Interconnection Evaluation Study – Project G243

(120MW Coal unit at Estill County, KY)

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1. Executive Summary

MISO received the generator interconnection request for project G243, MISO Queue # 37384-01 from an Independent Power Producer on August 16, 2002. The request was for an interconnection of 120 MW coal unit to LG&E ENERGY's transmission system in Estill County KY, with a target in-service date in April 2006. Interconnection point for the new generator is LG&E ENERGY's West Irvine 161kV substation. MISO started Interconnection Evaluation Study for this project (here in after referred to as 'G243') in May 2003. This report evaluates the impact of the new unit on the transmission system of LG&E ENERGY and EKPC.

Study indicated that the new interconnection at West Irvine would overload one of the outlet facilities under N-1 contingency. Results showed that for an outage of the 161kV branch from West Irvine to West Irvine tap; West Irvine 161/69kV transformer is overloaded to 215%. Following are the upgrade options proposed to alleviate the overloading of the transformer:

Option 1: Double circuit the 161kV line from West Irvine to West Irvine tap and upgrade the West Irvine 161/69 kV transformer
Total cost (2003 cost based on rule of thumb estimate): **$3.5 millions**

Option 2: Double circuit the 161kV line from West Irvine to West Irvine tap and add a parallel 161/69kV transformer at West Irvine
Total cost (2003 cost based on rule of thumb estimate): **$3.8 millions**

Results show under the assumptions made in this study, the system is capable of handling 120 MW of injection after implementing either of the upgrade options listed above. According to Section 2.3 in Attachment R of MISO OATT, which says that an Interconnection Study is not applicable to the delivery portion of transmission service, the results may vary in the delivery study of this generator, because of the system conditions and prior reservations. N-2 analysis did not show any cascading outage problem caused by the proposed interconnection.

Short circuit analysis indicated the need to replace the three existing 69 kV breakers at West Irvine. Cost to replace these three breakers was estimated as **$0.3 million** (2003 cost based on Rule of thumb estimate). Short Circuit Results didn't show any impact on the breakers in EKPC system.

Transient Stability Analysis was performed by simulating 3-phase faults near the point of interconnection. There were no identified significant impacts on the stability of other units in the area due to interconnection of the proposed generator. However, the protection scheme at West Irvine will require breaker-failure protection to maintain clearing times within the critical values identified in this study. Any additional cost associated with such a protection scheme, will be determined in the Facility Study.

Based on the Evaluation Study Results, more detailed and accurate estimate of the cost to implement one of these system upgrades will be done in the Facility Study under the MISO process of Generation Interconnection. Construction schedule related to the interconnection of the proposed generator will also be determined in the Facility Study.

2. Introduction

2.1 Project Description

The project is based on a waste coal fueled circulating fluidized bed boiler powering a steam turbine generator of 120 MW in Estill County, Kentucky. It was entered in the MISO Generation Interconnection queue on Aug.16, 2002. The project, designated as MISO project G243, queue # 37384-01, has an in-service date of April 2006 and the interconnection point is the West Irvine 161 kV substation in LG&E ENERGY's transmission system. The plant site is located about 1.9 miles North East of West Irvine substation. The interconnection is to be achieved by building a new 161 kV line from the plant site to the West Irvine substation and connecting the generator to the 161kV facilities at West Irvine. Network representation around the point of interconnection is shown in Figure (2.1)†.

