Transition Cluster Phase I Interconnection Study Report

Hydrogen Energy International LLC

Hydrogen Energy California Project

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

Table of Contents

Appendices:

1. Executive Summary

Hydrogen Energy International LLC, an Interconnection Customer (IC), has submitted a completed Interconnection Request (IR) to the California Independent System Operator Corporation (CAISO) for their proposed Hydrogen Energy California Project (Project). The Project proposes to build an Integrated Gasification Combined Cycle facility co-generating power and CO2 in a 1 on 1 configuration. The major equipment consists of one combustion turbine generator, one duct fired heat recovery steam generator, and one steam turbine generator. The project proposes to produce a maximum net output of 383.1 MW to the CAISO Controlled Grid. The proposed Commercial Operation Date of the Project is September 1, 2014. The Project will interconnect to Pacific Gas and Electric Company's (PG&E's) Midway Substation via the 230 kV Bus. The alternate point of interconnection will be looping into the Midway – Wheeler Ridge 230 kV Lines via a new PG&E owned switching station.

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, requests were processed together in Clusters. Transition Cluster projects are initially grouped for study purposes[1] according to their geographical locations. There were seven (7) generation projects including the Project located in Los Padres and Kern divisions assigned to the Transition Cluster Group 3 (Group 3) for the Phase 1 Study. This study report provides the following:

1. Transmission system impacts caused by the addition of the Project and/or Group 3 projects

2. The system reinforcements necessary to mitigate the adverse impact of the Project and or Group 3 projects under various system conditions

3. Preliminary evaluation on the feasibility of the proposed interconnection on the CAISO Controlled Grid

4. A list of required facilities and assign cost responsibility to the Project and a non-binding, good faith estimated time to construct

To determine the system impacts caused by the interconnection of the Project, Phase 1 study of Transition Cluster Group 3 was performed using the following full-loop base cases:

[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

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

The studies based on Transition Cluster Group 3 projects performed included:

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

The Transition Cluster Phase 1 study results have determined that interconnection of the Group 3 projects to the CAISO Controlled Grid causes the following new transmission facilities to become overloaded:

Category "A"

- Gates - McCall 230 kV Line (McCall - Henrietta Tap)
- Morro Bay Midway 230 kV Line Nos. 1 and 2
- Morro Bay - Templeton 230 kV Line
- Panoche - Oro Loma 115 kV Line (Panoche Jct - Hammonds)
- Taft - Cuyama 70 kV Line No. 1 (Taft - T356 Tap)
- Wilson - Le Grand 115 kV Line

Category "B"

- Los Banos - Midway 500 kV Line
- Midway 500/230 kV Bank 11
- Midway 500/230 kV Bank 12
- Midway 500/230 kV Bank 13
- Morro Bay - Gates 230 kV Line
- Callendar Sw Sta - Mesa 115 kV Line
- Fellows - Midsun 115 kV Line (Morgan - Midset)
- Midsun - Midway 115 kV Line (Cymric - Texaco NM)
- Midsun - Midway 115 kV Line (Midway - Cymric)

Category "C"

- Arco - Midway 230 kV Line
- Templeton - Gates 230 kV Line
- Westley - Los Banos 230 kV Line
- Kern - Old River 70 kV Line No. 1
- Maricopa - Old River 70 kV Line
- Midway - Taft 115 kV Line (Taft - Navy 35R)
- Midway - Temblor - Belridge 115 kV Line
- San Luis Obispo - Callendar Sw Sta 115 kV Line
- Taft - Maricopa 70 kV Line (Maricopa - Moco Jct)
- Temblor - San Luis Obispo - Carrizo 115 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 **$1.4 million** exclusive of ITCC[3]. The non-binding cost estimate for the Network Upgrade[4] to interconnect the project would be approximately **$19.6 million**.

2. Interconnection Information

Table 2-1 shows the project information

Project Name	Hydrogen Energy California Project
Project Location	Section 22, Township 30 S, Range 24 E, Mount Diablo Meridan (MDM) Kern County
PG&E Planning Area	Kern Division
Number and Type of Generators	3 CTG1 (GE 7FB), 1 CTG2 (GE LMS100) and 1 STG
Maximum Generator Output	396 MW
Generator Auxiliary Loads	10 MW
Maximum Net Output to Grid	383.1 MW
Power Factor Range	0.85 Lag to 0.95 Lead
Description of Interconnection Configuration	HECA 230 kV Swyd (Dual Circuit) to PG&E Midway Sub (10 miles of 1158 kcmil ACSS per circuit)
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 reliable to the CAISO Controlled Grid

Z (Step-up Transformers)	CTG1 (7FB) – 1 transformer rated for 238/18 kV, 170/227/238 MVA , with 9% impedance at 170 MVA Base CTG2 (LMS100) – 1 transformer rated for 230/13.8 kV, 82/112/140 MVA, with 9% impedance at 38 MVA Base STG – 1 transformer rated for 230/18 kV, 125/167/208 MVA, with 9% impedance at 125 MVA Base
Z (Generators)	(CTG1 – 7FB) Positive Sequence Subtransient (sat.) – X"1 17.0% Positive Sequence Subtransient (unsat.) – X"1 22% Negative Sequence Subtransient (sat.) – X"2 17.0% Negative Sequence Subtransient (unsat.) – X"2 22.5% Zero Sequence Subtransient (sat.) – X"0 11.6% Zero Sequence Subtransient (unsat.) – X"0 50.0% (CTG2 – LMS100) Positive Sequence Subtransient (sat.) – X"1 14.4% Positive Sequence Subtransient (unsat.) – X"1 18.1% Negative Sequence Subtransient (sat.) – X"2 14.1% Negative Sequence Subtransient (unsat.) – X"2 17.6% Zero Sequence Subtransient (sat.) – X"0 9.5% Zero Sequence Subtransient (unsat.) – X"0 9.5% (STG) Positive Sequence Subtransient (sat.) – X"1 0.135 Positive Sequence Subtransient (unsat.) – X"1 0.175 Negative Sequence Subtransient (sat.) – X"2 0.133 Negative Sequence Subtransient (unsat.) – X"2 0.173 Zero Sequence Subtransient (sat.) – X"0 0.110 Zero Sequence Subtransient (unsat.) – X"0 0.110

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.

