or equivalent (3 miles)
Delta Pumps - Tesla 230 kV Line (Delta Pumps - Altamont)	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1130	142	13%	1592	141%	128%	Reconductor with 1113 ACSS or equivalent (4.7 miles)
Kelso - Tesla 230 kV Line (Kelso - USWP RLF)	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1129	82	7%	1705	151%	144%	Reconductor with 1113 ACSS or equivalent (3.3 miles)
Kelso - Tesla 230 kV Line (USWP RLF - Tesla)	Vaca-Dixon - T275 #1 and #2 230 kV Lines	1129	100	9%	1726	153%	144%	Reconductor with 1113 ACSS or equivalent (4.7 miles)
Lambie - Birds Landing 230 kV Line	Contra Costa Sub - Contra Costa and Birds Landing - Contra Costa 230 kV Lines	1893	1368	72%	2244	119%	47%	Install SPS to drop generation.
Las Positas - Newark 230 kV Line	Vaca-Dixon - T275 #1 and #2 230 kV Lines	851	277	33%	1026	121%	88%	Reconductor with 954 ACSS or equivalent (21 miles)
Vaca-Dixon - T275 #1 230 kV Line	Contra Costa Sub - Contra Costa and Birds Landing - Contra Costa 230 kV Lines	1893	1367	72%	2588	137%	65%	Reconductor with 2-795 ACSS (5 Miles)
Vaca-Dixon - T275 #2 230 kV Line	Contra Costa Sub - Contra Costa and Birds Landing - Contra Costa 230 kV Lines	1893	882	47%	2588	137%	90%	Reconductor with 2-795 ACSS (5 Miles)

7. Short Circuit Current Calculation

Short circuit studies were performed to determine the impact of adding the Group 1 projects to the transmission system and to ensure system coordination. The fault duties were calculated before and after the projects to identify for any equipment overstress conditions.

7.1 System Protection Study Input Data

The following input data provided by the Applicant of this Project was used in this study:

Short Circuit Data @ 71.176 MVA Base:

- Positive Sequence subtransient reactance (X"1) = 0.144p.u.
- Negative Sequence subtransient reactance (X"2) = 0.176p.u.
- Zero Sequence subtransient reactance (X"0) = 0.095p.u.

Station Step-up Transformers (total of four):

- Each is three-phase 13.8/230 kV transformer rated for 36/48/60/67.2 MVA OA/FA/FA @ 55/65 degree C temperature with an impedance of 8.3% at 36 MVA base

7.2 Results

The available short circuit duty at the buses electrically adjacent to the Group 1 projects is listed in Appendix H. This data was used to determine if any equipment is projected to be overstressed by the interconnection of the Group 1 projects.

8. Reactive Power Deficiency Analysis

The power flow studies of Category "B" and "C" contingencies indicate that the Group 1 projects did not cause voltage drops of 5% or more from the pre-project levels, or cause the PG&E system to fail to meet applicable voltage criteria

9. Dynamic Stability Evaluation

Dynamic stability studies were conducted using the 2013 summer peak full loop base cases to ensure that the transmission system remains in operating equilibrium, as well as operating in a coordinated fashion through abnormal operating conditions after the Group 1 projects begin operation. The generator dynamic data used for the study is shown in Appendix E.

9.1 Dynamic Stability Study Scenarios

Disturbance simulations were performed for a study period of up to 20 seconds to determine whether the Group 1 projects will create any system instability during a variety of line and generator outages. For this Project, the following line and generator outages were evaluated:

Category "B" Contingencies:

- Full load rejection of the 197.6 MW Project.
- A three-phase close-in fault on the Brentwood – Kelso 230 kV Line at Kelso Substation 230 kV bus with normal clearing time followed by loss of the Brentwood – Kelso 230 kV Line.
- A three-phase close-in fault on the Brentwood – Kelso 230 kV Line at Brentwood Sub 230 kV bus with normal clearing time followed by loss of the Brentwood – Kelso 230 kV Line..
- A three-phase close-in fault on the Kelso – Tesla 230 kV Line at Kelso Substation 230 kV bus with normal clearing time followed by the loss of the Kelso – Tesla 230 kV Line.

- A three-phase close-in fault on the Kelso – Tesla 230 kV Line at Tesla Sub 230 kV bus with normal clearing time followed by loss of Kelso – Tesla 230 kV Line.

Category "C" Contingencies:

- A three-phase fault on the Kelso 230 kV bus with normal clearing time.
- A three-phase fault on Brentwood 230 kV bus with normal clearing time.
- A three-phase fault on Tesla 230 kV bus with normal clearing time.

9.2 Parameters Monitored to Evaluate System Stability Performance

9.2.1 Rotor Angle

The rotor angle plots shown in Appendix F provide a measure for determining how the proposed generation units would swing with respect to one another. The plots also provide a measure of how the units would swing with respect to other generation units in the area.

9.2.2 Bus Voltage

The bus voltage plots, in conjunction with the relative rotor angle plots, also shown in Appendix F, provide a means of detecting out-of-step conditions. The bus voltage plots are useful in assessing the magnitude and the duration of post disturbance voltage dips and peak-to-peak voltage oscillations. The bus voltage plots also give an indication of system damping and the level to which voltages are expected to recover in steady state conditions.

9.2.3 Bus Frequency

The bus frequency plots, also shown in Appendix F, provide information on the magnitude and the duration of post fault frequency swings with the Project in service. These plots indicate the extent of possible over-frequency or under-frequency, which can occur because of the imbalance between the generation and load within an area.

9.2.4 Other Parameters

- Generator Terminal Power
- Generator Terminal Voltage
- Generator Rotor Speed

- Generator Field Voltage
- Bus Angle
- Line Flow
- Voltage Spread
- Frequency Spread

9.3 Results

Dynamic stability studies were conducted using the 2013 summer peak base cases described in Section 4 and the generator models shown in Appendix E to determine whether the transmission system would maintain operating equilibrium following selected outages.

The study concluded that the Project would not cause the transmission system to go unstable under Category "B" and Category "C" outages.

- The results of the study are provided in the form of plots in Appendix F.

10. Deliverability Evaluations

10.1 On Peak Deliverability Assessment

CAISO performed an On-Peak Deliverability Assessment. The power flow study results for Category "A", "B", and "C" are detailed in Appendix I.

A modified version of the power flow 2013 Summer Peak base case prepared by PG&E for the reliability analysis was used to evaluate the deliverability of the proposed interconnection and the transmission system impacts of the Project. A description of the modifications follows.

- **Load Modeling**: For the On-Peak Deliverability Study, a coincident 1-in-5-year heat wave was modeled in the base case.
- **Generation Capacity (Pmax)**: The Net Qualified Capacity (NQC) was used for generation capacity values. Capacity values for intermittent generation were modeled as described in the On-Peak Deliverability Assessment Methodology: http://www.caiso.com/1c44/1c44b5c31cce0.html
- **Generation Dispatch in the base cases**: Please refer to the On-Peak Deliverability Assessment methodology document on the CAISO web-site: http://www.caiso.com/1c44/1c44b5c31cce0.html
- **Import Levels**: The On-Peak Deliverability Study base case modeled the 2009 Maximum Import Capability for each branch group based on the methodology for Import Capability Assignment Process for resource

adequacy (CAISO Tariff Section 40.4.6.2.1). These import capabilities were modeled as fully utilized in the base case and are listed in Table 10-1.