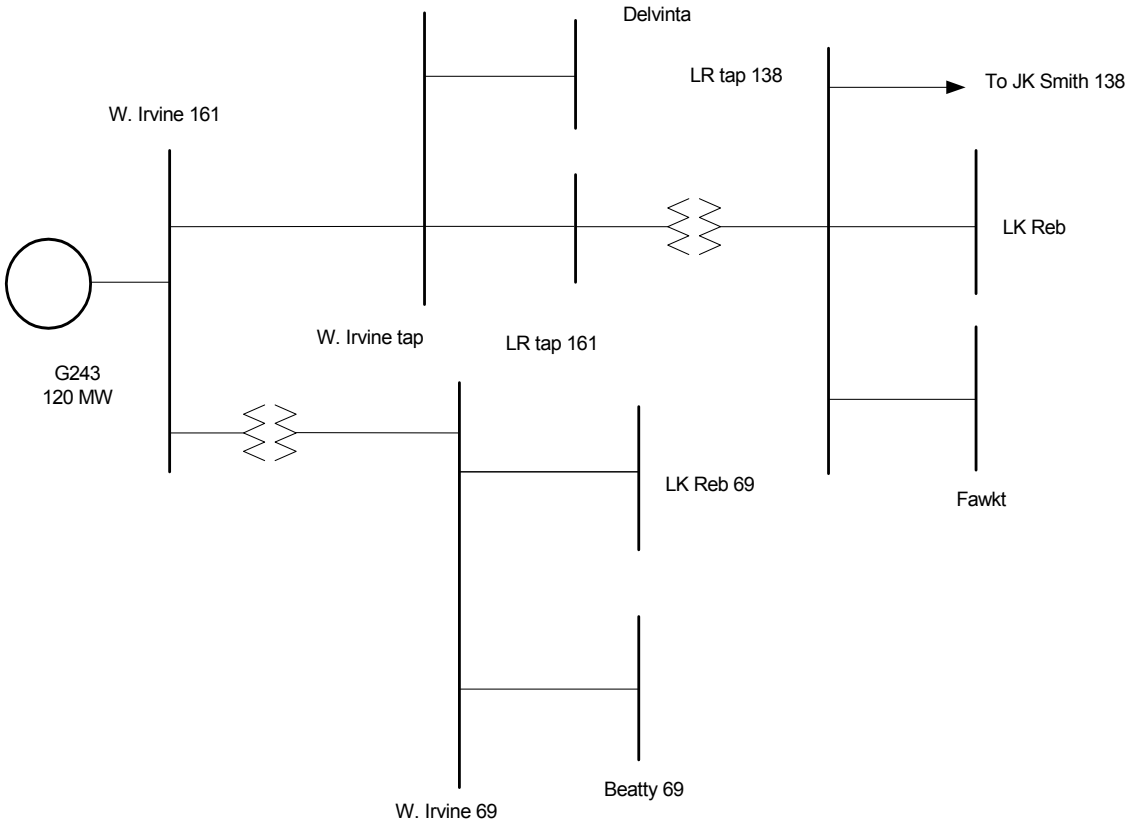


Figure (2.1) Network representation near the point of interconnection

†A piece of network near the point of interconnection have been drawn just to show the relative location of the generator

2.2 Study Process

The MISO process of Generation Interconnection does not assure delivery from the plant. A customer has to apply for a Transmission Service Request on the MISO OASIS, to deliver power from the plant. This study evaluates the impact of the proposed generation addition on the reliability of the transmission system of LG&E ENERGY and EKPC.

MISO Interconnection Evaluation Studies are divided into two phases. Phase 1 consists of Load flow Analysis; phase 2 is Stability and Short Circuit Analysis. The customer has an option to have either a sequential study or a concurrent study. In sequential study, phase 1 and phase 2 are performed sequentially and two separate reports are published while in the concurrent study, phase 1 and 2 are studied together and a combined report is presented at the end of the study. This report is for a concurrent study, as requested by the customer.

The study presents the outcome of Load flow, Short Circuit and Transient Stability analysis. Load flow work consists of N-1, N-2 and FCITC (first contingency incremental transfer capacity) analysis. The purpose of Load flow is to give the customer an indication of the thermal problems when delivering power out from the plant. Short circuit analysis is done to determine the impact of the new generator on the short circuit current capability of the circuit breakers at the interconnection point and at the other nearby stations affected by the new generator. Stability study determines the ability of the proposed generator to remain in synchronism after a disturbance in the system. It also evaluates the impact of the new generation on the system stability in that region.

Project G243 has an in-service date of April 2006. Project G218 (750MW in Trimble County), which is just above G243 in MISO Generator Interconnection queue, has an in-service date of January 2007. Project G218 has some system upgrades associated with it. In the MISO study process, all higher queued projects are included in the study. If the project G243 goes in-service before the system improvements of G218 are made, there is a need to ensure that no additional constraints would exist with 120MW of generation at Estill county even without the system upgrades of project G218. Therefore, additional scenarios have been run to identify if G243 requires any upgrades until G218 connects to the grid.

2.3 Ad hoc Study Group

In the MISO process of interconnection studies, an ad hoc group is formed before starting the study. Usually the ad hoc study group includes representatives from MISO, the project developer, consultant performing the study, direct connect transmission owner and neighboring transmission owner potentially affected by the new generator. Ad hoc group members are invited to attend all the meeting/conference call related to the project. Intermediate study results are discussed among the group members and suggestions are implemented whenever possible. Ad hoc group for project G243 consists of the

developer, LG&E ENERGY, EKPC, and MISO. An email distribution list was also formed to share the progress reports, meeting minutes, and the email conversations regarding the project. Besides the ad hoc group members, TVA and AEP were also included in this list.

