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September 1, 2011

Mr. Terrence O'Brien
Deputy Director
Siting, Transmission and
Environmental Protection Division
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814-5512

Re: North Brawley Geothermal Project Generating Capacity

Dear Mr. O'Brien:

The information outlined in this letter is in response to your letter dated August 15, 2011. The information requested in the engineering questionnaire is enclosed separately or contained in the response filed in response to Docket 11-CAI-02. Some background information regarding the North Brawley Geothermal Development Project is provided below.

The North Brawley Geothermal Project ("North Brawley") is located within the North Brawley Known Geothermal Resource Area ("North Brawley KGRA") north of the City of Brawley and separated by the New River. The North Brawley Geothermal Exploration Project was permitted by Imperial County by Conditional Use Permit (CUP) #06-0021 in August 2006. The North Brawley Geothermal Development Project was permitted by Imperial County by CUP #07-0017 in November 2007. Construction of North Brawley began in December 2007. North Brawley has been operating since 2008.

1. Are there or will there be any shared facilities between North Brawley and existing or planned ORMAT local geothermal generation facilities, including East Brawley? If yes, please describe those facilites.

   North Brawley will likely share the same point of interconnection to the Imperial Irrigation District's ("IID's) transmission system as the proposed East Brawley Geothermal Development Project ("East Brawley"). North Brawley interconnects to IID's 92 kV line that runs north south along the east side of Hovley Road through the North Brawley substation. The proposed East Brawley power plant, which will also have its own substation, will also interconnect to the IID line at the North Brawley substation as this is where there is available capacity on the IID transmission system.

   In order to improve efficiency, while North Brawley and East Brawley will each have its own control room, the proposed East Brawley power plant would be designed to allow

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for monitoring and operation from dedicated computers at two locations: one located at the offices in the North Brawley power plant on Hovley Road, and the other at the East Brawley facility itself. Given that all instrumention is computerized this is common in today's power facilities.

Given the delay in getting East Brawley permitted and the well field problems encountered at North Brawley, the decision was made to request an amendment to the North Brawley CUP requesting that the exploration wells drilled for the East Brawley Geothermal Exploration Project be added to North Brawley to add additional production and injection capacity. The amendment to CUP #07-0017 was approved in June 2010. These wells are for the sole use of North Brawley, and will not be shared.

2. Does ORMAT plan to build additional power plants in the area? If yes, what is the schedule and what are the MW capacity increments.

   No. ORMAT has no plans to build any additional power plants within the North Brawley KGRA.

3. Does North Brawley have its own dedicated production and injection wells?

   Yes. The North Brawley Geothermal Development Project has both production and injection wells dedicated to it. There are currently 16 production and 15 injection wells.

4. Are North Brawley's geothermal steam production and delivery system shared or interconnected with another geothermal plant and or its geothermal steam production and delivery system, including East Brawley? If yes, please describe.

   No. There are no shared systems. The North Brawley power plant is a stand alone binary power plant that contains 5 Ormat Energy Converters (OECs). There is no steam production from the wells or a steam turbine at this facility, only hot geothermal fluid. Six wells drilled for the East Brawley Geothermal Exploration Project were connected to North Brawley as described in #1. These are not shared wells, and are for the sole use of North Brawley.

5. Will North Brawley's geothermal steam production and delivery system be shared or interconnected with another planned geothermal plant and or its geothermal steam production and delivery system, including East Brawley? If yes, please describe.

   No. There are no other interconnections planned.

6. If additional steam can be provided to North Brawley, what is the maximum generating capacity that the unit can achieve?

   If additional hot water from production wells and additional injection capacity can be developed for the North Brawley power plant the maximum gross generating capacity is 80 MW (16 MW x 5 OECs) based on generator limitations. There are other limiting factors such as cooling tower auxiliaries and gathering and injection pipe sizing that

would increasingly reduce efficiency as more brine was added to the facility beyond the design point of 80 MW gross. Based on the California Energy Commission method for determining the average net generation at 61 degrees Fahrenheit, the net capacity would be less than 50 MW, because of increasing auxiliary and parasitic load, and reduced efficiencies. See the information provided in the table for #3 of the engineering questionnaire calculations.This is a hypothetical case. Since cooling capacity is limited, heat input would have to be drastically increased from present resource conditions to reach a gross generating capacity of 80 MW.

7. Is there a transmission interconnection study for North Brawley and can it be provided to us?

   Yes. The Transmission Interconnection Study for North Brawley is included with this response.

Sincerely,

Charlene L Wardlow

Charlene L. Wardlow
Director Business Development

Enclosure: Engineering Questionaire responses

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North Brawley
System Impact Study

An Analysis for the
Imperial Irrigation District

~Final Report~
December 11, 2007

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EXECUTIVE SUMMARY

Power Flow Analysis

KEMA Inc. and IID's Planning Section performed the Power Flow Analysis to review the impact of the proposed North Brawley 150 MW generation project ("Project") when delivering power to IID internal electrical network (50 MW), (50 MW) to SCE and 50 MW for North Brawley load project in the 2010 timeframe. The base case has modeled the new IID Niland Generation Project with 100 MW (Heavy Summer ON-Line, Light Winter OFF-Line). The Project was modeled as Twelve 12.5 MW generators connected to the "CO" 92 kV line. The System Impact Study included power flow, transient and post-transient stability analysis for peak (heavy summer) and off-peak (light winter) conditions, modeled using Western Electric Coordinating Council ("WECC") cases with a detailed IID system representation for 2010. The short circuit analysis, performed by PDS consulting, PLC, is also included as part of this system impact study at the request of IID.

For the conditions modeled, the system impact study indicated that the addition of the North Brawley Project will have some impact on IID's voltage and thermal loading conditions for the different scenarios studied under normal and contingency conditions. Voltage deviation and thermal rating violations attributable to the addition of the Project will require the design and implementation of a few System Operating Procedures (SOPs) and/or system upgrades. The addition of the Project and its associated dispatch to Southern California Edison showed 2.5 MW increase on IID system losses for the Heavy Summer and 5.0 MW for the Light Winter system condition. The study results show that there were pre-existing voltage and thermal violations under outage conditions that were not attributable to the project. These system violations were not included in this report and are being addressed in other planning forums.

Transient Stability

KEMA Inc. on behalf of Imperial District ("IID") performed this Transient Stability analysis indicated that the addition of the Project does not adversely impact the stability response of the system. On stability outages of the generator transformers, it has been noted that the generator itself must be tripped. Generation tripping for the loss of the step-up transformer is a common practice and does not represent any additional problems to the IID system.