10-1: On-Peak Deliverability Assessment Import Target

BG Name	BG Import Dir	Net Import MW	Import Unused ETC MW
Lugo_victrville_BG	N-S	1047	523
COI_BG	N-S	3770	548
BLYTHE_BG	E-W	106	0
CASCADE_BG	N-S	23	0
CFE_BG	S-N	-154	0
ELDORADO_BG	E-W	935	0
IID-SCE_BG	E-W	268	0
IID-SDGE_BG	E-W	-174	163
INYO_BG	E-W	0	0
LAUGHLIN_BG	E-W	0	0
MCCULLGH_BG	E-W	-15	316
MEAD_BG	E-W	539	516
MERCHANT_BG	E-W	425	0
N.GILABK4_BG	E-W	-170	168
NOB_BG	N-S	1449	0
PALOVRDE_BG	E-W	2984	233
PARKER_BG	E-W	66	52
SILVERPK_BG	E-W	9	0
SUMMIT_BG	E-W	-32	15
SYLMAR-AC_BG	E-W	-351	471
Total		10726	3005

11. Transition Cluster Group 1 Overload Mitigations

The preferred method to mitigate these normal as well as Category "B" emergency overloads is to re-conductor these overloaded lines with higher capacity conductors.

For CAISO Category "C" contingencies (according to WECC reliability criteria), the overloads may be mitigated by load shedding or generation dropping. PG&E or CAISO or both may require new generators to take part in and be responsible for the costs of operating procedures and/or Special Protection Systems (SPS)

for the Category "C" emergency overloads caused by this Project. Only new Category "C" overload mitigation will be provided in the Phase 1 Study.

11.1 Mitigation for Category Normal Overloads Category "A"

11.1.1 Castro Valley - Newark 230 kV Line

Limiting Factor		795 ACSR at 2 fps wind speed summer interior rating 743/851 Amps Normal/Emergency. (0.34 miles)	
Pre-project Normal Loading	503 Amps (67%)	Post-project Normal Loading	781 Amps (105%)
Pre-project Emergency Loading	631 Amps (75%)	Post-project Emergency Loading	1022 Amps (120%)
Worst Contingency		T171-Tesla 500 kV Line	
Worst Overload Condition		2013 Summer Peak	

Solution: Re-conductor a total of 22.8 miles of the Castro Valley – Newark 230 kV Line with 795 ACSS or equivalent conductors. The 795 ACSS conductors are rated for 1517 Amps normal/emergency at 2 fps wind speed summer interior. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.1.2 Cayetano – North Dublin 230 kV Line

Limiting Factor		1004 Amps Underground at 2 fps wind speed summer interior rating Normal/Emergency (2.8 miles)	
Pre-project Normal Loading	707 Amps (67%)	Post-project Normal Loading	1023 Amps (102%)
Pre-project Emergency Loading	875 Amps (87%)	Post-project Emergency Loading	1249 Amps (124%)
Worst Contingency		Contra Costa-Las Positas 230 kV Line and RCEC STG1	
Worst Overload Condition		2013 Summer Peak	

Solution: Install a 230 kV switching station with a 3-bay BAAH configuration and loop the Lonetree-Cayetano, Contra Costa-Las Positas, and North Dublin-Vineyard 230 kV Lines.

11.1.3 Contra Costa – Brentwood 230 kV Line

Limiting Factor		1113 Al at 2 fps wind speed summer interior rating 825 Normal (3.2 miles). 954 ACSR at 4 fps wind speed summer interior rating 1130 Amps Emergency (6.8 miles).	
Pre-project Normal Loading	718 Amps (87%)	Post-project Normal Loading	1108 Amps (134%)
Pre-project Emergency Loading	876 Amps (78%)	Post-project Emergency Loading	1434 Amps (127%)
Worst Contingency		Delta Pumps-Tesla 230 kV Line	
Worst Overload Condition		2013 Summer Peak	

Solution: Re-conductor a total of 10 miles of the Contra Costa - Brentwood 230 kV Line with 954 ACSS or equivalent conductors. The 954 ACSS conductors are rated for 1714 Amps normal/emergency at 2 fps wind speed summer interior. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.1.4 Contra Costa – Delta Pumps 230 kV Line (Contra Costa – Windmaster)

Limiting Factor		1113 Al at 2 fps wind speed summer interior rating 825 Amps Normal(0.3 miles) 954 ACSR at 4 fps wind speed summer interior rating 1130 Amps Emergency (16.7miles)	
Pre-project Normal Loading	637 Amps (77%)	Post-project Normal Loading	1287 Amps (156%)
Pre-project Emergency Loading	754 Amps (67%)	Post-project Emergency Loading	1667 Amps (148%)
Worst Contingency		Kelso-Tesla 230 kV Line	
Worst Overload Condition		2013 Summer Peak	

Solution: Re-conductor a total of 17 miles of the Contra Costa - Windmaster 230 kV Line section with 1113 ACSS or equivalent conductors. The 1113 ACSS conductors are rated for 1893 Amps normal/emergency at 2 fps wind speed summer interior. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.1.5 Contra Costa – Delta Pumps 230 kV Line (Windmaster – Delta Pumps)

Limiting Factor		1113 Al at 2 fps wind speed summer interior rating 825 Amps Normal (1.1 miles) 954 ACSR at 4 fps wind speed summer interior rating 1130 Amps Emergency (0.3 miles)	
Pre-project Normal Loading	634 Amps (77%)	Post-project Normal Loading	1285 Amps (156%)
Pre-project Emergency Loading	752 Amps (67%)	Post-project Emergency Loading	1665 Amps (147%)
Worst Contingency		Kelso-Tesla 230 kV Line	
Worst Overload Condition		2013 Summer Peak	

Solution: Re-conductor a total of 1.4 miles of the Windmaster – Delta Pumps 230 kV Line section with 1113 ACSS or equivalent conductors. The 1113 ACSS conductors are rated for 1893 Amps normal/emergency at 2 fps wind speed summer interior. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.1.6 Delta Pumps – Tesla 230 kV Line (Altamont - Delta Pumps)

Limiting Factor		954 ACSR at 4 fps wind speed summer interior rating 996/1130 Amps Normal/Emergency (4.7 miles)	
Pre-project Normal Loading	631 Amps (63%)	Post-project Normal Loading	1282 Amps (129%)
Pre-project Emergency Loading	748 Amps (66%)	Post-project Emergency Loading	1663 Amps (147%)
Worst Contingency		Kelso-Tesla 230 kV Line	
Worst Overload Condition		2013 Summer Peak	

Solution: Re-conductor a total of 4.7 miles of the Altamont – Delta Pumps 230 kV Line section with 1113 ACSS or equivalent conductors. The 1113 ACSS conductors are rated for 1893 Amps normal/emergency at 2 fps wind speed summer interior. Substation terminal equipment will also be upgraded to match or exceed the ampacity of the new conductors.