3. Study Methodology

3.1 Load Flow Analysis

The purpose of Load flow analysis is to give the customer an indication of the thermal overloading problems when delivering power out from the plant. Sink for the new generator has not been determined yet. Two scenarios were simulated in load flow analysis:

i) Sending 120MW from generator to the North
ii) Sending 120MW from generator to the South

N-1, N-2 and FCITC analysis were performed using PTI's MUST 5.0. For contingency analysis, North case was developed by dispatching the proposed generator to MECS control area; similarly South case was developed by sending the power from Generator to SOCO control area.

Base Case: 2001 series 2007 summer peak NERC MMWG base case was used for the load flow analysis of project G243. Based on the suggestions of the ad hoc group, the model was revised by:

- Including the 69kV detail near the West Irvine substation (presented in Appendix D).
- Updating the EKPC area details in the model (presented in Appendix D).

Analysis were repeated without project G218 and associated upgrades to see if any additional upgrades are required for this project to connect before G218. Additional cases were developed to simulate LG&E ENERGY's maximum and minimum generation dispatch scenarios at its Brown generation site, which is in this area. N-1 analysis was repeated on these two scenarios. Simulations were run with and without including the new generator in the model and the results were compared to see the impact caused by the new generator.

Load flow analysis showed that system upgrades are required for the interconnection of the proposed generator. Two upgrade options were identified by the ad hoc study group. Analysis was repeated with these upgrades in the model. Study case for Short circuit and Stability analysis was developed by including these upgrade options in the model.

3.2 Short Circuit Analysis

Short circuit analysis was performed to find out the increase in fault current due to the new generator. LG&E ENERGY's in-house model was used for the analysis. Following are the changes made to this model:

- Project G031, 95MW in Livingston County, KY was added
- Project G032, 95MW in Hancock County, KY was added.
- Trimble county units 2,7,8,9,10 and associated upgrades were added

Three phase fault and Single line to ground faults were simulated at all the busses 69kV and above. Simulations were run with and without the new generator in the model. Incremental change in the fault current due to the proposed generator was evaluated under both the upgrade options. PTI's PSSE version 28 was used to perform the Short Circuit Study.

3.3 Transient Stability Analysis

Stability analysis is done to determine the ability of the proposed generator to remain in synchronism after a disturbance in the system. It also evaluates the impact of the new generator on the system stability in that region. Base case for this study was developed starting from SIR (Southern Indiana Restudy) base case. This case was developed from 2001 series 2007 summer peak case for ECAR region. MISO added the details of the projects in Indiana-Kentucky region to this model in the Southern Indiana Restudy last year. PTI's PSSE version 28 was used for transient stability analysis. Following are the projects added to SIR base case in order to get a base case for project G243:

- Project G031, 95MW in Livingston county, KY was added
- Project G032, 95MW in Hancock county KY was added
- Project G084, 320MW in Lawrence county, IN was added
- Project G107, 750MW in BREC area was added
- System upgrades associated with above project were modeled
- Project G218, 750MW in Trimble county, KY was added
- System upgrades associated with G218 were modeled

Following are the projects dropped out of MISO generation interconnection queue between the kick off meeting for this project and starting the simulations:

- Project G053, 260MW in Posey county, IN
- Project G108, 1000MW in Henderson county, KY.

In the MISO process of Interconnection Evaluation Study, all the higher queued projects are modeled in the base case. Since this project is located adjacent to the transmission system of EKPC, MISO coordinated this study with them. EKPC reviewed the representation of their area in the model and submitted some network related changes in their system. While modeling projects in EKPC's area, MISO applied the same criteria and the generators having queue date prior to G243, were added to the base case. As a result, following projects were removed from EKPC's area:

- JK Smith CTs unit 6 and 7
- JK Smith CTs unit 8,9, and 10.

Three phase faults with normal clearing and with breaker failure were simulated near the point of interconnection. A list of all the fault scenarios run for this study has been presented in Table (4.13). Voltage and rotor angle were monitored on all the generators in LG&E ENERGY and EKPC area.

4. Results and Analysis

4.1 Load Flow

Non-linear N-1, N-2, and FCITC analysis were performed using PTI's MUST 5.0. Sink for the new generator has not been determined yet. On the recommendation of the customer, two scenarios were simulated in the load flow analysis- dispatching 120MW towards the North and then towards the South. Simulations were run with and without including the new generator in Estill County. A comparison was done using Microsoft Access database, to determine the impact of new generator on the transmission system.