LIST OF APPENDICES

Appendix A – Contingency lists

Appendix B – Peak Heavy Summer Power Flow Results – Pre and Post Project

Appendix C – Off-peak Light Winter Power Flow Results - Pre and Post Project

Appendix D – Peak Heavy Summer Transient Stability Plots – Post Project

Appendix E – Off-peak Light Winter Transient Stability Plots – Post Project

Appendix F – Short Circuit Analysis

Appendix G – Sensitivity Short Circuit Analysis

Appendix H – Post-Transient Stability Analysis

Short Circuit Analysis

A short circuit analysis was performed by PDS consulting, PLC. The executive summary reports the following:

A short circuit study and breaker capability analysis has been performed to determine the impact of the additional North Brawley generation facility to the IID Energy transmission system. The analysis found minimal impacts to the interrupting capability of the IID Energy transmission system due to the addition of the North Brawley generation facility. The analysis also found that the interrupting capability of two of the breakers, H40 and H50, at the Euclid Substation will be exceeded (the pre-Project fault levels were at 99% of the interrupting capability while the post-Project fault level was found to be 101%), however IID Energy can re-schedule to an earlier date a project to replace the affected equipment with sufficient interrupting capacity prior to the in-service date of the North Brawley project.

The results of the study also indicated that there are a few fault interrupting devices on the IID Energy system which have fault current exposure levels near of their respective interrupting ratings (specifically Imperial Valley 230kV and El Centro 92kV). However, these interrupting rating concerns have been identified as pre-existing conditions and not directly related to the North Brawley generation project.

Sensitivity Short Circuit Analysis

A sensitivity analysis of to the original short circuit study and breaker capability analysis has been performed per project owner request to determine the impact of the North Brawley project phase A (6 generators in the amount of 12.5MW each) connected to the IID Energy transmission system.

The analysis found that the fault duty at the Euclid 92 kV substation will exceed the interrupting capability of two of the breakers, H40 and H50, at this substation (the pre-Project fault levels were at 98.4% of the interrupting capability while the post-Project fault level was found to be 100.04%), Even though these short circuit violations are marginal, the IID standard requires the replacement of these breakers once they reach their interrupting capability.

Post-Transient Stability Analysis

The addition of the North Brawley Project did not impact the existing reactive power margins at selected buses for all the outage simulation studied with the exception of the Imperial Valley – Miguel 500 kV line outage. An outage of the Imperial Valley-Miguel 500 kV line caused the reactive power margin at five (5) IID buses to decrease up to 4 MVAR. In particular, the addition of the North Brawley Project and the subsequent outage of the Imperial Valley –Miguel 500 kV line caused the reactive power margin at N. LAQUITA 92 kV bus to decrease from 103 MVAR to 99 MVAR.

A summary of the post-transient reactive power margin analysis can be found at Appendix B. Positive reactive power margins were obtained at all the buses monitored following the selected outages.

1 INTRODUCTION

KEMA Inc. and PDS Consulting, on behalf of Imperial Irrigation District ("IID"), performed this System Impact Study to review the impact of the proposed North Brawley 150 MW generation project ("Project") when delivering power to IID internal network (50 MW), (50 MW) to SCE and 50 (MW) to serve the Project internal load in the 2010 timeframe. The base case has modeled the new IID Niland Generation Project with 100 MW (Heavy Summer ON-Line, Light Winter OFF-Line). The Project was modeled as Twelve 12.5 MW generators connected to the "CO" 92 kV line. The System Impact Study included power flow, transient and post-transient stability analysis for peak (heavy summer) and off-peak (light winter) conditions, modeled using Western Electric Coordinating Council ("WECC") cases with a detailed IID system representation for 2010. The short circuit analysis, performed by PDS consulting, PLC, is also included as part of this system impact study at the request of IID.

2 STUDY ASSUMPTIONS

2.1 Cases Studied

This North Brawley analysis used power flow models representative of an IID 2010 system. The following peak (heavy summer) and off-peak (light winter) scenarios were studied:

Season	PSLF Case Name	Description
Heavy Summer	Pre-Project	Planned heavy summer configuration without the Project
Heavy Summer	Post-Project	Planned heavy summer configuration with Project - net output 100 MW
Light Winter	Pre-Project	Planned light winter configuration without the Project
Light Winter	Post-Project	Planned light winter configuration with the Project - net output 100 MW

2.2 Case Assumptions

The two WECC Approved Power Flow Base Cases used to develop the North Brawley System Impact Study were:

Heavy summer . . . . 10hs1a.SAV .....Approved 08/24/05

Light winter . . . . . 12lw1sa.SAV.....Approved 01/19/06

Both cases were selected because they were the most recently developed and available cases in the WECC library in the vicinity of the Project's in-service date. The IID system loads, resources, and topology were adjusted to represent the conditions expected in the year the Project planned to initiate operations.

The 2010 case used to model the impact of the Project included planned transmission elements internal to the IID system for the timeframe as well as the following changes to the base case:

- Generation was modeled according to the IID's current generation interconnection (IID Queue list) that reflects generation expected to be in operation during the study time frame. The generation at Niland 92 kV substation was dispatched according to typical usage, Heavy Summer ON-Line, Light Winter OFF-Line.
- IV – Dixieland 230 kV line and 230/92 kV transformer.
- El Centro 230/92 kV transformer.

2.3 Dynamic Models

The stability models used for the Project were provided by the Project sponsor and included:
Generator – GENSA1 - Salient pole generator represented by equal mutual inductance rotor modeling.
Exciter – EXAC8B – Brushless exciter with PID voltage regulator.
Governor –W2301- Woodward 2301 governor and basic turbine model.

2.4 Loads and Resources

The table below shows the IID loads, losses, generation, and area interchange for the cases studied.

Case	Summer Pre	Summer Post	Winter Pre	Winter Post
Load (MW)	1193.6	1243.6	268.5	318.5
Load (MVAR)	443.8	474.7	60.7	91.6
Losses (MW)	58.1	59.5	37.0	42.7
Losses (MVAR)	323.5	332.6	195.3	243.3
Interchange (MW)	74	174	770.7	870.3
Total IID Shunts (MVAR)	-558.7	-587.8	-197.4	-214.4
IID Generation (MW)	1325.5	1476.9	1076.3	1231.5
IID Generation (MVAR)	179.9	209.7	60.7	112.1

2.5 Power Flow Evaluation Criteria

For this analysis, the system was evaluated for its thermal loading capacity and voltage performance (primarily voltage drop). The system was evaluated both with all lines in service and under emergency or unplanned outage conditions that might occur such as the outage of a line or transformer. WECC Reliability Criteria and the North American Electric Reliability Council ("NERC") Planning Standards were used to evaluate the system as noted below. While the NERC/WECC criteria are applicable, the interconnecting transmission system owner/operator may have stricter voltage or thermal conditions based on operating or reliability needs.