11.1.7 Delta Pumps – Tesla 230 kV Line (Altamont - Tesla)

Limiting Factor		954 ACSR at 4 fps wind speed summer interior rating 996/1130 Amps Normal/Emergency (3 miles)	
Pre-project Normal Loading	631 Amps (63%)	Post-project Normal Loading	1281 Amps (129%)
Pre-project Emergency Loading	748 Amps (66%)	Post-project Emergency Loading	1662 Amps (147%)
Worst Contingency		Kelso-Tesla 230 kV Line	
Worst Overload Condition		2013 Summer Peak	

Solution: Re-conductor a total of 3 miles of the Altamont – Tesla 230 kV Line section with 1113 ACSS or equivalent conductors. The 1113 ACSS conductors are rated for 1893 Amps normal/emergency at 2 fps wind speed summer interior. Substation terminal equipment will also be upgraded to match or exceed the ampacity of the new conductors.

11.1.8 Kelso – Tesla 230 kV Line (Kelso – USWP RLF)

Limiting Factor		954 ACSR at 4 fps wind speed summer interior rating 997/1129 Amps Normal/Emergency (0.73 miles)	
Pre-project Normal Loading	399 Amps (40%)	Post-project Normal Loading	1261 Amps (127%)
Pre-project Emergency Loading	557 Amps (49%)	Post-project Emergency Loading	1599 Amps (140%)
Worst Contingency		Contra Costa-Delta Pumps 230 kV Line	
Worst Overload Condition		2013 Summer Peak	

Solution: Re-conductor a total of 3 miles of the Kelso – USWP RLF 230 kV Line section with 1113 ACSS or equivalent conductors. The

1113 ACSS conductors are rated for 1893 Amps normal/emergency at 2 fps wind speed summer interior. Substation terminal equipment will also be upgraded to match or exceed the ampacity of the new

11.1.9 Kelso – Tesla 230 kV Line (USWP RLF - Tesla)

Limiting Factor		954 ACSR at 4 fps wind speed summer interior rating 997/1129 Amps Normal/Emergency (0.73 miles)	
Pre-project Normal Loading	412 Amps (41%)	Post-project Normal Loading	1277 Amps (128%)
Pre-project Emergency Loading	571 Amps (51%)	Post-project Emergency Loading	1599 Amps (140%)
Worst Contingency		Contra Costa-Delta Pumps 230 kV Line	
Worst Overload Condition		2013 Summer Peak	

Solution: Re-conductor a total of 5 miles of the USWP RLF - Tesla 230 kV Line section with 1113 ACSS or equivalent conductors. The 1113 ACSS conductors are rated for 1893 Amps normal/emergency at 2 fps wind speed summer interior. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.1.10 Las Positas - Newark 230 kV Line

Limiting Factor		795 ACSR at 2 fps wind speed summer interior rating 743/851 Amps Normal/Emergency (21.3 miles)	
Pre-project Normal Loading	743 Amps (83%)	Post-project Normal Loading	999 Amps (134%)
Pre-project Emergency Loading	788 Amps (93%)	Post-project Emergency Loading	1228 Amps (144%)
Worst Contingency		Contra Costa-Lonetree 230 kV Line	
Worst Overload Condition		2013 Summer Peak	

Solution: Re-conductor a total of 21 miles of the Las Positas – Newark 230 kV Line with 954 ACSS or equivalent conductors. The 954 ACSS conductors are rated for 1714 Amps normal/emergency at 2 fps wind speed summer interior. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.1.11 Lonetree - Cayetano 230 kV Line (Lonetree – USWP JRW)

Limiting Factor		795 ACSR at 4 fps wind speed summer interior rating 886/1005 Amps Normal/Emergency (total 12 miles)	
Pre-project Normal Loading	767 Amps (87%)	Post-project Normal Loading	1083 Amps (122%)
Pre-project Emergency Loading	932 Amps (93%)	Post-project Emergency Loading	1307 Amps (130%)

Worst Contingency	Contra Costa-Las Positas 230 kV Line and RCEC STG1
Worst Overload Condition	2013 Summer Peak

Solution: Re-conductor a total of 12 miles of the Lonetree – USWP JRW 230 kV Line section with 954 ACSS or equivalent conductors. The 954 ACSS conductors are rated for 1714 Amps normal/emergency at 2 fps wind speed summer interior. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.1.12 Lonetree - Cayetano 230 kV Line (USWP JRW – Cayetano)

Limiting Factor		795 ACSR at 4 fps wind speed summer interior rating 886/1005 Amps Normal/Emergency (3 miles). 1004 Amps Underground at 2 fps wind speed summer interior rating Normal/Emergency (2.4 miles)	
Pre-project Normal Loading	764 Amps (88%)	Post-project Normal Loading	1081 Amps (122%)
Pre-project Emergency Loading	932 Amps (93%)	Post-project Emergency Loading	1307 Amps (130%)
Worst Contingency		Contra Costa-Lonetree 230 kV Line	
Worst Overload Condition		2013 Summer Peak	

Solution: Install a 230 kV switching station with a 3-bay BAAH configuration and loop the Lonetree-Cayetano, Contra Costa-Las Positas, and North Dublin-Vineyard 230 kV Lines. Re-conductor a total of 3 miles of the USWP JRW-Cayetano 230 kV Line section with 954 ACSS or equivalent conductors. The 954 ACSS conductors are rated for 1714 Amps normal/emergency at 2 fps wind speed summer interior. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.1.13 Moraga – Castro Valley 230 kV Line

Limiting Factor		954 ACSR at 2 fps wind speed summer coastal rating 911/1021 Amps Normal/Emergency (15 miles).	
Pre-project Normal Loading	688 Amps (76%)	Post-project Normal Loading	965 Amps (106%)
Pre-project Emergency Loading	823 Amps (93%)	Post-project Emergency Loading	1210 Amps (119%)
Worst Contingency		T171-Tesla 500 kV Line	
Worst Overload Condition		2013 Summer Peak	

Solution: Re-conductor a total of 15 miles of the Moraga – Castro Valley 230 kV Line with 795 ACSS or equivalent conductors. The 795 ACSS conductors are rated for 1542 Amps normal/emergency at 2 fps wind speed summer coastal. Substation terminal equipment will

also be upgraded to match or exceed the ampacity rating of the new conductors.

11.1.14 North Dublin – Vineyard 230 kV Line

Limiting Factor		2000 kcmil CU underground cable at summer rating 1004/1004 Amps Normal/Emergency (5.4 miles) 795 ACSR at 4 fps wind speed summer interior rating 886/1005 Amps Normal/Emergency (10 miles).	
Pre-project Normal Loading	654 Amps (74%)	Post-project Normal Loading	969 Amps (109%)
Pre-project Emergency Loading	875 Amps (87%)	Post-project Emergency Loading	1249 Amps (124%)
Worst Contingency		Contra Costa-Las Positas 230 kV Line and RCEC STG1	
Worst Overload Condition		2013 Summer Peak	

Solution: Install a 230 kV switching station with a 3-bay BAAH configuration and loop the North Dublin - Vineyard, Las Positas – Newark, and Vineyard - Newark 230 kV Lines. Re-conductor a total of 10 miles of the North Dublin-Vineyard 230 kV Line section with 954 ACSS or equivalent conductors. The 954 ACSS conductors are rated for 1714 Amps normal/emergency at 2 fps wind speed summer interior. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.1.15 T171 – Tesla 500 kV Line

Limiting Factor		2-2300 Al at 2 fps wind speed summer interior rating 2430/2816 Amps Normal/Emergency (limited by series capacitors)	
Pre-project Normal Loading	1821 Amps (75%)	Post-project Normal Loading	2636 Amps (108%)
Pre-project Emergency Loading	2663 Amps (95%)	Post-project Emergency Loading	3559 Amps (126%)
Worst Contingency		Olinda-Tracy 500 kV Line	
Worst Overload Condition		2013 Summer Peak	

Solution: Congestion management.