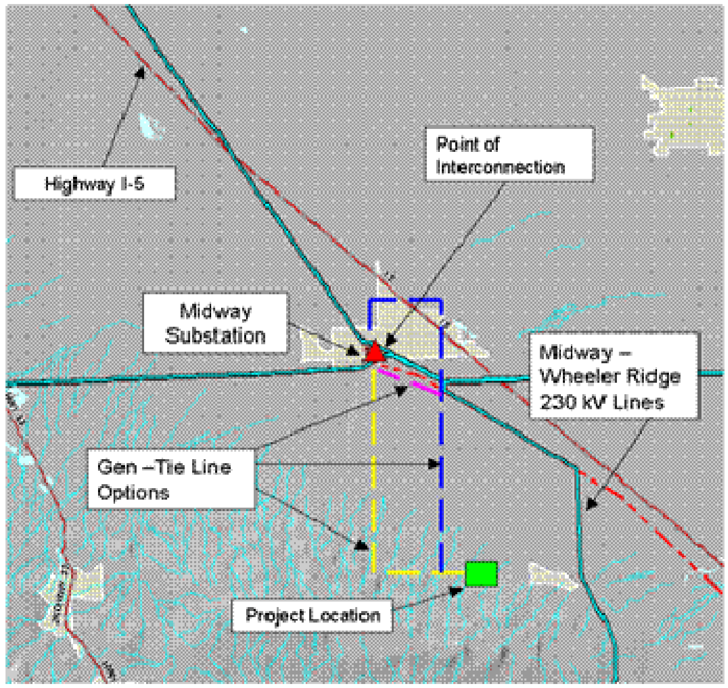

Figure 2-1 : Map of the Project

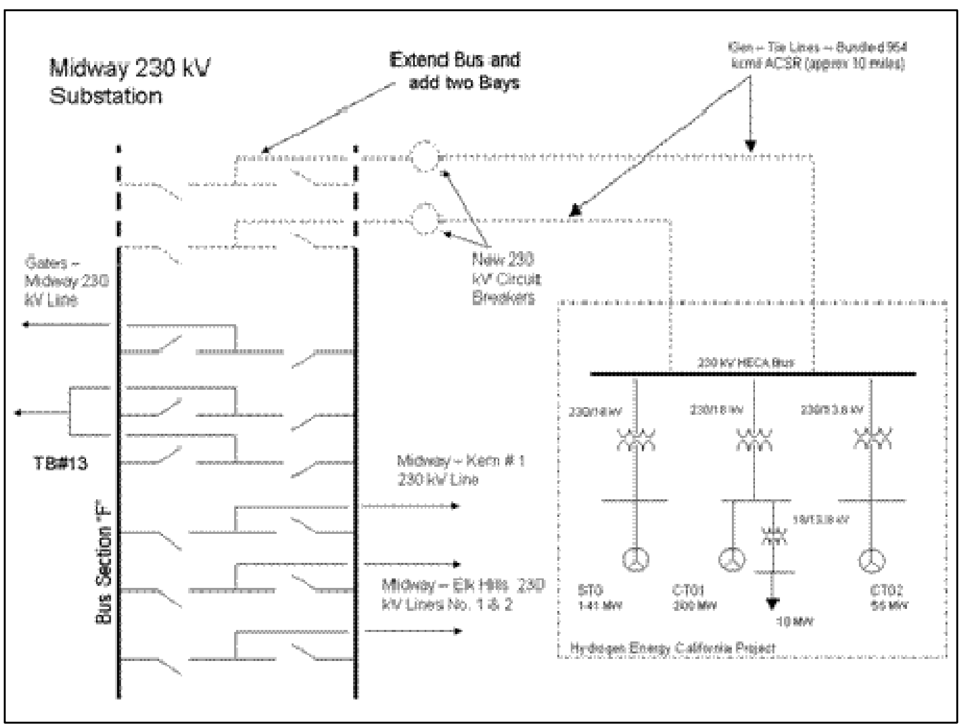

Figure2-2: Proposed Single Line Diagram

3. Study Assumptions

PG&E conducted the Phase 1 Study using the following assumptions:

- The winter maximum rated output is 396 MW. The auxiliary load is 10 MW. The maximum net output, calculated by the IC, of the Project to the CAISO Controlled Grid is 383.1 MW.

- The expected Commercial Operation Date of the Project is September 1, 2014.

- The Project has one CTG1 (7FB) transformer rated for 238/18 kV, 170/227/238 MVA, with 9% impedance at 170 MVA Base, one CTG2 (LMS100) transformer rated for 230/13.8 kV, 82/112/140 MVA, with 9% impedance at 38 MVA Base, and one STG – 1 transformer rated for 230/18 kV, 125/167/208 MVA, with 9% impedance at 125 MVA Base.

- The IC will engineer, procure, construct, own, and maintain its project facility, including the generator tie-lines.

- PG&E will modify the 230 kV bus at Midway Substation with a breaker and a half (BAAH) configuration in order to accommodate the new loop lines.

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

3-1: Transition Cluster Phase I Group 3 Generation Interconnection Projects in SLO/KERN

Queue	MW	Point of Interconnection	Online Date
239	250	Midway-Morro Bay 230 kV line	12/1/2011
242	390	Morro Bay-Midway 230 kV line	9/1/2012
300	400	Midway Substation 230 kV bus	9/1/2014
304	50	Smyrna-Alpaugh 115 kV line	5/3/2010
356	45	Taft-Cuyama 70 kV lines	5/1/2011
357	100	Midway-Sunset to Midway Substation 230 kV	5/1/2010
403	60	Midway Substation 230 kV bus	6/1/2012

4. Power Flow Study Base cases

Two power flow base cases were used to evaluate the transmission system impacts of the Project. 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 three base cases represented extreme loading and generation conditions for the study area.

The CAISO and PG&E cannot guarantee that the Project 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 the Project 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 Fresno 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 in the Greater Fresno area are about 30% - 35% of the summer peak loads. This base case was used to evaluate single element contingencies only on PG&E's 60 kV through 230 kV systems.

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. The base case assumptions are provided in Appendix B. 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.

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 the Project on the PG&E transmission system.