The following criteria were used to determine the impact of the facility on IID's system for pre-contingency and post-contingency conditions:

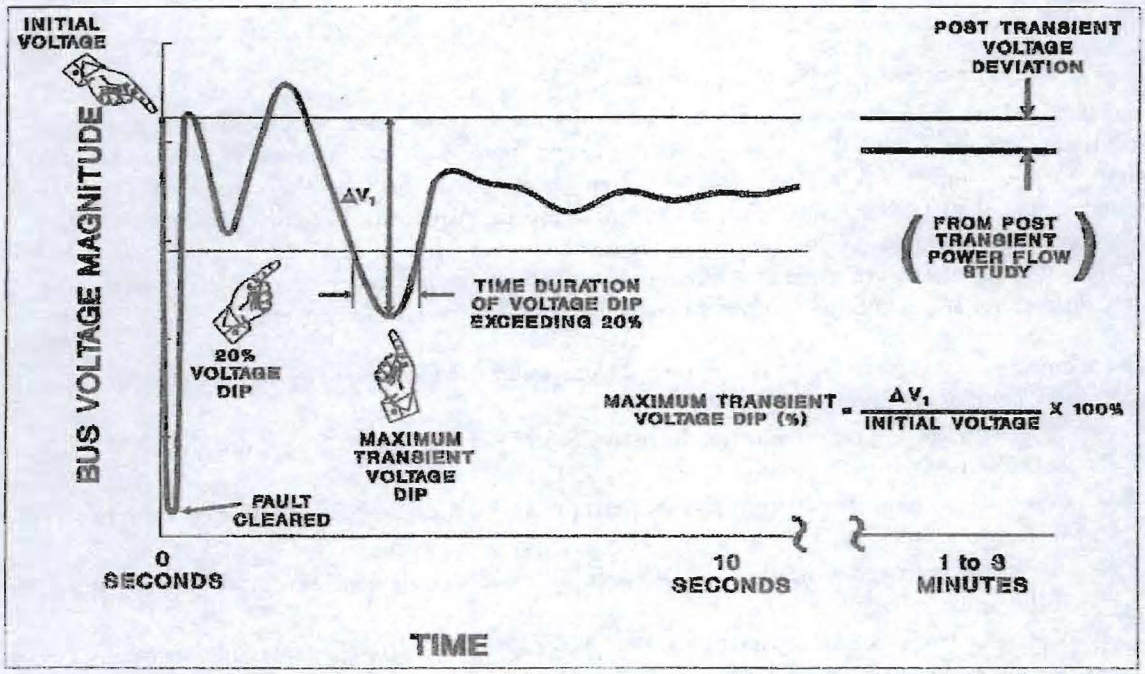
- Pre-disturbance bus voltage must be between 0.95 per unit and 1.05 per unit. (an IID-specific requirement)
- Allowable voltage deviation of five (5) percent for N-1 Contingencies (deviation from pre-disturbance voltage).
- Allowable voltage deviation of ten (10) percent for N-2 contingencies (deviation from pre-disturbance voltage).
- Post-transient bus voltage must be at least 0.90 per unit (an IID-specific requirement)
- Pre- and post-disturbance loading to remain within the emergency ratings of all equipment and line conductors. The emergency ratings are determined by the owner/operator of each equipment item.

As applied in the analysis, all tables and results for loading criteria were based on the normal or continuous rating (Rating 1) for all lines in service conditions and the emergency rating (Rating 2) for outage conditions.

2.6 Stability Analysis Evaluation Criteria

The following NERC/WECC stability criteria[1] were used to evaluate the impact of the Project:

NERC and WECC Categories	Outage Frequency Associated with the Performance Category (outage/year)	Transient Voltage Dip Standard	Minimum Transient Frequency Standard	Post Transient Voltage Deviation Standard
A System normal	Not Applicable	Nothing in addition to NERC		
B One element out-of-service	≥ 0.33	Not to exceed 25% at load buses or 30% at non-load buses. Not to exceed 20% for more than 20 cycles at load buses.	Not below 59.6Hz for 6 cycles or more at a load bus.	Not to exceed 5% at any bus.
C Two or more elements out-of-service	0.033 – 0.33	Not to exceed 30% at any bus. Not to exceed 20% for more than 40 cycles at load buses.	Not below 59.0Hz for 6 cycles or more at a load bus.	Not to exceed 10% at any bus.
D Extreme multiple-element outages	< 0.033	Nothing in addition to NERC		



[1] Reference: Western Electricity Coordinating Council NERC/WECC Planning Standards, Revised August 9, 2002, page 12-13.

3 STUDY METHODOLOGY

3.1 Power Flow Methodology

Power flow analysis considers a snapshot in time where tap changing transformers, static var devices, and phase-shifters have had time to adjust. In addition, a swing generator balances generation and load (plus losses) on the system during each contingency scenario. All power flow analysis was conducted with version 16 of General Electric's PSLF software. Power flow results were monitored and reported for the IID area.

Thermal and voltage performance of the system was evaluated under normal N-0 (no contingency), emergency N-1 (single contingency) and select N-2 (double contingency) conditions. Thermal loadings were reported when a modeled transmission component loaded to 100% or more of its normal MVA rating (as provided in the power flow database).

Transmission voltage violations for normal N-0 (no contingency) conditions were reported where per unit voltages were less than 0.95 or greater than 1.05. Emergency (N-1, single contingency and N-2 double contingencies) voltage violations were reported when per unit voltage was less than 0.90 or greater than 1.05. In addition, voltage deviations between the pre- and post-contingency conditions were recorded whenever these deviations were greater than 5% for single contingencies and 10% for double contingencies between the pre- and post-Project power flow cases.

3.2 Transient Stability Methodology

Transient stability analysis is a time-based simulation that assesses the performance of the power system shortly before, during, and shortly following a contingency. Transient stability studies were performed to verify the stability of the system following a system fault.

Transient stability analysis was performed based on WECC Disturbance-Performance Criteria for selected system contingencies using version 16 of General Electric's PSLF software. Transient stability contingencies were simulated for 10 seconds, including 1 second of pre-disturbance data and 9 seconds of post disturbance response. All faults for all voltages assumed a 4 cycle breaker clearing time. System damping was assessed visually with the aid of stability plots.