11.1.16 Trimble – San Jose B 115 kV Line

Limiting Factor		715 Al at 2 fps wind speed summer coastal rating 703 Amps Normal and 100 deg conductor temperature 924 Amps Emergency (1.1 miles). 3000 MCM AL Underground with 965 Amps normal and emergency ratings (1.1 miles)	
Pre-project Normal Loading	427 Amps (61%)	Post-project Normal Loading	728 Amps (104%)
Pre-project Emergency Loading	614 Amps (67%)	Post-project Emergency Loading	1071 Amps (116%)

Worst Contingency	Tesla-Metcalf 500 kV Line
Worst Overload Condition	2013 Summer Peak

Solution: Re-conductor a total of 1.1 miles of the Trimble – San Jose B 115 kV Line with 477 ACSS or equivalent conductors. The 477 ACSS conductors are rated for 1144 Amps normal/emergency at 2 fps wind speed summer coastal. Re-rate the underground cable section for 1160 Amps emergency rating (needed also for Category C emergency overload mitigation). Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.1.17 Vineyard – Newark 230 kV Line

Limiting Factor		2000 kcmil CU underground cable at summer rating 1004/1004 Amps Normal/Emergency (5.7 miles) 795 ACSR at 4 fps wind speed summer interior rating 886/1005 Amps Normal/Emergency (14 miles).	
Pre-project Normal Loading	427 Amps (61%)	Post-project Normal Loading	728 Amps (104%)
Pre-project Emergency Loading	614 Amps (67%)	Post-project Emergency Loading	1071 Amps (116%)
Worst Contingency		Contra Costa-Las Positas 230 kV Line and RCEC STG1	
Worst Overload Condition		2013 Summer Peak	

Solution: Install a 230 kV switching stations with a 3-bay BAAH configuration and loop the North Dublin-Vineyard, Las Positas-Newark, and Vineyard-Newark 230 kV Lines. Re-conductor a total of 14 miles of the Vineyard-Newark 230 kV Line section with 954 ACSS or equivalent conductors. The 954 ACSS conductors are rated for 1714 Amps normal/emergency at 2 fps wind speed summer interior. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.2 Mitigation for New Category "B" Emergency Overload

The mitigations for new Category "B" emergency overload listed below are in addition to the mitigations for new normal overloads Category "A" described in Section 11.1 which also mitigate the Category "B" emergency overloads.

11.2.1 Birds Landing – Contra Costa 230 kV Line

Limiting Factor		1113 ACSS at 2 fps wind speed summer interior rating 1893 Amps Emergency	
Pre-project Emergency Loading	1713 Amps (90%)	Post-project Emergency Loading	2597 Amps (137%)
Worst Contingency		Contra Costa-Contra Costa Sub 230 kV Line and Gateway PP	
Overload Condition		2013 Summer Peak	

Solution: Loop the Contra Costa – Moraga 230 kV Line No. 1 into the Contra Costa Substation. Install one 230 kV bay BAAH configuration at Contra Costa Sub.

11.2.2 Brentwood – Kelso 230 kV Line

Limiting Factor		954 ACSR at 4 fps wind speed summer interior rating 1130 Amps Emergency.	
Pre-project Emergency Loading	584 Amps (52%)	Post-project Emergency Loading	1136 Amps (101%)
Worst Contingency		Contra Costa-Delta Pumps 230 kV Line	
Overload Condition		2013 Summer Peak	

Solution: Congestion management.

11.2.3 Contra Costa – Contra Costa Sub 230 kV Line

Limiting Factor		1113 ACSS at 2 fps wind speed summer interior rating 1893 Amps Emergency	
Pre-project Emergency Loading	1599 Amps (84%)	Post-project Emergency Loading	2786 Amps (147%)
Worst Contingency		Birds Landing-Contra Costa 230 kV Line and Gateway PP	
Overload Condition		2013 Summer Peak	

Solution: Loop the Contra Costa – Moraga 230 kV Line No. 1 into the Contra Costa Substation. Install one 230 kV bay BAAH configuration at Contra Costa Sub. Convert Contra Costa Substation 230 kV bus into a six-bay, eighteen-breaker BAAH configuration.

11.2.4 Cooley Landing – Stanford 60 kV Line (Cooley Landing-SRI)

Limiting Factor		600 Amps switches	
Pre-project Emergency Loading	553 Amps (92%)	Post-project Emergency Loading	622 Amps (104%)
Worst Contingency		Cardinal Units #1 and #2	
Overload Condition		2013 Summer Peak	

Solution: PG&E project will replace the 600 Amps switches to utilize the emergency conductor coastal ratings of 703 Amps.

11.2.5 Newark 230/115 kV Bank No. 11

Limiting Factor		462 MVA emergency rating	
Pre-project Emergency Loading	443 MVA (96%)	Post-project Emergency Loading	502 MVA (109%)
Worst Contingency		Newark 230/115 kV Bank No. 7	
Overload Condition		2013 Summer Peak	

Solution: Congestion management.

11.2.6 Oakland C – Oakland L 115 kV Line

Limiting Factor		790 Amps underground cable emergency rating	
Pre-project Emergency Loading	772 Amps (98%)	Post-project Emergency Loading	828 Amps (105%)
Worst Contingency		Moraga-San Ramon 230 kV Line and DEC	
Overload Condition		2013 Summer Peak	

Solution: Congestion management.

11.2.7 Pittsburg 230/181 kV TBC Bank

Limiting Factor		450 MVA emergency rating	
Pre-project Emergency Loading	427 MVA (95%)	Post-project Emergency Loading	462 MVA (103%)
Worst Contingency		Pittsburg-San Mateo 230 kV Line and DEC	
Overload Condition		2013 Summer Peak	

Solution: Congestion management.

11.2.8 Potrero 115/181 kV TBC Bank

Limiting Factor		450 MVA emergency rating	
Pre-project Emergency Loading	408 MVA (94%)	Post-project Emergency Loading	456 MVA (101%)
Worst Contingency		Moraga-San Ramon 230 kV Line	
Overload Condition		2013 Summer Peak	

Solution: Congestion management.

11.2.9 Sobrante – El Cerrito No. 1 115 kV Line

Limiting Factor		600 Amps switches	
Pre-project Emergency Loading	570 Amps (95%)	Post-project Emergency Loading	619 Amps (103%)
Worst Contingency		Sobrante-El Cerrito No. 2 115 kV Line	
Overload Condition		2013 Summer Peak	

Solution: Replace the 600 Amps switches to utilize the emergency conductor coastal ratings of 802 Amps.

11.2.10 Sobrante – El Cerrito No. 2 115 kV Line

Limiting Factor		600 Amps switches	
Pre-project Emergency Loading	571 Amps (95%)	Post-project Emergency Loading	620 Amps (103%)
Worst Contingency		Sobrante-El Cerrito No. 1 115 kV Line	

Overload Condition	2013 Summer Peak

Solution: Replace the 600 Amps switches to utilize conductor emergency coastal rating of 802 Amps.

11.2.11 Table Mountain – Tesla 500 kV Line

Limiting Factor		2-2300 Al at 2 fps wind speed summer interior rating 2964 Amps Emergency.	
Pre-project Emergency Loading	2501Amps (84%)	Post-project Emergency Loading	3071 Amps (104%)
Worst Contingency		T171-Tesla 500 kV Line	
Overload Condition		2013 Summer Peak	

Solution: Congestion management.