5.1 Steady State Study Criteria – Normal Overloads

Normal overloads are those that exceed 100 percent of normal ratings. The CAISO Controlled Grid Reliability Criteria requires the loading of all transmission system facilities be within their normal summer 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 to be evaluated as part of this study, it is impractical to study all the CAISO Category "C" contingencies. For this reason, select critical Category C contingencies (C1 – C9) will be evaluated as part of this study.

6.2 Study Results

The Transition Cluster Group 3 Phase 1 Study caused 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 addition of the Group 3 projects caused eight (8) new Category "A" normal overloads. Under projected 2013 summer off-peak conditions, the addition of the Group 3 projects causes two (2) new normal overloads. The Category "A" normal overloads are summarized in Table 6-2-1.

6-2-1: Summer 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 SLO/Kern Transition Cluster							
Morro Bay - Templeton 230 kV Line	825	812	98%	1046	127%	29%	Reconductor 16 miles of the Morro Bay - Templeton 230 kV Line
Panoche - Oro Loma 115 kV Line (Panoche Jct - Hammonds)	487	460	94%	489	101%	7%	Congestion Management should be relied upon
Q166 - T239 #2 230 kV Line	826	660	80%	872	106%	26%	T1093A: Reconductor 81 miles of 230 kV DCTLs between Midway and Morro Bay
Q194 - T239 #1 230 kV Line	826	636	77%	923	112%	35%	
T239 - Midway #1 230 kV Line	826	636	77%	1202	146%	69%	
T239 - Midway #2 230 kV Line	826	660	80%	1202	146%	66%	
Taft - Cuyama #1 70 kV Line (Taft - T356 Tap)	297	78	26%	308	104%	78%	SPS to drop the generator
Wilson - Le Grand 115 kV Line	442	401	91%	441	100%	9%	Congestion Management should be relied upon
Category A Normal Overloads – 2013 Summer Off-Peak SLO/Kern Transition Cluster							
Gates - McCall 230 kV Line (McCall - Henrietta Tap)	825	788	95%	829	100%	5%	Congestion Management should be relied upon
Taft - Cuyama #1 70 kV Line (Taft - T356 Tap)	297	44	15%	352	119%	104%	SPS to drop the generator

6.2.2 Emergency Overloads (Category "B")

Under projected 2013 summer peak conditions, the addition of the Group 3 projects caused ten (10) new Category "B" emergency overloads. Under projected 2013 summer off-peak conditions, the addition of the Group 3 projects caused eleven (11) new and exacerbates three (3) pre-project Category "B" emergency overloads. The Category "B" emergency overloads are summarized in Table 6-2-2. The pre-project overloads are shown as shaded in the table.

6-2-2: Summer 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
Category B Emergency Overloads – 2013 Summer Peak SLO/Kern Transition Cluster								
Callendar Sw Sta - Mesa 115 kV Line	Morro Bay 230/115 kV Bank 6	372	362	97%	378	102%	5%	Short Term Rating or Operating or SPS
Midway 500/230 kV Bank 11	Midway 500/230 kV Bank 12	1122 MVA	905 MVA	81%	1401 MVA	125%	44%	Obtain One-Hour Emergency Rating for Midway Bank Nos. 11, 12, and 13
Midway 500/230 kV Bank 12	Midway 500/230 kV Bank 11	1122 MVA	909 MVA	81%	1407 MVA	125%	44%	
Midway 500/230 kV Bank 13	Midway 500/230 kV Bank 12	1122 MVA	890 MVA	79%	1378 MVA	123%	44%	
Morro Bay - Gates 230 kV Line	Morro Bay - Templeton 230 kV Line with SPS for Q016	975	797	82%	1125	115%	33%	Reconductor 68 miles of the Morro Bay - Gates 230 kV Line
Morro Bay - Templeton 230 kV Line	T239 - Midway #1 230 kV Line with SPS to trip Q016	975	924	95%	1130	116%	21%	Reconductor 16 miles of the Morro Bay - Templeton 230 kV Line
Q166 - T239 #2 230 kV Line	Q194 - T239 #1 230 kV Line with SPS to trip Q016	977	777	80%	1578	162%	82%	T1093A: Reconductor 81 miles of Midway - Morro Bay 230 kV DCTL lines
Q194 - T239 #1 230 kV Line	Q166 - T239 #2 230 kV Line with SPS to trip Q016/Q166	977	620	64%	1231	126%	62%	
T239 - Midway #1 230 kV Line	T239 - Midway #2 230 kV Line with SPS to trip Q016/Q166	977	620	64%	1633	167%	103%	
T239 - Midway #2 230 kV Line	T239 - Midway #1 230 kV Line with SPS to trip Q016	977	777	80%	1959	201%	121%	
Category B Emergency Overloads – 2013 Summer Off- Peak SLO/Kern Transition Cluster								
Kern - Live Oak 115 kV Line	Kern - Magunden - Witco 115 kV Line	482	518	107%	527	109%	2%	Congestion Management should be relied upon
Fellows - Midsun 115 kV Line (Morgan - Midset)	Midway - Taft 115 kV Line	512	333	65%	515	101%	36%	Congestion Management should be relied upon
Midsun - Midway 115 kV Line (Cymric - Texaco NM)	Midway - Taft 115 kV Line	603	462	77%	639	106%	29%	
Midsun - Midway 115 kV Line (Midway - Cymric)	Midway - Taft 115 kV Line	603	528	88%	701	116%	28%	
Morro Bay - Q166 #1 230 kV Line	Morro Bay - Q166 #2 230 kV Line	977	581	60%	1031	106%	46%	T1093A: Reconductor 81 miles of Midway - Morro Bay 230 kV DCTL lines
Morro Bay - Q166 #1 230 kV Line	Morro Bay - Q166 #2 230 kV Line and Morro Bay Unit 4	977	581	60%	1031	106%	46%	
Morro Bay - Q166 #2 230 kV Line	Morro Bay - Q166 #1 230 kV	977	602	62%	1031	106%	44%	
Morro Bay - Q166 #2 230 kV Line	Morro Bay - Q166 #1 230 kV Line and Morro Bay Unit 4	977	602	62%	1031	106%	44%	