The following parameters were plotted on the stability plots:

Rotor Angle

The rotor angle plots assist in determining how the proposed Project would swing with respect to other generators in the area. The plots indicate whether the unit would remain synchronous with the rest of the system following a disturbance.

Generator Speed

The generator speed plots, assist in determining how the proposed Project would react (speed up, slow down) with respect to other generators in the area. The plots indicate whether the unit would remain synchronous with the rest of the system following a disturbance.

Bus Voltage

Bus voltage plots provide a means of detecting out-of-step conditions and are useful to assess the magnitude and duration of post disturbance voltage dips and peak-to-peak voltage oscillations. The voltage plots also indicate system damping response and the expected bus voltage following the disturbance.

Bus Frequency

Bus frequency plots provide expected magnitude and duration of post-disturbance frequency swings as well as indicating possible over-frequency or under-frequency conditions.

3.3 Post-Transient Stability Methodology

The WECC/NERC standard was used to assess the adequacy of the study results. The post-Transient analysis related evaluation criteria used are:

Maximum voltage deviations allowed at all buses in the post-transient time frame will be 5% for N-1 and 10% for N-2 unless a lower standard has been previously adopted on selected buses. Southern California Edison (SCE) allows a lower standard of 7% post-transient voltage deviation for N-1 contingencies. Table 1 also provides a summary of the WECC/NERC post-transient deviation standard.

The post-transient reactive power margin analysis evaluated criteria used are:

- Minimum reactive power margin at any bus following N-1 outage is 100 Mvar
- Minimum reactive power margin at any bus following N-2 outage is 50 Mvar.

NERC and WECC Categories	Outage Frequency Associated with the Performance Category (outage/year)	Transient Voltage Dip Standard	Minimum Transient Frequency Standard	Post Transient Voltage Deviation Standard
A System normal	Not Applicable	Nothing in addition to NERC		
B One element out-of-service	□ 0.33	Not to exceed 25% at load buses or 30% at non-load buses. Not to exceed 20% for more than 20 cycles at load buses.	Not below 59.6Hz for 6 cycles or more at a load bus.	Not to exceed 5% at any bus.
C Two or more elements out-of-service	0.033 – 0.33	Not to exceed 30% at any bus. Not to exceed 20% for more than 40 cycles at load buses.	Not below 59.0Hz for 6 cycles or more at a load bus.	Not to exceed 10% at any bus.
D Extreme multiple element outages	< 0.033	Nothing in addition to NERC		

Table 1: WECC/NERC Post-Transient and Stability Analysis Evaluation Criteria

4 PEAK (HEAVY SUMMER) POWER FLOW FINDINGS

This section provides the results obtained by applying the assumptions and methodology. It illustrates the findings associated with the power flow analysis for the peak, heavy summer condition.

4.1 Peak (heavy summer) Pre and Post Project Cases

The pre-project case was used as a benchmark for the analysis. The post-Project case energized the North Brawley Project connected radial to the Calipatria – Park View 92 kV line and scheduled 50 MW of power for delivery to Southern California Edison.

As compared to the benchmark (pre-Project) case, the addition of the Project showed a few voltage and thermal loadings violations. These violations were noted in the base case under both, the single and double contingency scenarios. Below are violations attributable to the project as shown in the following tables. The impact to IID system losses was 2.5 MW. The primary direction of flow from the Project was towards the Park View substation.
The tables depict voltage deviation greater than 5% for N-1 conditions and greater than 10% for N-2 conditions.

N-1 Voltage Deviation Findings

Bus	Name	kV	Area	Zone	Outage	Pre	Post	Outage description
8378	SALTCITY	92	8	163	Line_8	0.0495	0.0509	Line AVE58-OASIS 92 Circuit 1

N-2 Voltage Deviation Findings

Bus	Name	kV	Area	Zone	Outage	Pre	Post	Outage description
NONE								

4.2 Peak (heavy summer) Loading Comparison tables

To ease the comparison between cases, the following tables show the loading on IID elements for all equipment in service (no outage, N-0) and for contingency conditions (N-1 and N-2). Overload percentages are based on the continuous rating for N-0 conditions and emergency ratings for contingency conditions. IID, for screening purposes, typically uses identical continuous and emergency ratings for its facilities. Typically 110% of continuous rating is an acceptable emergency rating.

4.2.1 Peak (heavy summer) N-0 Continuous Loading

No thermal loading violations were observed on any IID system element prior to simulating a contingency outage. This observation applies to both the pre-project and post-project summer cases.

4.2.2 Peak (heavy summer) N-1 Single Contingency Loading

The following table shows the element loadings for the most significantly overloaded elements and shows the impact the Project has on the loadings of elements due to outages. Please refer to Appendix B (Pre) and Appendix C (Post) for all the loading data.

From	Name	kV	To	Name	kV	ck	Type	MVA	Outage	Pre	Post	Outage description
8279	CVSUB	92	8808	CVSUB161	161	1	Tran	125	tran_96	95.30%	103.30%	Tran AVE58 92.00 to AV58 161.00 Circuit 1
8281	AVE58	92	8805	AV58	161	1	Tran	125	line_4	98.50%	101.60%	Line CVSUB 92.0 to JACKSON 92.0 Circuit 1
8281	AVE58	92	8805	AV58	161	1	Tran	125	line_8	97.40%	100.60%	Line AVE58 92.0 to OASIS 92.0 Circuit 1

4.2.3 Peak (heavy summer) N-2 Double Contingency Loading

The following table shows the element loadings for the most significantly overloaded elements and shows the impact the Project has on the loadings of elements due to outages. Please refer to Appendix B (Pre) and Appendix C (Post) for all the loading data.

From	Name	kV	To	Name	kV	ck	Type	MVA	Outage	Pre	Post	Outage description
NONE												

4.3 Peak (heavy summet) Element Flow

The following table highlights the magnitude (not direction) of flow (in MW) of various IID elements and WECC-defined paths under continuous conditions.