11.2.12 Vaca Dixon – T171 500 kV Line

Limiting Factor		2-2300 Al at 2 fps wind speed summer interior rating 2816 (series capacitor) Amps Emergency.	
Pre-project Emergency Loading	2663Amps (95%)	Post-project Emergency Loading	3007 Amps (107%)
Worst Contingency		Olinda-Tracy 500 kV Line	
Overload Condition		2013 Summer Peak	

Solution: Congestion management.

11.2.13 Vaca Dixon – T275 No. 1 230 kV Line

Limiting Factor		1113 ACSS at 2 fps wind speed summer interior rating 1893 Amps Emergency (5 miles)	
Pre-project Emergency Loading	484 Amps (26%)	Post-project Emergency Loading	2747 Amps (120%)
Worst Contingency		Vaca Dixon-T275 No. 2 230 kV Line	
Overload Condition		2013 Summer Off-Peak	

Solution: Re-conductor a total of 5 miles of the Vaca Dixon-T275 230 kV Line No. 1 with bundled 795 ACSS or equivalent conductors. The bundled 795 ACSS conductors are rated for 3984 Amps normal/emergency at 2 fps wind speed summer interior. New double circuit towers will be installed and the existing towers will be removed. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.2.14 Vaca Dixon – T275 No. 2 230 kV Line

Limiting Factor		1113 ACSS at 2 fps wind speed summer interior rating 1893 Amps Emergency (5 miles)	
Pre-project Emergency Loading	338 Amps (18%)	Post-project Emergency Loading	2747 Amps (120%)

Worst Contingency	Vaca Dixon-T275 No. 1 230 kV Line
Overload Condition	2013 Summer Off-Peak

Solution: Re-conductor a total of 5 miles of the Vaca Dixon-T275 230 kV Line No. 2 with bundled 795 ACSS or equivalent conductors. The bundled 795 ACSS conductors are rated for 3984 Amps normal/emergency at 2 fps wind speed summer interior. New double circuit towers will be installed and the existing towers will be removed. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.3 Mitigation for New Category "C" Emergency Overload

The mitigation for the new Category "C" emergency overloads listed below are in addition to the mitigations for new Category "A" normal overloads and Category "B" emergency overloads described in Sections 11.1 and 11.2 which also mitigate the Category "C" emergency overloads.

11.3.1 Birds Landing – Contra Costa 230 kV Line

Limiting Factor		1113 ACSS at 2 fps wind speed summer interior rating 1893 Amps Emergency	
Pre-project Emergency Loading	1465 Amps (77%)	Post-project Emergency Loading	2370 Amps (125%)
Worst Contingency		Contra Costa Sub 230 kV Bus Section 2	
Overload Condition		2013 Summer Peak	

Solution: Install SPS to drop generation.

11.3.2 Birds Landing – Contra Costa Sub 230 kV Line

Limiting Factor		1113 ACSS at 2 fps wind speed summer interior rating 1893 Amps Emergency	
Pre-project Emergency Loading	1340 Amps (71%)	Post-project Emergency Loading	1992 Amps (105%)
Worst Contingency		Vaca Dixon-T275 Nos. 1 and 2 230 kV Lines	
Overload Condition		2013 Summer Peak	

Solution: Install SPS to drop generation.

11.3.3 Brentwood - Kelso 230 kV Line

Limiting Factor		954 ACSR at 4 fps wind speed summer interior rating 1130 Amps Emergency.	
Pre-project Emergency Loading	515 Amps (46%)	Post-project Emergency Loading	1289 Amps (114%)
Worst Contingency		Contra Costa Sub 230 kV Bus Section 2F	
Overload Condition		2013 Summer Peak	

Solution: Congestion management.

11.3.4 Contra Costa – Las Positas 230 kV Line

Limiting Factor		954 ACSS at 2 fps wind speed summer interior rating 1714 Amps Emergency.	
Pre-project Emergency Loading	1207 Amps (46%)	Post-project Emergency Loading	1786 Amps (104%)
Worst Contingency		Contra Costa Sub 230 kV Bus Section 2F	
Overload Condition		2013 Summer Peak	

Solution: Install SPS to drop generation.

11.3.5 East Shore – San Mateo 230 kV Line

Limiting Factor		954 ACSS at 2 fps wind speed summer coastal rating 1742 Amps Emergency.	
Pre-project Emergency Loading	1715 Amps (98%)	Post-project Emergency Loading	1776 Amps (102%)
Worst Contingency		Newark-Ravenswood and Tesla-Ravenswood 230 kV Lines	
Overload Condition		2013 Summer Peak	

Solution: Install SPS to drop generation.

11.3.6 Lambie – Birds Landing 230 kV Line

Limiting Factor		1113 ACSS at 2 fps wind speed summer interior rating 1893 Amps Emergency	
Pre-project Emergency Loading	1182 Amps (63%)	Post-project Emergency Loading	2077 Amps (110%)
Worst Contingency		Contra Costa Sub-Contra Costa and Birds Landing-Contra Costa 230 kV Lines	
Overload Condition		2013 Summer Peak	

Solution: Install SPS to drop generation.

11.3.7 Oleum – North Tower – Christie 115 kV Line

Limiting Factor		250 CU at 2 fps wind speed summer coastal rating 522 Amps Emergency	
Pre-project Emergency Loading	1182 Amps (63%)	Post-project Emergency Loading	2077 Amps (110%)
Worst Contingency		Sobrante-El Cerrito Nos. 1 and 2 115 kV Lines	
Overload Condition		2013 Summer Peak	

Solution: Rerate the Oleum – North Tower – Christie 115 kV Line with 4 feet per second (fps) wind speed.

11.3.8 Sobrante – Christie 115 kV Line

Limiting Factor		250 CU at 2 fps wind speed summer coastal rating 522 Amps Emergency	
Pre-project Emergency Loading	532 Amps (102%)	Post-project Emergency Loading	596 Amps (114%)
Worst Contingency		Sobrante-El Cerrito Nos. 1 and 2 115 kV Lines	
Overload Condition		2013 Summer Peak	

Solution: The Category "C" emergency overload is Pre-Project. PG&E will rerate Sobrante – Christie 115 kV Line with 4 fps wind speed.

11.3.9 Trimble – San Jose B 115 kV Line

Limiting Factor		715 Al at 2 fps wind speed summer coastal rating 703 Amps Normal and 100 deg conductor temperature 924 Amps Emergency (1.1miles). 3000 MCM AL Underground with 965 Amps normal and emergency ratings (1.1 miles)	
Pre-project Emergency Loading	957 Amps (104%)	Post-project Emergency Loading	1160 Amps (126%)
Worst Contingency		Metcalf-El Patio Nos. 1 and 2 115 kV Lines	
Overload Condition		2013 Summer Peak	

Solution: The Category "C" emergency overload is Pre-Project. The Trimble – San Jose B 115 kV Line will be reconductored with 477 ACSS (1144 Amps coastal normal and emergency ratings) to mitigate normal Category "A" and "B" emergency overloads for the Group 1 projects. PG&E will rerate the new 477 ACSS conductors with 4 fps wind speed and the underground cable to match the ratings of the overhead conductors.