N-1 Analysis: All the elements 50 kV and above in LG&E ENERGY and EKPC areas were selected in monitored and contingency element list. By comparing the overloading level before and after including G243, violations on one element was identified as being significantly affected by G243. All the elements where either (1) the overload difference is greater than 10%; or (2) the overload only occurs with G243, have been reported here. Table (4.1) and (4.2) show the results of N-1 Analysis for North and South case respectively.

Table (4.1) N-1 results when the generator dispatched to the North

Element	Worst overloading without G243	Worst overloading with G243	Rating (MVA)	Contingency
27044 11W IRVI 161 27292 11W IRVI69.0 1 TR	N/A	215.2%	56	27044 11W IRVI 161 27045 11WI TAP 161 1

Table (4.2) N-1 results when the generator dispatched to the South

Element	Worst overloading without G243	Worst overloading with G243	Rating (MVA)	Contingency
27044 11W IRVI 161 27292 11W IRVI69.0 1 TR	N/A	215.2%	56	27044 11W IRVI 161 27045 11WI TAP 161 1

Case North: 120MW was dispatched to Michigan area
Case South: 120MW was dispatched to Southern Cos.

Results of N-1 analysis show that one of the injection facilities is overloaded because of the new generator at West Irvine substation. There are two outlets at the interconnection point and when one facility is out of service, all the power flows through

the 161kV/69kV transformer, causing it to be overloaded. This situation has been shown in Figure (4.1) †

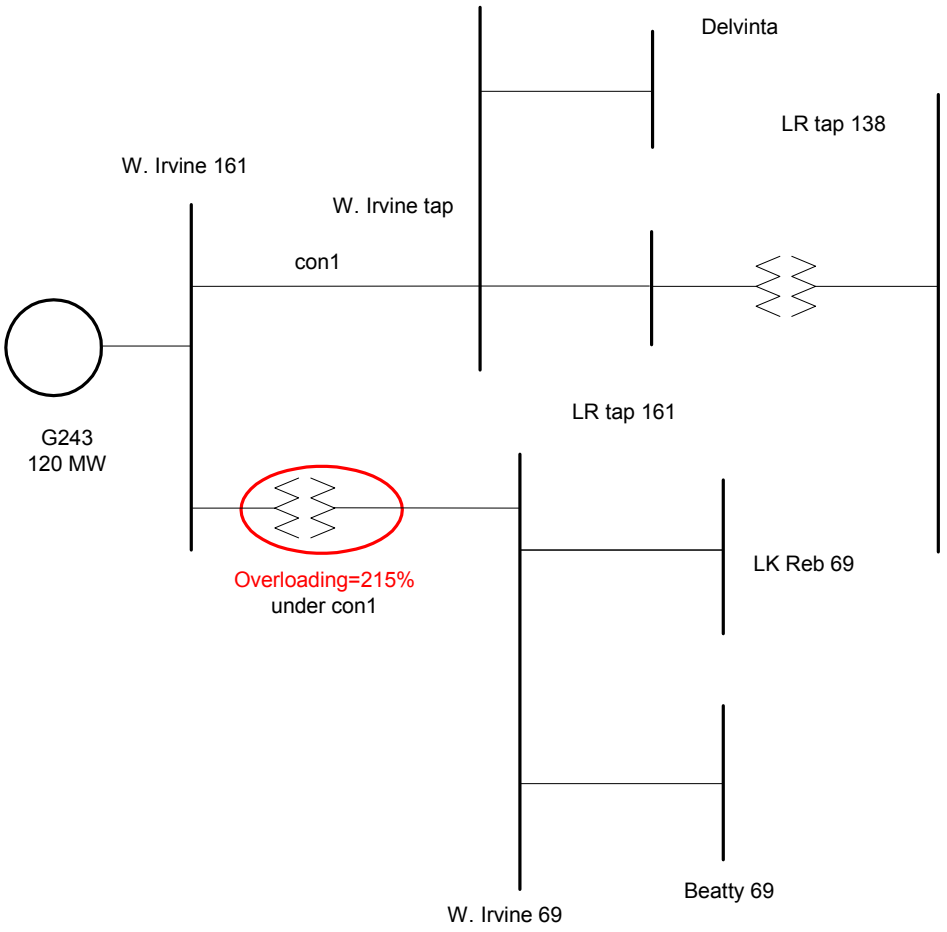


Figure (4.1) overloading at the injection facilities

†A piece of network near the point of interconnection have been drawn just to show the relative location of the generator