Element (unit of measure)	Summer Pre	Summer Post
EC 161/230 Transformer (MW)	6.6	0.2
AVE 58 161/92 Transformer Circuit 1 (MW)	109.4	113.3
NILAND 161/92 Transformer Circuit 1 (MW)	4.1	17.2
CV 92/161 Transformer Circuit 1 (MW)	44.9	52.3
IV 500/230 Transformer Circuit 1 (MW)	104.2	147.2
IV 500/230 Transformer Circuit 2 (MW)	23.4	33.1
Niland-Blythe 161 kV (MW)	-117.7	-109.1
Niland-Blythe 161 kV (MVAR)	34.3	30.8
IV-El Centro SW 230 kV (MW)	2.3	41.8
IV-El Centro SW 230 kV (MVAR)	30.8	27.6
Mirage-Ramon 230 kV (MW)	149.5	161.5
Mirage-Ramon 230 kV (MVAR)	-30.5	-20.3
Coachella-Devers 230 kV (MW)	58.0	67.3
Coachella-Devers 230 kV (MVAR)	-21.5	-23.0
Path 42 (MW)	207.2	228.4
Path 42 (MVAR)	-60.5	-65.2
Path 46 (MW)	6210.4	6241.5
Path 49 (MW)	4078.8	4034.4
SCIT (MW)	14218.3	14251.1

5 OFF-PEAK (LIGHT WINTER) POWER FLOW FINDINGS

This section provides the results obtained by applying the assumptions and methodology. It illustrates all findings associated with the power flow analysis for the winter, off-peak, conditions.

5.1 Off-peak (light winter) Pre and Post Project Cases

The pre-project case was used as a benchmark for the analysis. The post-Project case energized the North Brawley Project connected radial to the Calipatria – Park View 92 kV line and scheduled 50 MW of power for delivery to Southern California Edison

As compared to the benchmark (pre-Project) case, the addition of the Project showed a few voltage and thermal loadings violations. These violations were noted in the base case under both, the single and double contingency scenarios. The highlighted violations are attributable to the project as shown in the following tables. The impact to IID system losses was 5.0 MW. The primary direction of flow from the Project was towards the Park View substation.

The tables depict voltage deviation greater than 5% for N-1 conditions and greater than 10% for N-2 conditions.

N-1 Voltage Deviation Findings

Bus	Name	kV	Area	Zone	Outage	Pre	Post	Outage description
NONE								

N-2 Voltage Deviation Findings

Bus	Name	kV	Area	Zone	Outage	Pre	Post	Outage description
NONE								

5.2 Off-peak (light winter) Loading Comparison tables

To ease the comparison between cases, the following tables show the loading on IID elements for all equipment in service (no outage, N-0) and for contingency conditions (N-1 and N-2). Overload percentages are based on the continuous rating for N-0 conditions and emergency ratings for contingency conditions. IID, for screening purposes, typically uses identical continuous and emergency ratings for its facilities. Typically 110% of continuous rating is an acceptable emergency rating.

5.2.1 Off-peak (light winter) N-0 Continuous Loading

No thermal loading violations were observed on any IID system element prior to simulating a contingency outage. This observation applies to both the pre-project and post-project winter cases.

5.2.2 Off-peak (light winter) N-1 Single Contingency Loading

The following table shows the element loadings for the most significantly overloaded elements and shows the impact the Project has on the loadings of elements due to outages. Please refer to Appendix D (Pre) and Appendix E (Post) for all the loading data.

From	Name	kV	To	Name	kV	ck	Type	MVA	Outage	Pre	Post	Outage description
8331	ELCENTSW	161	8335	ELSTEAMP	92	1	Tran	125	line_42	77.8%	107.8%	Line ELCENTSW 230.0 to IMPRLVLY 230.0

5.2.3 Off-peak (light winter) N-2 Double Contingency Loading

The following table shows the element loadings for the most significantly overloaded elements and shows the impact the Project has on the loadings of elements due to outages. Please refer to Appendix D (Pre) and Appendix E (Post) for all the loading data.

From	Name	kV	To	Name	kV	ck	Type	MVA	Outage	Pre	Post	Outage description
NONE												

5.3 Off-peak (light winter) Element Flow

The following table highlights the magnitude of flow (in MW) of various IID elements and WECC-defined paths under continuous conditions.

Element (unit of measure)	Winter Pre	Winter Post
EC 161/230 Transformer (MW)	23.4	29.8
AVE 58 161/92 Transformer Circuit 1 (MW)	29.3	38.1
NILAND 161/92 Transformer Circuit 1 (MW)	22.1	40.1
CV 92/161 Transformer Circuit 1 (MW)	22.7	30.2
IV 500/230 Transformer Circuit 1 (MW)	190.5	222.0
IV 500/230 Transformer Circuit 2 (MW)	42.7	49.7
Niland-Blythe 161 kV (MW)	8.9	20.0
Niland-Blythe 161 kV (MVAR)	0.5	3.6
IV-El Centro SW 230 kV (MW)	164.5	208.4
IV-El Centro SW 230 kV (MVAR)	14.3	-1.2
Mirage-Ramon 230 kV (MW)	314.9	331.7
Mirage-Ramon 230 kV (MVAR)	18.1	-14.1
Coachella-Devers 230 kV (MW)	246.0	259.8
Coachella-Devers 230 kV (MVAR)	21.6	32.2
Path 42 (MW)	557.2	587.4
Path 42 (MVAR)	-13.7	-2.3
Path 46 (MW)	6733.1	6782.8
Path 49 (MW)	5185.8	5142.4
SCIT (MW)	5979.9	6030.8

6 TRANSIENT STABILITY FINDINGS

Transient stability analysis was performed to assess impacts pertaining to the North Brawley generators. Transient voltage dips and first swing angular stability were studied to identify any stability issues. Stability analysis was performed using the heavy summer and light winter base cases. Six normal fault clearing and six backup fault clearing cases (**Appendix D**) were selected very close to the proposed generator. Monitored parameters included rotor angles, terminal or bus voltage and frequency profiles. The study found that voltage dips are within acceptable limits and the rotor angles damp adequately followed by a disturbance in the system.