11.3.10 Westley – Los Banos 230 kV Line

Limiting Factor		1700 Amps emergency rating.	
Pre-project Emergency Loading	888 Amps (52%)	Post-project Emergency Loading	2220 Amps (131%)
Worst Contingency		Tesla-Los Banos and Tracy-Los Banos 500 kV Lines	
Overload Condition		2013 Summer Peak	

Solution: Install SPS to drop generation.

11.4 Summary of Network Upgrade Cost Estimates

Table 11-1 Summary of Transition Cluster Group 1 Network Upgrade Cost Estimates

Over Loaded Component	Overloads		Existing Conductor			Post-Project Loading N/E (Amps)	Re-conductor To			Cost Estimates
	Normal	Cat. "B"	Size	Ratings (Amps) N	Ratings (Amps) E		Size	Ratings (Amps) N	Ratings (Amps) E	
Birds Landing-Contra Costa 230 kV Line	N/A	Yes	1113 ACSS	1893	1893	N/A/2597	Loop Line	N/A	N/A	$28 million (Note 1)
Brentwood-Kelso 230 kV Line	N/A	Yes	954 ACSR	826	1130 (4fps)	N/A/1136	N/A	N/A	N/A	Note 2
Castro Valley-Newark 230 kV Line (23 miles)	Yes	Yes	795 ACSR	743	851	781/1022	795 ACSS	1517	1517	$17.25 million
Cayetano-North Dublin 230 kV Line	Yes	Yes	1004A (UG)	1004	1004	1023/1249	N/A	N/A	N/A	$50 million (Note 3)
Contra Costa-Brentwood 230 kV Line (10 miles)	Yes	Yes	954 ACSR	826	1130 (4fps)	1108/1434	954 ACSS	1714	1714	$8.0 million
Contra Costa-Contra Costa Sub 230 kV Line	N/A	Yes	1113 ACSS	1893	1893	N/A/2786	Loop Line	N/A	N/A	$28 million (Note 1)
Contra Costa - Delta Pumps 230 kV Line (Contra Costa - Windmaster) – 17 miles	Yes	Yes	954 ACSR	826	1130 (4fps)	12871667	1113 ACSS	1893	1893	$15.3 million
Contra Costa - Delta Pumps 230 kV Line (Windmaster - Delta Pumps) – 1.4 miles	Yes	Yes	954 ACSR	826	1130 (4fps)	1285/1665	1113 ACSS	1893	1893	$1.26 million
Contra Costa – RossmoorTap1	N/A	Yes	954 ACSS	1714	1714	N/A/1748	Loop Line	N/A	N/A	$3.0 million (Note 1)
Cooley Landing-Stanford 60 kV Line (Cooley Landing-SRI)	N/A	Yes	715 AL	600 (switch)	600 (switch)	N/A/622	Replace Switch	703	802	$0.3 million
Delta Pumps - Tesla 230 kV Line (Altamont - Tesla) – 4.7 miles	Yes	Yes	954 ACSR	996 (4fps)	1130 (4fps)	1282/1662	1113 ACSS	1893	1893	$2.7 million
Delta Pumps - Tesla 230 kV Line (Delta Pumps - Altamont) – 3 miles	Yes	Yes	954 ACSR	996 (4fps)	1130 (4fps)	1281/1663	1113 ACSS	1893	1893	$4.23 million
Kelso- Tesla 230 kV Line (Kelso - USWP RLF) – 3.3 miles	Yes	Yes	954 ACSR	997 (4fps)	1129 (4fps)	1261/1599	1113 ACSS	1893	1893	$2.97 million
Kelso - Tesla 230 kV Line (USWP RLF - Tesla) – 4.7 miles	Yes	Yes	954 ACSR	997 (4fps)	1129 (4fps)	1277/1599	1113 ACSS	1893	1893	$4.23 million
Las Positas - Newark 230 kV Line (21 miles)	Yes	Yes	795 ACSR	743	851	999/1228	954 ACSS	1714	1714	$16.8 million
Lonetree - Cayetano 230 kV Line (Lonetree - USWP JRW) – 12 miles	Yes	Yes	795 ACSR	886 (4fps)	1005 (4fps)	1083/1310	954 ACSS	1714	1714	$12 million (Recond. Portion only)
Lonetree - Cayetano 230 kV Line (USWP JRW - Cayetano) – 3 miles	Yes	Yes	795 ACSR	886 (4fps)	1005 (4fps)	1081/1307	954 ACSS	1714	1714	
Moraga - Castro Valley 230 kV Line (15 miles)	Yes	Yes	954 ACSR	911	1021	965/1210	795 ACSS	1542	1542	$11.25 million
Newark 230/115 kV Bank 11	N/A	Yes	462 MVA	420 (MVA)	462 (MVA)	N/A/502 (MVA)	N/A	N/A	N/A	Note 2
North Dublin - Vineyard	Yes	Yes	795	886	1005	969/1196	954	1714	1714	$58 million

Over Loaded Component	Overloads		Existing Conductor			Post-Project Loading N/E (Amps)	Re-conductor To			Cost Estimates
	Normal	Cat "B"	Size	Ratings (Amps) N	E		Size	Ratings (Amps) N	E	
230 kV Line (10 miles)			ACSR	(4fps)	(4fps)		ACSS			(Note 4)
Oakland C - Oakland L 115 kV Line	N/A	Yes	790A (UG)	790	790	N/A/828	N/A	N/A	N/A	Note 2
Pittsburg 230/181 kV TBC Bank	N/A	Yes	450 MVA	N/A	450	N/A/462 (MVA)	N/A	N/A	N/A	Note 2
Potrero 115/181 kV TBC Bank	N/A	Yes	450 MVA	N/A	450	N/A/456 (MVA)	N/A	N/A	N/A	Note 2
Sobrante 230/115 kV #1	N/A	Yes	403	403	463	N/A/495	Add 420 MVA Bank	420	420	$10.0 million
Sobrante 230/115 kV #2	N/A	Yes	403	403	463	N/A/482				
Sobrante - El Cerrito #1 115 kV Line	N/A	Yes	715 AL	600 (switch)	600 (switch)	N/A/619	Replace switch	703	802	$0.3 million
Sobrante - El Cerrito #2 115 kV Line	N/A	Yes	715 AL	600 (switch)	600 (switch)	N/A/619	Replace switch	703	802	$0.3 million
Table Mountain - Tesla 500 kV Line	N/A	Yes	2-2300 AL	N/A	2964	N/A/3071	N/A	N/A	N/A	Note 2
Tesla - T171 500 kV Line	Yes	Yes	2-2300 AL	2430	2816 (series cap)	2636/3559	N/A	N/A	N/A	Note 2
Trimble - San Jose B 115 kV Line (2.5 miles)	Yes	Yes	715 AL	703	924 (col. B)	728/1071	477 ACSS	1144	1144	$0.77 million (Note 5)
Vaca-Dixon - T171 500 kV Line	N/A	Yes	2-2300 AL	N/A	2816 (series cap)	N/A/3007	N/A	N/A	N/A	Note 2
Vaca-Dixon - T275 #1 230 kV Line (5 miles)	N/A	Yes	1113 ACSS	1893	1893	N/A/2269	2-795 ACSS	3034	3034	$36 million (Note 6)
Vaca-Dixon - T275 #2 230 kV Line	N/A	Yes	1113 ACSS	1893	1893	N/A/2269	2-795 ACSS	3034	3034	
Vineyard - Newark 230 kV Line (14 miles)	Yes	Yes	795 ACSR	743	851	749/975	954 ACSS	1714	1714	$11.2 million (Recond. Portion only)

NOTES:

1. Convert Contra Costa Substation 230 kV bus into a six-bay, eighteen-breaker BAAH configuration. Loop Contra Costa – Moraga 230 kV Line No. 1 into Contra Costa Substation.