Over Loaded Component	Contingency	Rating (Amps)	Pre- Project Loading (Amps | %Rating)		Post-Project Loading (Amps | %Rating)		% Change from Pre-Project Loading	Mitigations
Category B Emergency Overloads – 2013 Summer Peak SLO/Kern Transition Cluster								
T239 - Midway #1 230 kV Line	T239- Midway #1 230 kV Line and Morro Bay Unit 4	977	80	8%	1077	110%	102%	
T239 - Midway #1 230 kV Line	T239 - Midway #1 230 kV Line	977	80	8%	1077	110%	102%	
Category B Post-Transient Emergency Overloads - 2013 Summer Off-peak SLO/Kern Area Transition Cluster								
Gates - Midway 500 kV Line	Los Banos-Midway 500 kV SLO	2964	3296	112%	3544	120%	8%	Obtain Short Term Emergency Rating
Gates - Midway 500 kV Line	Gates-Midway 500 kV SLO	941	905	97%	1016	108%	11%	
Gates - Midway 500 kV Line	PDCI Bipole Outage	2964	2952	100%	3100	105%	5%	
Los Banos - Midway 500 kV Line	Gates-Midway 500 kV SLO	2964	2738	92%	2962	100%	8%	

6.2.3 Emergency Overloads (Category "C")

Under projected 2013 summer peak conditions, the addition of the Group 3 projects caused eighteen (18) new and exacerbates one (1) pre-project Category "C" emergency overloads. Under projected 2013 summer off-peak conditions, the addition of the Group 3 projects caused fourteen (14) new and exacerbates nine (9) pre-project Category "C" emergency overloads. The Category "C" emergency overloads are summarized in Table 6-2-3. The pre-project overloads are shown as shaded in the table.

6-2-3: Summer 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
Category C Emergency Overloads – 2013 Summer Peak SLO/Kern Transition Cluster								
Morro Bay - Gates 230 kV Line	T239 - Midway #1 and #2 230 kV Lines with SPS to trip Q016/Q166/Q194	975	499	51%	1193	122%	71%	T1093A: Reconductor 81 miles of Midway - Morro Bay 230 kV DCTL lines
Morro Bay - Templeton 230 kV Line	Q166 - Q194 #1 and Q166 - T239 #2 230 kV Lines with SPS to trip Q016/Q166/Q194	975	834	86%	1288	132%	46%	
Q166 - Q194 #1 230 kV Line	Morro Bay - Gates and Morro Bay - Templeton 230 kV Lines with SPS for Q016 and trip Q016/Q166/Q194	977	582	60%	1094	112%	52%	
Q194 - T239 #1 230 kV Line	Morro Bay - Gates and Templeton - Gates 230 kV Lines with SPS to trip Q016 & Q166	977	785	80%	1116	114%	34%	
T239 - Midway #1 230 kV Line	Midway 230 kV Bus Section 2D with SPS to trip Q016 & Q166	977	634	65%	1662	170%	105%	T1093A: Reconductor 81 miles of Midway -

Over Loaded Component	Contingency	Rating (Amps)	Pre- Project Loading (Amps		%Rating)	Post-Project Loading (Amps		%Rating)	% Change from Pre-Project Loading	Mitigations
Category C Emergency Overloads – 2013 Summer Peak SLO/Kern Transition Cluster								
T239 - Midway #2 230 kV Line	Morro Bay - Gates and Templeton - Gates 230 kV Lines with SPS to trip Q016 & Q166	977	519	53%	1398	143%	90%	Morro Bay 230 kV DCTL lines
Templeton - Gates 230 kV Line	T239 - Midway #1 and #2 230 kV Lines with SPS to trip Q016/Q166/Q194	975	399	41%	1082	111%	70%	Reconductor 26 miles of Templeton-Gates 230 kV lines
Westley - Los Banos 230 kV Line	Tesla-Los Banos & Tracy-Los Banos 500 kV DLO	1700	1266	75%	1832	108%	33%	Obtain Short Term Emergency Rating
Midway - Temblor 115 kV Line (Belridge - Temblor)	T239 - Midway #1 and #2 230 kV Lines with SPS to trip Q016/Q166/Q194	461	315	68%	536	116%	48%	Reconductor 8 miles of Midway - Temblor 115 kV Line (Belridge - Temblor)
Midway - Temblor 115 kV Line (Midway - Belridge)	T239 - Midway #1 and #2 230 kV Lines with SPS to trip Q016/Q166/Q194	461	293	64%	512	111%	47%	
Kern - Old River #2 70 kV Line (Old River - Union Jct)	Kern Power 70 kV Bus Section 2	330	338	102%	343	104%	2%	T1081 Reconductor the Kern - Old River 70 kV Line No. 2 (Old River - Union Jct)
Maricopa - Old River 70 kV Line (Basic School Jct - Copus)	Midway - Taft and Fellows - Taft 115 kV Lines	355	239	67%	613	173%	106%	Explore RAS To Drop T-356
Maricopa - Old River 70 kV Line (Copus - San Emidio Jct)	Midway - Taft and Fellows - Taft 115 kV Lines	371	191	52%	564	152%	100%	
Maricopa - Old River 70 kV Line (Gardner - Basic School Jct)	Midway - Taft and Fellows - Taft 115 kV Lines	355	243	68%	617	174%	106%	
Maricopa - Old River 70 kV Line (Maricopa - Gardner)	Midway - Taft and Fellows - Taft 115 kV Lines	355	251	71%	625	167%	96%	
Maricopa - Old River 70 kV Line (San Emidio Jct - Old River)	Midway - Taft and Fellows - Taft 115 kV Lines	355	190	54%	562	159%	105%	
Taft - Maricopa 70 kV Line (Maricopa - Moco Jct)	Midway - Taft and Fellows - Taft 115 kV Lines	511	286	56%	661	129%	73%	
Taft - Maricopa 70 kV Line (Taft A - Taft A Jct)	Midway - Taft and Fellows - Taft 115 kV Lines	379	214	56%	581	153%	97%	
Taft - Maricopa 70 kV Line (Taft A Jct - Moco Jct)	Midway - Taft and Fellows - Taft 115 kV Lines	379	289	76%	653	172%	96%	
Category C Emergency Overloads – 2013 Summer Off- Peak SLO/Kern Transition Cluster								
Coalinga #1 - San Miguel 70 kV Line	Templeton 230 kV Bus with SPS for Q016	346	429	124%	434	125%	1%	SPS
Kern - Live Oak 115 kV Line	Kern - Magunden - Witco and Westpark - Magunden 115 kV Lines	482	517	107%	526	109%	2%	Con
Kern - Old River #1 70 kV Line	Midway - Taft and Fellows - Taft 115 kV Lines	346	242	70%	497	143%	73%	Kern - Old River #1 70 kV Line T1081 Reconductor the Kern - Old River 70 kV Line No. 2 (Old River - Union Jct)
Maricopa - Old River 70 kV Line (Basic School Jct - Copus)	Midway - Taft and Fellows - Taft 115 kV Lines	355	456	128%	830	234%	106%	Explore RAS To Drop T-356