6.1 Peak (heavy summer) cases

The following outages were simulated and monitored for impact at the local project bus (North Brawley) and selected regional busses for the Pre-Project and Post-Project:

Outage	Summer Pre-Project	Summer Post-Project
No Outage	Stable	Stable
Three phase fault at bus 8963 opens: NTHBRTP2 92/13.2 transformer	Not In service	Stable
Three phase fault at bus 8967 opens: NTHBRTP2 92/13.2 GPNB01and NTHBRTP2 92/13.2 GPNB02 transformers	Not in service	Stable
Three phase fault at bus 8962 opens: NTHBRTP2 92/13.2 GPNB01, NTHBRTP2 92/13.2 GPNB02, NTHBRTP3 92/13.2 GPNB03 and NTHBRTP3 92/13.2 GPNB04 transformers plus NWSWYRD-NTHBRTP2 and NWSWYRD-NTHBRTP3 lines	Not in service	Stable
Three phase fault at bus 8970 opens: NTHBRTP2 92/13.2 GPNB01, NTHBRTP2 92/13.2 GPNB02, NTHBRTP3 92/13.2 GPNB03 and NTHBRTP3 92/13.2 GPNB04 transformers plus NWSWYRD-NTHBRTP2, NWSWYRD-NTHBRTP3, NTAP-PARKVEW and NTAP-CALIPAT lines (Entire project)	Not in service	Stable
Three phase fault at bus 8740 opens: PARKVIEW-BRAW92	Stable	Stable
Three phase fault at bus 8697 opens: CALIPAT-CALTP2	Stable	Stable

6.2Off-peak (light winter) Cases

Outage	Winter Pre-Project	Winter Post-Project
No Outage	Stable	Stable
Three phase fault at bus 8963 opens: NTHBRTP2 92/13.2 transformer	Not in service	Stable
Three phase fault at bus 8967 opens: NTHBRTP2 92/13.2 GPNB01and NTHBRTP2 92/13.2 GPNB02 transformers	Not in service	Stable
Three phase fault at bus 8962 opens: NTHBRTP2 92/13.2 GPNB01, NTHBRTP2 92/13.2 GPNB02, NTHBRTP3 92/13.2 GPNB03 and NTHBRTP3 92/13.2 GPNB04 transformers plus NWSWYRD-NTHBRTP2 and NWSWYRD-NTHBRTP3 lines	Not in service	Stable
Three phase fault at bus 8970 opens: NTHBRTP2 92/13.2 GPNB01, NTHBRTP2 92/13.2 GPNB02, NTHBRTP3 92/13.2 GPNB03 and NTHBRTP3 92/13.2 GPNB04 transformers plus NWSWYRD-NTHBRTP2, NWSWYRD-NTHBRTP3, NTAP-PARKVEW and NTAP-CALIPAT lines (Entire project)	Not in service	Stable
Three phase fault at bus 8740 opens: PARKVIEW-BRAW92	Stable	Stable
Three phase fault at bus 8697 opens: CALIPAT-CALTP2	Stable	Stable

7 SHORT CIRCUIT FINDINGS

A short circuit study and breaker capability analysis has been performed by PDS consulting, PLC. to determine the impact of the additional North Brawley generation facility to the IID Energy transmission system. The analysis found minimal impacts to the interrupting capability of the IID Energy transmission system due to the addition of the North Brawley generation facility. The analysis also found that the interrupting capability of two of the breakers, H40 and H50, at the Euclid Substation will be exceeded (the pre-Project fault levels were at 99% of the interrupting capability while the post-Project fault level was found to be 101%), however IID Energy can re-schedule to an earlier date a project to replace the affected equipment with sufficient interrupting capacity prior to the in-service date of the North Brawley project.

The results of the study also indicated that there are a few fault interrupting devices on the IID Energy system which have fault current exposure levels near of their respective interrupting ratings (specifically Imperial Valley 230kV and El Centro 92kV). However, these interrupting rating concerns have been identified as pre-existing conditions and not directly related to the North Brawley generation project.

8 SENSITIVITY SHORT CIRCUIT FINDINGS

A sensitivity analysis of to the original short circuit study and breaker capability analysis has been performed per project owner request to determine the impact of the North Brawley project phase A (6 generators in the amount of 12.5MW each) connected to the IID Energy transmission system.
The analysis found that the fault duty at the Euclid 92 kV substation will exceed the interrupting capability of two of the breakers, H40 and H50, at this substation (the pre-Project fault levels were at 98.4% of the interrupting capability while the post-Project fault level was found to be 100.04%). Even though these short circuit violations are marginal, the IID standard requires the replacement of these breakers once they reach their interrupting capability.

9 POST-TRANSIENT STABILITY FINDINGS

Imperial Irrigation District (IID) has contracted PDS consulting, PLC (PDS) to perform a post-transient power flow analysis including reactive power margin test for the integration of the North Brawley Generation Project to the IID energy system. The scope of the post-transient analysis is to determine the impact caused solely by the addition the North Brawley generation project to the IID Energy transmission system during the post-transient time frame.

9.1 Post-transient Power Flow Analysis

Post-transient power flow analysis was performed on both the pre-project and post-project base cases for the 2010 heavy summer and 2010 light winter operating conditions. The two base cases were used to simulate the impact of the North Brawley Project during single (N-1) as well as multiple contingencies. The N-1 and selected multiple contingencies simulated included:

- All single (92-230 kV) transmission circuit outages within the vicinity of the project
- All single transformer outages within the vicinity of the project
- Selected outages of double circuit tower lines (92-230 kV) within the vicinity of the project.

The contingency lists for the post-transient analysis can be found in Appendix C.

The WECC/NERC standard was used to assess the adequacy of the study results. The post-transient analysis related evaluation criteria used are:

- Maximum voltage deviations allowed at all buses in the post-transient time frame will be 5% for N-1 and 10% for N-2 unless a lower standard has been previously adopted on selected buses. Southern California Edison (SCE) allows a lower standard of 7% post-transient voltage deviation for N-1 contingencies. Table 1 also provides a summary of the WECC/NERC post-transient deviation standard.

9.2 Post-transient Reactive Power Margin

Post-transient reactive power margin analysis was performed on selected buses in the IID transmission system following selected critical outages. This analysis was performed using the 2010 pre- and post-project base cases. The list outages simulated and the buses monitored are provided below.

- N. Laquinta-Avenue42 92 kV line outage
- Imperial Valley-Miguel 500 kV line outage
- Palo Verde-Devers 500 kV line outage
- N. Gila-Imperial Valley 500 kV line outage
- Imperial Valley-Elcentro 230 kV line outage
- EL.STM2 and REPU2 generator outages

The monitored buses included:

- Avenue 58 161 kV
- Coachella Valley 161 kV
- N. Laquinta 92 kV
- Coachella Valley 92 kV
- Midway 92 kV
- Niland 92 kV
- Elcentro 92 kV
- Calexico 92 kV
- Pilot Knob 92 kV
- Dixieland 92 kV

The post-transient reactive power margin analysis evaluated criteria used are:

- Minimum reactive power margin at any bus following N-1 outage is 100 Mvar
- Minimum reactive power margin at any bus following N-2 outage is 50 Mvar.