2. Congestion management.

3. Install a 230 kV switching station and loop the Lonetree – Cayetano, Contra Costa – Las Positas, and North Dublin – Vineyard 230 kV lines. The cost to build a switching station and looped the 230 kV lines is estimated at $50 million because the switching station will be located in highly developed area which may require undergrounding the looped lines.

4. Install a 230 kV switching station and loop the North Dublin – Vineyard, Las Positas – Newark, and Vineyard – Newark 230 kV lines. The cost to build a switching station and looped the 230 kV lines is estimated at $50 million because the switching station will be located in highly developed area which may require undergrounding the looped lines.

5. Re-rate the underground section (1.1 miles) to match the ratings of the overhead line section.

6. Build new double circuit tower line on the existing right-of-ways (5 miles) and remove existing towers.

11.5 Mitigation for Dynamic Stability Study Category "C" Emergency

11.5.1 Category "C" Voltage Violation

Solution: None.

11.5.2 Category "C" Frequency violation

Solution: None.

11.6 Mitigation for Fault Duty

Solution: None.

12. Network Upgrades and Overload Mitigation Responsibility By the Project

The cost of the Network Upgrades associated with Group 1 will be divided among the projects in Group 1. To determine the cost responsibility of each generation project assigned to the Groups, the CAISO developed cost allocation factors based on the individual contribution of each project (Appendix J). The cost allocation of this Project for the Network Upgrades for Group 1 is as follows:

- **Contra Costa – Delta Pumps 230 kV Line (Windmaster – Delta Pumps): Reconductor 1.4 miles with 1113 ACSS conductors.**

  The total cost of the project to reconductor the Windmaster – Delta Pumps 230 kV Line section is [redacted] The Project's responsibility based on 0.1% of the total cost per Appendix J is approximately [redacted]

- **Contra Costa – Delta Pumps 230 kV Line (Contra Costa - Windmaster): Reconductor 17 miles with 1113 ACSS conductors.**

  The total cost of the project to reconductor the Contra Costa - Windmaster 230 kV Line section is [redacted]. The Project's responsibility based on 0.1% of the total cost per Appendix J is approximately [redacted]

- **Contra Costa – Contra Costa Sub and Contra Costa – Rossmoor Tap No. 1 230 kV Lines: Loop Contra Costa – Moraga No. 1 230 kV Line into Contra Costa Substation**

  The total cost of the project to loop the Contra Costa – Moraga No. 1 230 kV Line into Contra Costa Substation is [redacted]. Contra Costa Substation 230 kV bus will be converted to six-bay, eighteen-breaker BAAH configuration. The Project's responsibility based on 3.7 % of the total cost per Appendix J is approximately [redacted]

- **Delta Pumps – Tesla 230 kV Line (Delta - Altamont): Reconductor 4.7 miles with 1113 ACSS conductors.**

  The total cost of the project to reconductor the Altamont - Tesla 230 kV Line section is [redacted]. The Project's responsibility based on 0.1% of the total cost per Appendix J is approximately [redacted]

- **Kelso – Tesla 230 kV Line (Kelso - USWP RLF): Reconductor 3.3 miles with 1113 ACSS conductors.**

  The total cost of the project to reconductor the Kelso – USWP RLF 230 kV Line section is [redacted]. The Project's responsibility based on 32.5% of the total cost per Appendix J is approximately [redacted]

- **Kelso – Tesla 230 kV Line (USWP RLF - Tesla): Reconductor 4.7 miles with 1113 ACSS conductors.**

  The total cost of the project to reconductor the USWP RLF - Tesla 230 kV Line section is [redacted]. The Project's responsibility based on 32.5% of the total cost per Appendix J is approximately [redacted]

- **Vaca Dixon – T275 No. 1 230 kV Line: Reconductor 5 miles with bundled 795 ACSS bundled conductors.**

  The total cost of the project to reconductor the Vaca Dixon – T275 230 kV Line No. 1 is [redacted]. The Project's responsibility based on 1.8% of the total cost per Appendix J is approximately [redacted].

- **Vaca Dixon – T275 No. 2 230 kV Line: Reconductor 5 miles with bundled 795 ACSS bundled conductors.**

  The total cost of the project to reconductor the Vaca Dixon – T275 230 kV Line No. 2 is [redacted]. The Project's responsibility based on 1.8% of the total cost per Appendix J is approximately [redacted]

The Project is responsible for approximately [redacted] of the total cost of the Network Upgrades associated with Group 1. The Project is also responsible for approximately [redacted] of the Network Upgrades to convert Kelso Substation 230 kV bus into two-bay, six-breaker BAAH configuration.

13. Preliminary Protection Requirements

Per Section G2.1 of the PG&E Interconnection Handbook, PG&E protection requirements are designed and intended to protect PG&E's system only. The applicant is responsible for the protection of its own system and equipment and must meet the requirements in the PG&E Interconnection Handbook.

The Preliminary Protection Requirements are detailed in Appendix G.

14. Transmission Line Evaluation

The transmission line evaluation included the following work:

- Reconductor the Castro Valley - Newark 230 kV Line
- Reconductor the Contra Costa - Brentwood 230 kV Line
- Reconductor the Contra Costa - Delta Pumps 230 kV Line (Contra Costa - Windmaster)
- Reconductor the Contra Costa - Delta Pumps 230 kV Line (Windmaster - Delta Pumps)
- Reconductor the Delta Pumps - Tesla 230 kV Line (Altamont - Delta Pumps)
- Reconductor the Delta Pumps - Tesla 230 kV Line (Altamont - Tesla)
- Reconductor the Kelso - Tesla 230 kV Line (Kelso - USWP RLF)
- Reconductor the Kelso - Tesla 230 kV Line (USWP RLF - Tesla)
- Reconductor the Las Positas - Newark 230 kV Line
- Reconductor the Lonetree - Cayetano 230 kV Line (Lonetree - USWP JRW)
- Reconductor the Lonetree - Cayetano 230 kV Line (USWP JRW - Cayetano)
- Reconductor the Moraga-Castro Valley 230 kV Line
- Reconductor the North Dublin - Vineyard 230 kV Line
- Reconductor the Vineyard - Newark 230 kV Line
- Reconductor the Vaca Dixon - T275 230 kV Line No. 1
- Reconductor the Vaca Dixon - T275 230 kV Line No. 2
- Loop the Contra Costa - Moraga No. 1 230 kV Line into Contra Costa - Substation
- Loop the Contra Costa - Las Positas, Lonetree - Cayetano, North Dublin - Vineyard, Cayetano - Las Positas, Las Positas - Newark, and Vineyard - Newark into new 230 kV switching stations.