Over Loaded Component	Contingency	Rating (Amps)	Pre- Project Loading (Amps |%Rating)		Post-Project Loading (Amps |%Rating)		% Change from Pre-Project Loading	Mitigations
Category C Emergency Overloads – 2013 Summer Peak SLO/Kern Transition Cluster								
Maricopa - Old River 70 kV Line (Copus - San Emidio Jct)	Midway - Taft and Fellows - Taft 115 kV Lines	371	430	116%	801	216%	100%	
Maricopa - Old River 70 kV Line (Gardner - Basic School Jct)	Midway - Taft and Fellows - Taft 115 kV Lines	355	459	129%	834	235%	106%	
Maricopa - Old River 70 kV Line (Maricopa - Gardner)	Midway - Taft and Fellows - Taft 115 kV Lines	355	465	131%	841	237%	106%	
Maricopa - Old River 70 kV Line (San Emidio Jct - Old River)	Midway - Taft and Fellows - Taft 115 kV Lines	346	428	121%	800	226%	105%	
Midway - Taft 115 kV Line (Taft - Navy 35R)	Midway 115 kV Bus Section 1D	739	550	74%	749	101%	27%	Congestion Management should be relied upon
Morro Bay - Q166 #1 230 kV Line	Morro Bay - Q194 #1 and Morro Bay - Q166 #2 230 kV Lines	977	580	59%	1030	105%	46%	Morro Bay - Q166 #1 230 kV Line
Morro Bay - Q166 #2 230 kV Line	Morro Bay 230 kV Bus Section 1E	977	596	61%	1025	105%	44%	Morro Bay - Q166 #2 230 kV Line
Q194 - T239 #1 230 kV Line	Morro Bay - Q166 #1 and #2 230 kV Lines	977	467	58%	1016	104%	46%	Q194 - T239 #1 230 kV Line
San Miguel - Paso Robles 70 kV Line	Templeton 230 kV Bus with SPS for Q016	346	374	108%	379	109%	1%	SPS
T239 - Midway #1 230 kV Line	Morro Bay - Q166 #1 and #2 230 kV Lines	977	467	58%	1302	133%	75%	T1093A: Reconductor 81 miles of Midway - Morro Bay 230 kV DCTL lines
T239 - Midway #2 230 kV Line	Morro Bay - Q166 #1 and #2 230 kV Lines	977	521	53%	1302	133%	80%	
T239 - Midway #2 230 kV Line	Midway 230 kV Bus Section 1D	977	79	8%	1079	110%	102%	
Taft - Maricopa 70 kV Line (Maricopa - Moco Jct)	Midway - Taft and Fellows - Taft 115 kV Lines	511	484	95%	862	169%	74%	Explore RAS To Drop T-356
Taft - Maricopa 70 kV Line (Taft A - Taft A Jct)	Midway - Taft and Fellows - Taft 115 kV Lines	379	376	99%	761	201%	102%	
Taft - Maricopa 70 kV Line (Taft A Jct - Moco Jct)	Midway - Taft and Fellows - Taft 115 kV Lines	379	460	121%	843	222%	101%	Taft - Maricopa 70 kV Line (Taft A Jct - Moco Jct)
Temblor - San Luis Obispo 115 kV Line (Carrizo - San Luis Obispo)	Morro Bay - T239 #1 and #2 230 kV Lines	437	222	51%	448	102%	51%	Reconductor the Temblor - San Luis Obispo 115 kV Line
Temblor - San Luis Obispo 115 kV Line (Temblor - Carrizo)	Morro Bay - T239 #1 and #2 230 kV Lines	437	224	51%	455	104%	53%	
CategoryC Post-Transient Emergency Overloads - 2013 Summer Off-peak SLO/Kern Area Transition Cluster								
Arco- Midway 230 kV Line	Los Banos-Midway & Gates - Midway 500 kV DLO	941	849	90%	990	105%	15%	Obtain Short Term Emergency Rating
Gates - Midway 230 kV Line	Los Banos-Midway & Gates - Midway 500 kV DLO	941	944	101%	1114	119%	18%	Obtain Short Term Emergency Rating

7. Short Circuit Current Calculation

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

7.1 System Protection Study Input Data

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

(CTG1 – 7FB)

- Positive Sequence Subtransient (sat.) – X”1 17.0%
- Positive Sequence Subtransient (unsat.) – X”1 22%
- Negative Sequence Subtransient (sat.) – X”2 17.0%
- Negative Sequence Subtransient (unsat.) – X”2 22.5%
- Zero Sequence Subtransient (sat.) – X”0 11.6%
- Zero Sequence Subtransient (unsat.) – X”0 50.0%

(CTG2 – LMS100)

- Positive Sequence Subtransient (sat.) – X”1 14.4%
- Positive Sequence Subtransient (unsat.) – X”1 18.1%
- Negative Sequence Subtransient (sat.) – X”2 14.1%
- Negative Sequence Subtransient (unsat.) – X”2 17.6%
- Zero Sequence Subtransient (sat.) – X”0 9.5%
- Zero Sequence Subtransient (unsat.) – X”0 9.5%

(STG)

- Positive Sequence Subtransient (sat.) – X”1 0.135
- Positive Sequence Subtransient (unsat.) – X”1 0.175
- Negative Sequence Subtransient (sat.) – X”2 0.133
- Negative Sequence Subtransient (unsat.) – X”2 0.173

- Zero Sequence Subtransient (sat.) – X”0 0.110
- Zero Sequence Subtransient (unsat.) – X”0 0.110

Step-up Transformer

- CTG1 (7FB) – 1 transformer rated for 238/18 kV, 170/227/238 MVA, with 9% impedance at 170 MVA Base.
- CTG2 (LMS100) – 1 transformer rated for 230/13.8 kV, 82/112/140 MVA, with 9% impedance at 38 MVA Base.
- STG – 1 transformer rated for 230/18 kV, 125/167/208 MVA, with 9% impedance at 125 MVA Base.