Table 1: WECC/NERC Post-Transient and Stability Analysis Evaluation Criteria

NERC and WECC Categories	Outage Frequency Associated with the Performance Category (outage/year)	Transient Voltage Dip Standard	Minimum Transient Frequency Standard	Post Transient Voltage Deviation Standard
A System normal	Not Applicable	Nothing in addition to NERC		
B One element out-of-service	≥ 0.33	Not to exceed 25% at load buses or 30% at non-load buses. Not to exceed 20% for more than 20 cycles at load buses.	Not below 59.6Hz for 6 cycles or more at a load bus.	Not to exceed 5% at any bus.
C Two or more elements out-of-service	0.033 – 0.33	Not to exceed 30% at any bus. Not to exceed 20% for more than 40 cycles at load buses.	Not below 59.0Hz for 6 cycles or more at a load bus.	Not to exceed 10% at any bus.
D Extreme multiple-element outages	< 0.033	Nothing in addition to NERC		

9.3 POST TRANSIENT POWER FLOW STUDY RESULTS

Post-transient power flow solutions were achieved for most of the outages studied using both the 2010 heavy summer and 2010 light winter base cases. Two multiple outages however did not result in post-transient solution using both the 2010 heavy summer and 2010 light winter pre- and post-project base cases. These outages are:

- Coachella-Devers and Coachella-Ramon 230 kV lines (without RAS)
- Ramon-Mirage and Coachella-Devers 230 kV lines (without RAS)

Post-transient power flow solutions were however achieved by implementing the RAS associated with the above outages. In particular, to achieve a post-transient power flow solution following the simultaneous outages of Coachella-Devers and Coachella-Ramon 230 kV lines, about 120 MW of generation were tripped at the collector system connected to Midway 92 kV substation.

Several bus voltage deviation violations were recorded following selected N-1 outages using the 2010 heavy summer pre- and post-project base cases. However, only one bus voltage deviation violation at the Deseret Shores 92 kV bus was due to the addition of the North Brawley Project.

The following sections provide details of the post-transient power flow findings for each of the operating condition evaluated.

9.3.1 Heavy Summer 2010 Base Case

A summary of the post-transient power flow study results is provided in Appendix A. Key post-transient power flow findings from the studies performed using the 2010 heavy summer base case are:

- Post-transient power flow solutions were obtained for all the N-1 outages simulated using both the pre- and post-project base cases.
- Several bus voltage deviation violations were recorded following selected N-1 outages during the 2010 heavy summer operating condition. The majority of the bus voltage deviation violations recorded were not due to the addition of the North Brawley Project.
- Coachella-Devers and Coachella-Ramon 230 kV lines (without RAS) did not result in post-transient power flow solution using both pre- and post-project base cases. Post-transient solution was obtained by tripping up to 120 MW of generation connected to the Midway 92 kV substation collector systems following the outages.
- Coachella-Devers and Ramon-Mirage 230 kV lines (without RAS) did not result in post-transient power flow solution using both pre- and post-project base cases. Post-transient solution was obtained by the implementation of the Path 42 RAS (416.2 MW of IID's internal generation reduction)
- No post-transient bus voltage deviation violations were recorded following any of the multiple outages simulated.

9.3.2 Light Winter 2010 Base Case

Post- transient power flow solutions were obtained for all the N-1 outages. Two multiple outages did not result in post-transient power flow solution without RAS:

- Coachella-Devers and Coachella-Ramon 230 kV lines (without RAS)
- Ramon-Mirage and Coachella-Devers 230 kV lines (without RAS)

Solutions were obtained with implementation of the RAS associated with the outages. No bus voltage deviation violation was recorded for all the outages studied using the 2010 light autumn base case.

9.4 POST-TRANSIENT REACTIVE POWER MARGIN STUDY RESULTS

A summary of the post-transient reactive power margin analysis can be found at Appendix B. Positive reactive power margins were obtained at all the buses monitored following the selected outages.

The addition of the North Brawley Project did not impact the existing reactive power margins at the selected buses for all the outages with the exception of the Imperial Valley –Miguel 500 kV line outage. An outage of the Imperial Valley-Miguel 500 kV line caused the reactive power margin at five (5) buses to decrease up to 4 MVar. In particular, the addition of the North Brawley Project and the subsequent outage of the Imperial Valley –Miguel 500 kV line caused the reactive power margin at North La Quinta 92 kV bus to decrease from 103 Mvar to 99 Mvar.

10. CONCLUSIONS

During the development of the North Brawley System Impact Study the IID System Planning team found the following system impacts attributable solely to the interconnection of the 150 MW project. In addition, the North Brawley Plant will need to participate in coordination with the IID System Operator in mitigating other system violations not solely attributable to this Project in order to maintain the IID System reliability:

Heavy Summer (Pre & Post-Project Cases)

N-1 Condition:

- Thermal Rating Violations
  The outage of Coachella Valley-Jackson (CW) 92 kV Line overloaded the Avenue 58 161/92 kV Bank #1 above its normal rating of 125 MVA (101.6%) while having the Project generating at 150 MW.

  Two alternatives were selected to mitigate the violation; a) A temporary solution would be to implement a System Operating Procedure (SOP) which would require reduction of the North Brawley MW generation output up to the point that the loading on the Ave.58 Bank #1 becomes below their normal rating. The first priority for reduction will be on the 50 MW (Export) scheduled to SCE, the second priority would be on the 50 MW serving IID load. b) A permanent solution to avoid affecting the Project MW output is, to replace the Ave. 58 Bank #1 with a higher capacity bank. This would represent to set ahead the in service date for a project to replace such bank with a new 300 MVA bank.

  The outage of Avenue 58-Oasis (R) 92 kV Line overloaded the Avenue 58 161/92 kV Bank #1 above its normal rating of 125 MVA (100.6%) while having the Project generating at 150 MW.
  Two alternatives were selected to mitigate the violation; a) A temporary solution would be to implement an Operating Procedure which would require reduction of the North Brawley MW generation output up to the point that the loading on these Ave.58 Bank #1 becomes below their normal rating. The first priority for reduction will be on the 50 MW (Export) scheduled to SCE, the second priority would be on the 50 MW serving IID load. b) A permanent solution to avoid affecting the Project MW output is, to replace the Ave. 58 Bank #1 with a higher capacity bank. This would represent to set ahead the in service date for a project to replace such bank with a new 300 MVA bank.