***N-2 Analysis*:** A full DC N-2 contingency analysis was performed, taking two elements (100kV and above) out of service simultaneously. From the results of the DC analysis, 2683 contingencies were selected as the most severe (severity index[1] > 500), and

[1] This is defined and calculated by PTI MUST software. In DC mode, Overload Severity Index provides the measure of the severity of a contingency based on post-contingency overloads and loss of load and generation:

$SI = \Sigma_I ((P_i - Plim_i)^{**}2 + LossofLoad^{**}2 + LossofGenerator^{**}2)$

where:

Pi = Post contingent branch flow.
Plim = Contingent branch rating.
LossOfLoad = Lost load.
LossOfGe n = Lost generation.

then an AC analysis was performed on those selected doubles. Table (4.3) and (4.4) show the elements significantly affected by G243, in North and South case respectively.

FCITC Analysis: In the FCITC (First Contingency Incremental Transfer Capability) analysis, transfers were simulated from the generator to the North and the generator to the South. Subsystem North consists of control areas in and north of Kentucky. Subsystem South consists of control areas in and south of Kentucky. This analysis shows how much power can be transferred under first contingency, without hitting any constraint. Results show that only 50 MW (approx.) can be transferred from the proposed generator, without making any system improvements. Results of FCITC analysis have been reported in Table (4.5).

Table (4.3) N-2 results for North case

Element	Overload without G243	Overload with G243	Rating (MVA)	Voltage Violation*	Contingency
27044 11W IRVI 161 27292 11W IRVI69.0 1 TR	N/A	216.9%	56	N/A	Dbl:11W IRVI-11WI TAP + 11LR TAP-11LK REB
27045 11WI TAP 161 27023 11DELVIN 161 1 LN	N/A	116%	201	11DELVIN 161 at 0.83 pu	Dbl:11POCKET-11POCK N + 11PINEVI-11PINEVI

* Only bus voltages with violations are reported in MUST software. The contingency low voltage limit used here is 0.9 pu. This also applies to Table 4.4

Table (4.4) N-2 results for South case

Element	Overload without G243	Overload with G243	Rating (MVA)	Voltage Violation	Contingency
27044 11W IRVI 161 27292 11W IRVI69.0 1 TR	N/A	216.9%	56	N/A	Dbl:11W IRVI-11WI TAP + 11LR TAP-11LK REB
27045 11WI TAP 161 27023 11DELVIN 161 1 LN	N/A	116.7%	201	11DELVIN 161 at 0.83 pu	Dbl:11POCKET-11POCK N + 11PINEVI-11PINEVI

Table (4.5) FCITC results

Dispatch mode	Constrained element	Contingency	Transfer limit (DC)	Transfer limit (AC)
North	27044 11W IRVI 161 27292 11W IRVI69.0 1	27023 11DELVIN 161 27045 11WI TAP 161	60.0MW	49.4MW
South	27044 11W IRVI 161 27292 11W IRVI69.0 1	27023 11DELVIN 161 27045 11WI TAP 161	59.7MW	49.1MW

4.2 System Upgrades

Results of Load flow analysis show that it is impossible to inject 120 MW at the West Irvine substation under the existing network configuration. Based on the results of Load flow analysis, the ad hoc study group identified the following upgrade options to alleviate the injection point overloads:

Option 1: Double circuit the line from W.Irvine to W.Irvine tap and upgrade the 161/69kV transformer at W.Irvine

Associated Cost: Following is the break up of the cost of different components associated with Option 1. The cost presented here, is 2003 cost based on rule of thumb estimate. The cost should be inflated by **3.3%** per year in order to get the estimate in the year in which construction is desired.

- Construct 3 miles of 161 kV line from West Irvine Tap to West Irvine using 556 kcm ACSR conductor: **$1.5 M**
- Construct a 161 kV bus at West Irvine and install three 161 kV breakers: **$1.3 M**
- Replace the West Irvine 161/69 kV, 56 MVA transformer with a 90 MVA transformer: **$0.7 M**

Total estimated cost for Option 1 – $3.5 millions

Option 2: Double circuit the line from W.Irvine to W.Irvine tap and add a parallel 161/69kV transformer at W.Irvine

Associated Cost: Following is the break up of the cost of different components associated with Option 2. The cost presented here, is 2003 cost based on rule of thumb estimate. The cost should be inflated by **3.3%** per year in order to get the estimate in the year in which construction is desired.