7.2 Results

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

Bus fault current evaluation has identified that a 4-ohm reactor is required to mitigate the total fault current, contribution by the Group 3 projects, at 230 kV buses at Midway Substation. The Project is responsible 83.1 % of the total reactor costs.

8. Reactive Power Deficiency Analysis

The power flow studies of Category “B” and “C” contingencies indicate that the Project 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 coordination fashion through abnormal operating conditions after the new facility begins operation. The generator dynamic data used for the study can be found 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 new facility will create any system instability during the following line and generator outages:

Category "B" Contingencies:

- Full load rejection of the 396 MW Project.
- A three-phase close-in fault on the Gates - Midway 230 kV Line at the Gates Substation 230 kV bus with normal clearing time followed by loss of the new Gen-tie line #1 230 kV Line
- A three-phase close-in fault on the Kern - Midway 230 kV Line at the Midway Substation 230 kV bus with normal clearing time followed by loss of the Kern – Midway 230 kV Line
- A three-phase close-in fault on the Kern - Midway 230 kV Line at the Kern Substation 230 kV bus with normal clearing time followed by loss of the Kern – Midway 230 kV Line
- A three-phase close-in fault on the Midway - Elk Hills 230 kV Line No. 1 at the Midway Substation 230 kV bus with normal clearing time followed by loss of the Midway - Elk Hills 230 kV Line No. 1.
- A three-phase close-in fault on the Midway - Elk Hills 230 kV Line No. 1 at the Elk Hills Substation 230 kV bus with normal clearing time followed by loss of the Midway - Elk Hills 230 kV Line No.

Category "C" Contingencies:

- A three-phase fault on the Midway 230 kV bus with normal clearing time
- A three-phase fault on the new Hydrogen EC 230 kV bus with normal clearing time
- A three-phase fault on the Elk Hills 230 kV bus with normal clearing time
- A three-phase fault on the Gates 230 kV bus with normal clearing time
- A three-phase fault on the Midway Substation 230 kV bus with normal clearing time followed by loss of the Midway – Elk Hills #1 and #2 230 kV lines

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 have no adverse impact on the stable operation of the transmission system. Dynamic stability studies indicate that the transmission system's transient stability performance would not be impacted by the Project following the selected contingencies. The results of the study are provided in the form of plots in Appendix F

10. Deliverability Evaluations

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 3 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. The alternative method to mitigate the normal overloads is by generation curtailment. The Phase 1 Study only provides cost estimates for the re-conductoring alternatives.

11.1 Overload Mitigations for Category Normal Overloads Category "A"

11.1.1 Midway – Morro Bay 230 kV Double Circuit Tower Line

Limiting Factor		1113 AAC (81 miles), 826 Amps Normal, 975 Amps Emergency, 2fps wind speed rating	
Pre-Project Normal Loading	777 Amps (80%)	Post Project Normal Loading	1959 Amps (201%)
Worst Contingency		Midway - Morro Bay 230 kV Line + Local RAS Scheme (San Luis Obispo-Atascadero SPS) Also different sections of this line would exceed normal rating	
Worst Overload Condition		Summer Peak	

Solution: Re-conductor 81 miles of the Morro Bay – Midway 230 kV DCTL with 1431 ACSS or equivalent conductors. The 1431 ACSS conductors are rated for 2271 amps normal and emergency at 2 feet per second (fps) wind speed. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.1.2 Morro Bay – Templeton 230 kV Line

Limiting Factor		1113 kcmil AAC (16 miles), 825 Amps normal., 975 Amps Emergency, 2fps wind speed rating	
Pre-Project Normal Loading	By CAISO	Post Project Normal Loading	1877 Amps (192%)
Worst Contingency		Morro Bay – Midway 230 kV DCTL + Local RAS Scheme (SPS) Also this line would exceed normal rating	
Worst Overload Condition		Deliverability	

Solution: Re-conductor 16 miles of the Morro Bay – Templeton 230 kV Line with 1113 ACSS or equivalent conductors. The 1113 ACSS conductors are rated for 1893 amps normal and emergency at 2 fps wind speed. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.1.3 Panoche – Oro Loma 115 kV Line

Solution: Congestion Management

11.1.4 Wilson – Le Grand 115 kV Line

Solution: Congestion Management

11.1.5 Gates – Mc Call 230 kV Line

Solution: Congestion Management

11.1.6 Taft - Cuyama 70 kV Line

Solution: Install SPS to drop Q356

11.2 Overload Mitigation for New Category "B" Emergency

11.2.1 Morro Bay – Gates 230 kV Line

Limiting Factor		1113 kcmil AAC (68 miles), 975 Amps Emergency, 2fps wind speed rating	
Pre-Project Normal Loading	By CAISO	Post Project Normal Loading	1515 Amps (155%)
Worst Contingency		Midway - Morro Bay 230 kV DCTL + Local RAS Scheme (SPS)	
Worst Overload Condition		Deliverability	

Solution: Re-conductor 68 miles of the Morro Bay – Gates 230 kV Line with 1113 ACSS or equivalent conductors. The 1113 ACSS conductors are rated for 1893 amps emergency normal and emergency at 2 fps wind speed. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.2.2 Midway 500/230 kV Transformer Bank Nos. 11,12,13

Limiting Factor		1112 MVA	
Pre-Project Normal Loading	909 MVA (81%)	Post Project Normal Loading	1407 Amps (125%)
Worst Contingency		Any Midway 500/230 kV Parallel bank	
Worst Overload Condition		Summer Peak	

Solution: Re-rate the Midway Bank Nos. 11 and 13. Assuming balanced load between phases, the Midway Bank Nos. 11 and 13 are capable of carrying 1458.6 MVA – 3 Phase for 1 Hour under emergency conditions only. Due to existing problems with fans/cooling system of the Midway Bank No. 12, this bank is capable of only its OA rating, which is 672 MVA – 3 Phase, continuously.