15. Substation Evaluation

15.1 Overstressed Breakers

PG&E uses the following policy to allocate breaker replacement responsibility for projects that overstress or increase overstress[5] on existing circuit breakers:

- If a breaker is not overstressed before the project, and the project results in an overstressed condition of the breaker, then the project is responsible for the cost of replacement.
- If a breaker is already overstressed, and a project increases the overstress by 5% or more, or the post-project overstress level exceeds 25%, then the project is responsible for the cost of replacement.
- If the overstress level exceeds 25% before the project, and for all other circumstances, PG&E or other generation projects will be responsible for any replacement costs.

Using the short-circuit study results of the System Fault Duties Study in Appendix H, an initial breaker evaluation found that the Project did not contribute more than 100 Amps to any breakers that became overstressed.

15.2 Substation Evaluation

The non binding cost estimate for these Network Upgrades is included in the Substation work scope as detailed in Appendix E.

16. Environmental Evaluation/Permitting

16.1 CPUC General Order 131-D

PG&E is subject to the jurisdiction of the California Public Utilities Commission (CPUC) and must comply with CPUC General Order 131-D (Order) on the construction, modification, alteration, or addition of all electric transmission facilities (i.e., lines, substations, switchyards, etc.). This includes facilities to be constructed by others and deeded to PG&E. In most cases where PG&E's electric facilities are under 200 kV and are part of a larger project (i.e., electric generation plant), the Order exempts PG&E from obtaining an approval from the CPUC provided its planned facilities have been included in the larger project's California Environmental Quality Act (CEQA) review, the review has included circulation with the State Clearinghouse, and the project's lead agency (i.e., California Energy

[5] Overstressed Circuit Breaker – The percent of overstress, or level of overstress, is the percent of maximum fault current above the breaker's nameplate rating. For example, a breaker rated at 40,000 amps symmetrical current interrupting a 44,000 amp symmetrical fault is overstressed by 10%.

Commission) finds no significant unavoidable environmental impacts. PG&E or the project developer may proceed with construction once PG&E has filed notice with the CPUC and the public on the project's exempt status, and the public has had a chance to protest PG&E's claim of exemption. If PG&E facilities are not included in the larger project's CEQA review, or if the project does not qualify for the exemption, PG&E may need to seek approval from the CPUC (i.e., Permit to Construct) taking as much as 18 months or more since the CPUC would need to conduct its own environmental evaluation (i.e., Negative Declaration or Environmental Impact Report).

When PG&E's transmission lines are designed for immediate or eventual operation at 200 kV or more, the Order requires PG&E to obtain a Certificate of Pubic Convenience and Necessity (CPCN) from the CPUC unless one of the following exemptions applies: the replacement of existing power line facilities or supporting structures with equivalent facilities or structures, the minor relocation of existing facilities, the conversion of existing overhead lines (greater than 200 kV) to underground, or the placing of new or additional conductors, insulators, or their accessories on or replacement of supporting structures already built. Obtaining a CPCN can take as much as 18 months or more if the CPUC needs to conduct its own CEQA review, while a CPCN with the environmental review already done takes only 4-6 months or less.

Regardless of the voltage of PG&E's interconnection facilities, PG&E recommends that the project proponent include those facilities in its project description and application to the lead agency performing CEQA review on the project. The lead agency must consider the environmental impacts of the interconnection electric facility, whether built by the developer with the intent to transfer ownership to PG&E or to be built and owned by PG&E directly. If the lead agency makes a finding of no significant unavoidable environmental impacts from construction of substation or under-200 kV power line facilities, PG&E may be able to file an Advice Letter with the CPUC and publish public notice of the proposed construction of the facilities. The noticing process takes about 90 days if no protests are filed, but should be done as early as possible so that a protest does not delay construction. PG&E has no control over the time it takes the CPUC to respond when issues arise. If the protest is granted, PG&E may then need to apply for a formal permit to construct the project (i.e., Permit to Construct). Facilities built under this procedure must also be designed to include consideration of electric and magnetic field (EMF) mitigation measures pursuant to PG&E "EMF Design Guidelines for New Electrical Facilities: Transmission, Substation and Distribution". For projects that are not eligible for the Advice Letter/notice process but have already undergone CEQA review, PG&E would likely be able to file a "short-form" CPCN or PTC application, which takes about 4-6 months to process.

Please see Section III, in General Order 131-D. This document can be found in the CPUC's web page at:

http://www.cpuc.ca.gov/PUBLISHED/GENERAL_ORDER/589.htm

16.2 CPUC Section 851

Because PG&E is subject to the jurisdiction of the CPUC, it must also comply with Public Utilities Code Section 851. Among other things, this code provision requires PG&E to obtain CPUC approval of leases and licenses to use PG&E property, including rights-of-way granted to third parties for Interconnection Facilities. Obtaining CPUC approval for a Section 851 application can take several months, and requires compliance with the California Environmental Quality Act (CEQA). PG&E recommends that Section 851 issues be identified as early as possible so that the necessary application can be prepared and processed. As with GO 131-D compliance, PG&E recommends that the project proponent include any facilities that may be affected by Section 851 in the lead agency CEQA review so that the CPUC does not need to undertake additional CEQA review in connection with its Section 851 approval.

17. Cost and Construction Schedule Estimates

17.1 Interconnection Facilities Cost

Table 17-1 details the Interconnection Facilities cost to interconnect the Project.

Table 17-1 Interconnection Facilities Cost

Substation Work at Customer 's Substation	
Pre-parallel inspection, testing, SCADA/EMS setup, meters, etc.	[redacted]
Subtotal Substation Work	[redacted]
Transmission Work	
Construct gen-tie line	**Note 1**
Building & Land Work	
Land engineering support and permitting activities	[redacted]
Subtotal Building & Land Work	[redacted]
Total Interconnection Facilities Cost before ITCC	[redacted]

Note 1: This study assumes that the IC will engineer, procure, construct, own, and maintain its project facility including the generator tap line and their switchyard. Therefore the cost will be the IC's responsibility.

17.2 Network Upgrades Cost

Table 17-2 details the Network Upgrades cost to interconnect the Project.

Table 17-2 Network Upgrades Cost

Substation Work	
Share to convert Contra Costa Sub to BAAH (included in section 12)	[redacted]
100% share to convert Kelso Sub to BAAH	
Modify protection requirements at several substations	
Subtotal Substation Work	
Transmission Work	
Share of Network Upgrade costs shown in Section 12.	[redacted]
Subtotal Transmission Work	
Communications Work	
SCADA/EMS, programming, testing, screening at TOC and Switching Center	[redacted]
Subtotal Communications Work	[redacted]
Total Network Upgrades Cost	[redacted]

17.3 Construction Schedule Estimate

The non-binding construction schedule to engineer and construct the facilities based on the assumptions outlined in the Transition Cluster Phase 1 Study is approximately 24-36 months from the signing of the Large Generator Interconnection Agreement (LGIA). This is based upon the assumption that the environmental permitting obtained by the IC is adequate for permitting all PG&E activities.

Note that if CPUC may require PG&E to obtain a Permit to Construct (PTC) or a Certificate of Public Convenience and Necessity (CPCN) for the generator tie line and Network Upgrades work associated with the project. Hence, the facilities needed for the project interconnection could require an additional two years to three years to complete. The cost for obtaining any of this type of permitting is not included in the above estimates

18. Standby Power

The Phase 1 Study does not address any requirements for standby power that the Project may require. The IC should contact their PG&E Generation Interconnection Services representative regarding this service.

Note: The IC is urged to contact their PG&E Generation Interconnection Services representative promptly regarding standby service in order to ensure its availability for the Project's start up date.