- Construct 3 miles of 161 kV line from West Irvine Tap to West Irvine using 556 kcm ACSR conductor: **$1.5 M**
- Construct a 161 kV bus at West Irvine and install three 161 kV breakers: **$1.3 M**
- Install a 161/69 kV, 60 MVA transformer at West Irvine in parallel with the existing transformer: **$1.0 M**

Total estimated cost for Option 2 – $3.8 millions

Load flow analysis was repeated with the above options. Revised results are presented in the next section. Short circuit analysis was also performed with the above two options. Stability analysis was performed with the new double circuit line between West Irvine and West Irvine tap. These results have been discussed in the subsequent sections.

4.3 Revised Load flow Results

After discussing the first set of Load flow results with the ad hoc group, the study model was revised by implementing several changes, which include:

- Including the 69kV detail near the West Irvine substation
- Updating the EKPC area details in the model.
- Using the new rating for the line from West Irvine to West Irvine tap, provided by LG&E ENERGY.
- Revising the ratings of some 69 and 138 kV branches in LG&E ENERGY and EKPC area near the interconnection point.
- Implementing option 1 and 2 upgrades at West Irvine sub.

All these changes have been presented in the Appendix D. N-1, N-2 and FCITC analysis were repeated on the revised model.

N-1 Analysis: No overloads were observed under both the options in the revised model.

N-2 Analysis: N-2 contingency analysis is performed on system upgrade option 1 and option 2. Elements above 100kV in LG&E ENERGY and EKPC control areas were considered for contingencies. Comparison of thermal overloads with and without G243 showed no significant increase in loadings to cause a cascading outage.

FCITC Analysis: After implementing the required upgrades, FCITC analysis showed that 120 MW power could be transferred from the proposed generator, without hitting any constraints, under both the options. According to Section 2.3 in Attachment R of MISO OATT, which says that an Interconnection Study is not applicable to the delivery portion of transmission service, the results may vary in the delivery study of this generator, because of the system conditions and prior reservations. Results of FCITC analysis have been presented in Table (4.6).

Table (4.6) Results of FCITC analysis after implementing the system upgrades

Option	Dispatch mode	Constrained element	Contingency	Transfer limit (DC)	Transfer limit (AC)
1	North	27023 11DELVIN 161 27045 11WI TAP 161 1	29387 20JKSMIT 138 29501 20POWELL 138	142.6MW	125.6MW
	South	27023 11DELVIN 161 27045 11WI TAP 161 1	29387 20JKSMIT 138 29501 20POWELL 138	139.1MW	123.2MW
2	North	27023 11DELVIN 161 27045 11WI TAP 161 1	29387 20JKSMIT 138 29501 20POWELL 138	142.7MW	125.7MW
	South	27023 11DELVIN 161 27045 11WI TAP 161 1	29387 20JKSMIT 138 29501 20POWELL 138	139.1MW	123.3MW

4.4 Short Circuit Analysis

Three phase fault and Single line to ground faults were simulated at all the busses 69kV and above with and without G243. Busses with more than 2% increase in the fault current (total no. 52) were selected to present in the results. Simulations were run before and after including the new generator in the model. Incremental change in the fault current due to the proposed generator was evaluated under both the upgrade options.

The following scenarios were simulated to evaluate the effect of the new generator:

A) Base Case
B) Study case (with G243 modeled)
C) Study case without new Trimble unit and upgrades

Comparison of A) and B) shows the effect of new generator on the short circuit current capability of the breakers in that area. Scenario C) was run to determine the problems if G243 connects before G218 and associated upgrades are implemented. Table (4.7) shows comparison of fault current before and after the new generator, when option 1 upgrades are implemented. Table (4.8) shows the same under option 2 upgrades. Table (4.9) and (4.10) present a comparison if G243 connects before G218 and associated upgrades are implemented.