Midway Bank No. 12 should have its fans/cooling system repaired/replaced to restore at least its normal 2nd stage FOA capability of 1120 MVA – 3 Phase. Additionally, DGA oil samples should be completed as well. Once that is completed, re-rating Bank No. 12 can be re-evaluated for the possibility of granting additional emergency capacity.

As an interim solution, during any of Midway banks outage, the spare phase of the remaining banks can be restored by manual action. Restoring a spare phase can take up to 24 hours. Therefore, it is recommended to install a SPS to drop generation during that time. This is a temporary solution and PG&E is investigating for longer term plans for mitigating the Midway bank overloads.

11.2.3 Los Banos – Midway 230 kV Line

Solution: Congestion Management

11.2.4 Fellow – Midsun 115 kIV Line

Solution: Congestion Management

11.2.5 Midsun – Midway 115 kIV Line

Solution: Congestion Management

11.2.6 Gates – Midway 230 kV Line

Solution: Obtain Short Term Rating

11.2.7 Los Banos – Midway 230 kV Line

Solution: Obtain Short Term Rating

11.3 Overload Mitigation for New Category "C" Emergency

11.3.1 Templeton – Gates 230 kV Line

Limiting Factor		1113 kcmil AAC (53 miles), 975 Amps Emergency, 2fps wind speed rating	
Pre-Project Normal Loading	By CAISO	Post Project Normal Loading	1407 Amps (144%)
Worst Contingency		Morro Bay – Midway 230 kV DCTL + Local RAS Scheme (SPS)	
Worst Overload Condition		Deliverability	

Solution: Re-conductor 53 miles of the Templeton – Gates 230 kV Line with 1113 ACSS or equivalent conductors. The 1113 ACSS conductors are rated for 1893 amps normal and emergency at 2 fps wind speed. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.3.2 Westley – Los Banos 230 kV Line

Solution: Use Short Term Rating

11.3.3 Arco – Midway 230 kV Line

Solution: Use Short Term Rating

11.3.4 Midway – Temblor 115 kV Line

Limiting Factor		336.4 kcmil AAC (15 miles), 462 Amps Emergency, 2fps wind speed rating	
Pre-Project Normal Loading	By CAISO	Post Project Normal Loading	628 Amps (130%)
Worst Contingency		Morro Bay – Midway 230 kV DCTL + Local RAS Scheme (SPS)	
Worst Overload Condition		Deliverability	

Solution: Re-conductor 15 miles of the Midway – Temblor 115 kV Line with 715 ACC or equivalent conductors. The 715 ACC conductors are rated for 631 and 742 amps normal and emergency, respectively, at 2 fps wind speed. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.3.5 Midway – Taft 115 kV Line

Solution: Congestion Management

11.3.6 Temblor – San Luis Obispo 115 kV Line

Limiting Factor		4/0 Cu (57 miles), 462 Amps Emergency, 2fps wind speed rating	
Pre-Project Normal Loading	By CAISO	Post Project Normal Loading	498 Amps (113%)
Worst Contingency		Morro Bay – Midway 230 kV DCTL + Local RAS Scheme (SPS)	
Worst Overload Condition		Deliverability	

Solution: Re-conductor 57 miles of the Temblor – San Luis Obispo 115 kV Line with 715 ACC or equivalent conductors. The 715 ACC conductors are rated for 631 and 742 amps normal and emergency, respectively at 2 fps wind speed. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.3.7 Temblor – Kernridge 115 kV Line

Limiting Factor		336.4 kcmil AAC (5 miles), 461 Amps Emergency, 2fps wind speed rating	
Pre-Project Normal Loading	By CAISO	Post Project Normal Loading	628 Amps (135%)
Worst Contingency		Morro Bay – Midway 230 kV DCTL + Local RAS Scheme (SPS)	
Worst Overload Condition		Deliverability	

Solution: Re-conductor 5 miles of the Temblor – Kern Ridge 115 kV Line with 715 ACC or equivalent conductors. The 715 ACC conductors are rated for 631 and 742 amps normal and emergency, respectively at 2 fps wind speed. Substation terminal equipment will also be upgraded to match or exceed the ampacity rating of the new conductors.

11.3.8 Kern – Old River 70 kV Line No. 1

Solution: This line overload is a pre-project overload, and is not the responsibility of this project. Currently PG&E has a project (T1081) to reconductor both Kern – Old River Line Nos. 1 and 2 with higher capacity (SE ratings of 1080 Amps or above) conductors.

11.3.9 Kern Oil Jct. – Golden Bear 115 kV Line

Solution: Install SPS to drop T513

11.4 Overload Mitigation for Pre-Project Category "C" Emergency

The pre-project overload is a result of a generation project that has a superior queue position and an earlier online date. That project has been assigned the responsibility for mitigating this overload. Should that project not materialize or the mitigation provided by that project did not resolve the overload contributed by this Project, the IC may be responsible for mitigating the overloads caused by the Project. Following is a list of all the per-project overloads and their mitigation plans:

11.4.1 Kern – Live Oak 115 kV Line

Solution: Congestion Management or install SPS to drop load or generation.

11.4.2 Coalinga – San Miguel 70 kV Line

Solution: Install SPS to Drop load or Generation

11.4.3 San Miguel – Paso Robels 70 kV Line

Solution: Install SPS to Drop load or Generation

11.4.4 Kern - Old River 70 kV Line No. 2 (Old River - Union Jct)

Solution: This line overload is a pre-project overload, and is not the responsibility of this project. Currently, PG&E has a project (T1081) to reconductor both Kern – Old River Line Nos. 1 and 2 with higher capacity (SE ratings of 1080 Amps or above) conductors.

11.4.5 Taft - Maricopa 70 kV Line

Solution: This line overload is a post-project overload during Summer Peak Study and is pre-project overload during Deliverability and Summer Off-peak study. Also, this overload was not identified during System Assessment period and was only identified during Transition Cluster Group 3 Phase I study.