  The outage of Avenue 58 161/92 kV Transformer Bank #1 overloaded the Coachella Valley 161/92 kV Transformer Bank #3 above its normal rating of 125 MVA (103.3%) while having the Project generating at 150 MW.
  Two alternatives were selected to mitigate the violation; a) A temporary solution would be to implement an Operating Procedure which would require reduction of the North Brawley MW generation output up to the point that the loading on these CV Bank #3 becomes below their normal rating. The first priority for reduction will be on the 50 MW (Export) scheduled to SCE, the second priority would be on the 50 MW serving IID load. b) A permanent solution to avoid affecting the Project MW output is, to replace the Coachella Valley 161/92 kV Transformer Bank #3 with a higher capacity bank.

- Voltage Deviation Violations
  The outage of Avenue 58-Oasis 92 kV (R) Line created a voltage deviation violation of +5.1% at the Salton City 92 kV bus while having the Project generating at 150 MW.

Two alternatives were selected to mitigate the violation; a) A temporary solution would be to implement an Operating Procedure which would include adjustment of the North Brawley MVAR generation output up to the point that the Salton City 92 kV bus voltage become within a normal range of 0.95-1.05 p.u. or, b) A permanent mitigating solution would be to implement an Special Protection Scheme (SPS) which would trip a 4.8 MVAR capacitor bank of Desert Shores substation with the outage of Avenue 58-Oasis 92 kV (R) Line, simultaneously. In reality, the extremes of the "R" Line to trip are at Avenue 58 and Desert Shores Substations.

N-2 Condition:

- Thermal Rating Violations
  No Thermal Rating violations attributable to the Project were found in the IID transmission system

- Voltage Deviation Violations
  No Voltage Deviation violations attributable to the Project were found in the IID transmission system. Also, in order to eliminate pre-existing voltage issues in the Coachella Valley zone due to the same outage, IID will need to continue implementing its Transmission Expansion Plan to mitigate a few pre-existing voltage deviation violations.

Light Winter (Pre & Post-Project Cases)

N-1 Condition:

- Thermal Rating Violations
  The outage of El Centro-Imperial Valley 230kV (S) Line overloaded the El Centro 161/92 kV Transformer Bank #2 to 107.8% of its normal rating of 125 MVA while having the Project generating at 150 MW.
  Two alternatives were selected to mitigate the violation; a) A temporary solution would be to implement an Operating Procedure which will require reduction of the North Brawley MW generation output up to the point that the loading on the El Centro 161/92 kV Transformer Bank #2 becomes below their normal rating. The first priority for reduction will be on the 50 MW (Export) scheduled to SCE, the second priority would be on the 50 MW serving IID load. b) A permanent solution to avoid affecting the Project MW output is, to upgrade of the EC Bank #2 to a larger capacity bank.

- Voltage Deviation Violations
  No Voltage Deviation violations attributable to the Project were found in the IID transmission system.

N-2 Condition:

- Thermal Rating Violations
  No Thermal Rating violations attributable to the Project were found in the IID transmission system.
- Voltage Deviation Violations
  No Voltage Deviation violations attributable to the Project were found in the IID transmission system.

In summary, the mitigations for thermal rating and/or voltage deviation violations attributable to the Project will require to prepare and implement a few System Operating Procedures (SOPs) to resolve temporarily the violations, however in order to resolve permanently those violations, it is recommended to implement the described system upgrades before the in-service date of North Brawley project besides continuing with the implementation of the IID Transmission Expansion Plan.

The revision to the RAS description is necessary to include 50% of the net North Brawley plant output into the scheme which represent 50 MW since the outage of Path 42 (Ramon-Mirage & CV-Devers 230 kV) together with the RAS creates a voltage deviation violation at a few buses in the IID system. With the addition of the North Brawley project, the RAS will also include the simultaneous tripping of the Midway 92kV and Highline 92 kV 24.5 MVAR Capacitor Banks with the RAS operation. This is a task required within the SOPs preparation since this project exacerbates the operating condition for certain contingencies that overloaded Path 42. This would represent additional studies to be performed by IID to determine and document the sequence of mitigating actions to be taken by the System and Plant Operators when any of the mentioned critical outages occurs. This additional study work was not part of the scope of work for this system impact study.

In addition, pre-existing thermal and voltage violations under outage condition not included in this report were considered not attributable to the Project and are being addressed by IID in other planning forums.

This System Impact Study considered that there were no schedule capabilities available to deliver the North Brawley generation power to SCE through path 42, since as of today the scheduled capacity of this path is fully subscribed. It will require a Path 42 Rating Upgrade Study among the SCE and IID.

Transient Stability

Stability analysis indicated that the addition of the Project does not adversely impact the stability response of the system. On stability outages of the generator transformers, it has been noted that both, the generator and transformer must be tripped simultaneously. Generation tripping for the loss of the step-up transformer is a common practice and does not represent any additional problem to the IID system.

Short Circuit

The analysis found minimal impacts to the interrupting capability of the IID Energy transmission system due to the addition of the North Brawley generation facility. The analysis also found that the interrupting capability of two of the breakers, H40 and H50, at the Euclid Substation will be exceeded (the pre-Project fault levels were at 99% of the interrupting capability while the post-Project fault level was found to be 101%), however IID Energy can re-schedule to an earlier date a project to replace the affected equipment with sufficient interrupting capacity prior to the in-service date of the North Brawley project. The replacement of the two breakers with higher interrupting capability is required before connecting the project to the IID system.

Sensitivity Short Circuit

A sensitivity analysis of to the original short circuit study and breaker capability analysis has been performed per project owner request to determine the impact of the North Brawley project phase A (6 generators in the amount of 12.5MW each) connected to the IID Energy transmission system.

The analysis found that the fault duty at the Euclid 92 kV substation will exceed the interrupting capability of two of the breakers, H40 and H50, at this substation (the pre-Project fault levels were at 98.4% of the

interrupting capability while the post-Project fault level was found to be 100.04%). Even though these short circuit violations are marginal, the IID standard requires the replacement of these breakers once they reach their interrupting capability.

Post-Transient Stability Analysis

The addition of the North Brawley Project did not impact the existing reactive power margins at selected buses for all the outage simulation studied with the exception of the Imperial Valley –Miguel 500 kV line outage. An outage of the Imperial Valley-Miguel 500 kV line caused the reactive power margin at five (5) IID buses to decrease up to 4 MVAR. In particular, the addition of the North Brawley Project and the subsequent outage of the Imperial Valley –Miguel 500 kV line caused the reactive power margin at N. LAQUITA 92 kV bus to decrease from 103 Mvar to 99 Mvar, this does not represent a limitation and does not required a mitigation.