Notations used in SC result tables:
I3: 3-phase fault current in Amps
I1: Single line to ground current in Amps
OP*n*: With Option *n* upgrades implemented
BC: In the base case

$$\%I = \frac{\text{I\_OPn - I\_BC}}{\text{I\_BC}} * 100$$

X_I3: 3-phase fault current in Amps without G218 and associated upgrades
X_I1: Single line to ground fault current in Amps without G218 and associated upgrades

Table (4.7) Comparison of fault current under Option 1 (contd. on next page)

Bus	Bus name	Area	I3_BC	I3_OP1	%I3	I1_BC	I1_OP1	%I1
438	[W IRVINE 161]	LGEE	5244	7377.7	40.7	4471.2	7906.6	76.8
593	[W IRVINE69.0]	LGEE	6713.9	9317.9	38.8	6573.9	11002.3	67.4
1906	[DARKHOLL69.0]	LGEE	6057.3	7922.7	30.8	5378.8	7702.9	43.2
439	[W IRVN T 161]	LGEE	5830.9	7613.1	30.6	5048.7	7871.1	55.9
1055	[RICE TAP69.0]	LGEE	6334.3	8032.4	26.8	5390.6	7240.6	34.3
1054	[RICE STA69.0]	LGEE	6297.5	7974.2	26.6	5348.2	7164.4	34.0
531	[IRVINE 69.0]	LGEE	5606.8	7040	25.6	4686.9	6177.7	31.8
435	[LK REB T 161]	LGEE	6566.5	7460.5	13.6	6562.3	7436.6	13.3
509	[ESTL STO69.0]	LGEE	4558.5	5152.9	13.0	3394.9	3819.3	12.5
434	[DELVINTA 161]	LGEE	6715	7500.8	11.7	5888.3	6579.1	11.7
589	[WACO 69.0]	LGEE	6824.9	7591.9	11.2	5148.8	5676.5	10.2

Bus	Bus name	Area	I3_BC	I3_OP1	%I3	I1_BC	I1_OP1	%I1
57877	[BEATTYVJ 161]	EKPC	5795.7	6307	8.8	5163.5	5554.3	7.6
1043	[MILLR CR69.0]	LGEE	4409.6	4789.3	8.6	3298.2	3542.6	7.4
458	[LK REB T 138]	LGEE	10935.8	11867.7	8.5	10959.5	11872	8.3
58833	[GRNHALLJ 161]	EKPC	5963.9	6455.7	8.2	5077.6	5438	7.1
58825	[GRNHALL 161]	EKPC	5739.3	6193.4	7.9	4806.7	5128.5	6.7
60569	[UNION CY 138]	EKPC	10342.9	11124.6	7.6	9913.6	10580.8	6.7
459	[LK REBA 138]	LGEE	9558.9	10272.1	7.5	9319.3	9943.1	6.7
539	[LK REBA 69.0]	LGEE	12596.3	13347.2	6.0	13705.6	14417.4	5.2
452	[FAWK TAP 138]	LGEE	13644.9	14455.4	5.9	13769.8	14392.5	4.5
58569	[FAWKESEK 138]	EKPC	13673.9	14482.6	5.9	13811.9	14432.5	4.5
455	[FAWKS KU 138]	LGEE	13680	14488.7	5.9	13813	14433.6	4.5
60557	[TYNER 161]	EKPC	5595	5922.9	5.9	4989	5215.1	4.5
478	[BEAR TRA69.0]	LGEE	4996.4	5279.8	5.7	4271.2	4462.7	4.5
59133	[JKSMITH 138]	EKPC	11800	12416.4	5.2	14639.4	15283.5	4.4
57881	[BEATTYVL69.0]	EKPC	6161.8	6465.6	4.9	6987.1	7293.3	4.4
479	[BTTYV KU69.0]	LGEE	6153.8	6457.2	4.9	6960.6	7265.1	4.4
477	[RICHMD E69.0]	LGEE	10241.2	10732.8	4.8	9429	9760.8	3.5
59917	[POWELLCO 161]	EKPC	4803.5	5028.9	4.7	4471.9	4615.4	3.2
480	[BTTY 64969.0]	LGEE	5633.9	5887.4	4.5	5875.4	6091.1	3.7
60485	[THREEFKJ 138]	EKPC	12097.3	12632.3	4.4	11178.6	11505.6	2.9
59921	[POWELLCO 138]	EKPC	6505.1	6777.4	4.2	6053.2	6223.8	2.8
60489	[THREEFKS 138]	EKPC	11178.1	11633.3	4.1	9900.8	10156.6	2.6
58389	[DALE 138]	EKPC	13325.5	13837.6	3.8	13991.3	14374.6	2.7
518	[FAWKES 69.0]	LGEE	13750.6	14278.4	3.8	15160.5	15617.1	3.0
564	[RICHMOND69.0]	LGEE	10953.1	11365.8	3.8	9536.5	9769.7	2.4
57869	[BEATTYVD69.0]	EKPC	4645.5	4816.1	3.7	4307.1	4421.5	2.7
558	[BEREA T 69.0]	LGEE	8983.1	9309.3	3.6	7206.4	7368.2	2.2
557	[OKONITE 69.0]	LGEE	8765.9	9068.6	3.5	6914.1	7058.4	2.1
1901	[RICH IND69.0]	LGEE	8613.7	8898.3	3.3	6709.8	6841.4	2.0
471	[BG ORDN 69.0]	LGEE	7695.3	7933.4	3.1	5797.9	5902.1	1.8
569	[RICHMD S69.0]	LGEE	9221	9495.7	3.0	7344.2	7472	1.7
568	[RICHMD J69.0]	LGEE	8679	8937.5	3.0	6718.2	6833.4	1.7
566	[RICHMD 369.0]	LGEE	8917.1	9181.3	3.0	6985.4	7105.1	1.7
565	[RICHMD 269.0]	LGEE	8484.7	8730.1	2.9	6530.5	6638.9	1.7
58021	[BOONESTP 138]	EKPC	12581.3	12944.1	2.9	12311.3	12545.7	1.9
58037	[BOONSB N 138]	EKPC	12447.7	12802.7	2.9	12141.8	12369.6	1.9
59897	[PITTSBRG 161]	EKPC	5636.6	5797.3	2.9	5465.5	5574.4	2.0
567	[RICHMD 469.0]	LGEE	7541.1	7734.3	2.6	5557.4	5635.7	1.4
60641	[W.BEREA 138]	EKPC	5625.4	5758.8	2.4	4980.6	5053.4	1.5
59925	[POWELLCO69.0]	EKPC	8246	8428.3	2.2	9067.6	9221.7	1.7
60361	[STANTON 69.0]	EKPC	8158.3	8336.2	2.2	8833.2	8978.9	1.6