Currently PG&E and CAISO have agreed to explore a SPS option involving T356 being dropped during emergency conditions. However, PG&E will complete a sensitivity study to re-evaluate this overload in order to propose a longer term solution

11.5 Summary of Network Upgrade Cost Estimates

Table 11-1 provides cost estimates of the Network Upgrades for Group 3 projects.

11-1: Summary of Network Upgrade Cost Estimate

Over Loaded Component	Overloads			Existing Conductor			Post-Project Loading N/E (Amps)	Re-conductor To			Cost
				Size	Ratings (Amps)			Size	Ratings (Amps)		
	Normal	Cat "B"	Cat "C"		N	E		N	N	E	
Morro Bay – Midway 230 kV Line No. 1	Yes	Yes	Yes	1113 AAC	826	975	1960	1431 ACSS or 477 ACSS Bundled or equal	2260	2260	63.8 m
Morro Bay – Midway 230 kV Line No. 2	Yes	yes	Yes	1113 AAC	826	975	1960	1431 ACSS or 477 ACSS Bundled or equal	2260	2260	63.8 m
Morro Bay-Templeton 230kV Line	Yes	Yes	Yes	1113 AAC	826	975	1877	1113 ACSS or Higher	1893	1893	12.2 m
Morro Bay-Gates 230kV Line	No	Yes	Yes	1113 AAC	826	975	1515	1113 ACSS or Higher	1893	1893	51.4 m
Templeton-Gates 230kV Line	No	No	Yes	1113 AAC	826	975	1407	1113 ACSS or Higher	1893	1893	39.3 m
Midway-Temblor 115kV Line	No	No	Yes	336.4 AAC	397	462	628	715 AAC	631	742	7 m
Temblor-San Luis Obispo 115kV Line	No	No	Yes	4/0 Cu	375	436	498	715 AAC	631	742	28 m
Temblor-Kernridge 115kV Line	No	No	Yes	336.4 AAC	397	462	628	715 AAC	631	742	2.5 m

12. Network Upgrades and Overload Mitigations Responsible By the Project

The cost of the Network Upgrades associated with each Cluster will divided among the projects in each Group. To determine the cost responsibility of each generation project assigned to the Cluster, the CAISO developed cost allocation factors based on the individual contribution of each project (Appendix I Table 2). The cost allocation of this Project for the Network Upgrades is as follows:

12.1 Steady State Power Flow Category "A", Category "B", and Category "C" Emergency Mitigation

Midway 500/230 kV Transformer Bank Nos. 11,12,13

Re-rate the Midway Bank Nos. 11 and 13. Assuming balanced load between phases, the Midway Bank Nos. 11 and 13 are capable of carrying 1458.6 MVA – 3 Phase for 1 Hour under emergency conditions only. Due to existing problems with fans/cooling system of the Midway Bank No. 12, this bank is capable of only its OA rating which is 672 MVA – 3 Phase Continuously.

Midway Bank 12 should have its fans/cooling system repaired/replaced to restore at least its normal 2nd stage FOA capability of 1120 MVA – 3 Phase. Additionally, DGA oil samples should be completed as well. Once that is completed, re-rating Bank No. 12 can be re-evaluated for the possibility of granting additional emergency capacity.

As an interim solution, during any of Midway banks outage, the spare phase of the remaining banks can be restored by manual action. Restoring spare phase can take up to 24 hours. Therefore, it is recommended to install SPS to drop generation during that time. This is a temporary solution and PG&E is investigating for longer term plan for mitigating the Midway banks overload. The cost of rerating Midway transformers is about $500,000 and the cost of installing SPS involving Midway banks overload is about $3,000,000. The Project's responsibility based cost allocation factors is approximately $1.36 million.

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 IC will engineer, procure, construct, own, and maintain its project facility including the generation tie-line.

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.

[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%.

- 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 causes one 230 kV overstressed breaker (Gates CB 262). The Project's responsibility based on cost allocation factors is approximately $329,000.

Also, the Project would increase the existing fault duty at Midway Substation's 230 kV bus beyond its acceptable level (63 kA 3LG). Installing a new switching station with a Breaker – and – a – Half (BAHH) configuration and 5 ohms reactors between existing Midway 230 kV bus and the new 230 kV bus would be required to mitigate the Midway 230 kV bus fault duties. The Project's responsibility based cost allocation factors is approximately $10.4 million

15.2 Substation Evaluation

The existing Midway Substation 230 kV bus has eleven (11) elements on bus Section "D", and six (6) elements on each bus sections "E" and "F". The HECA generation tie-line will require two 230 kV lines out of Midway Substation. Due to space limitations at Midway Substation, it will be infeasible to increase the elements on the 230 kV Bus or to extent the 230 kV bus to accommodate two 230 kV lines for HECA.

To interconnect HECA to the Midway 230 kV bus, PG&E requires converting the existing Midway 230 kV bus into a BAAH bus configuration and extend the existing property fence.

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 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., Certificate of Public Convenience and Necessity or 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 Costs

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

Table 17-1 Interconnection Facilities Costs

Substation Work at Customer 's Substation	
Pre-parallel inspection, testing, SCADA/EMS setup, meters, etc.	$1000,000
Subtotal Substation Work	**$1000,000**
Building & Land Work	
Land engineering support and permitting activities	$400,000
Subtotal Building & Land Work	**$400,000**
Total Interconnection Facilities Cost before ITCC	**$1,400,000**

17.2 Network Upgrades Costs

Table 17-2 details the Network Upgrade costs to interconnect the Project.

Table 17-2 Network Upgrade Costs

Substation Work	
Interconnection to 230 kV Midway Bus	$6,000,000
Upgrade Relays at Midway	$600,000
DTT	$300,000
Install Reactors	$10,465,625
Install SPS involving bank overloads	$1,173,600
Midway bank rerates	$200,000
Overstressed Breaker CB 262	$329,000
Subtotal Substation Work	**$19,068,225**
Communications Work	
SCADA/EMS, programming, testing, screening at TOC and Switching Center	$500,000
Subtotal Communications Work	**$500,000**
Total Network Upgrades Interconnection Cost	**$19,568,225**

17.3 Construction Schedule Estimate

The non-binding construction schedule to engineer and construct the facilities based on the assumptions outlined in the ISIS 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 tap line or any other work associated with the project, the project could require an additional one to two 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.