Table (4.8) Comparison of fault current under Option 2 (contd. on next page)

Bus	Bus name	Area	I3_BC	I3_OP2	%I3	I1_BC	I1_OP2	%I1
438	[W IRVINE 161]	LGEE	5244	7377.5	40.7	4471.2	7800.1	74.5
593	[W IRVINE69.0]	LGEE	6713.9	9316.2	38.8	6573.9	10604.7	61.3
1906	[DARKHOLL69.0]	LGEE	6057.3	7921.4	30.8	5378.8	7526.6	39.9
439	[W IRVN T 161]	LGEE	5830.9	7612.9	30.6	5048.7	7784.1	54.2
1055	[RICE TAP69.0]	LGEE	6334.3	8031.1	26.8	5390.6	7110.7	31.9
1054	[RICE STA69.0]	LGEE	6297.5	7973	26.6	5348.2	7037.2	31.6
531	[IRVINE 69.0]	LGEE	5606.8	7038.9	25.5	4686.9	6075.1	29.6
435	[LK REB T 161]	LGEE	6566.5	7460.5	13.6	6562.3	7425.1	13.1
509	[ESTL STO69.0]	LGEE	4558.5	5152.4	13.0	3394.9	3796.6	11.8
434	[DELVINTA 161]	LGEE	6715	7500.8	11.7	5888.3	6567.5	11.5
589	[WACO 69.0]	LGEE	6824.9	7591.4	11.2	5148.8	5650.7	9.7
57877	[BEATTYVJ 161]	EKPC	5795.7	6307	8.8	5163.5	5548.8	7.5
1043	[MILLR CR69.0]	LGEE	4409.6	4789	8.6	3298.2	3531.7	7.1
458	[LK REB T 138]	LGEE	10935.8	11867.7	8.5	10959.5	11859.3	8.2
58833	[GRNHALLJ 161]	EKPC	5963.9	6455.7	8.2	5077.6	5433.2	7.0
58825	[GRNHALL 161]	EKPC	5739.3	6193.4	7.9	4806.7	5124.2	6.6
60569	[UNION CY 138]	EKPC	10342.9	11124.6	7.6	9913.6	10572.6	6.6
459	[LK REBA 138]	LGEE	9558.9	10272.2	7.5	9319.3	9934.5	6.6
539	[LK REBA 69.0]	LGEE	12596.3	13346.9	6.0	13705.6	14408.8	5.1
452	[FAWK TAP 138]	LGEE	13644.9	14455.5	5.9	13769.8	14389.3	4.5
58569	[FAWKESEK 138]	EKPC	13673.9	14482.7	5.9	13811.9	14429.4	4.5
455	[FAWKS KU 138]	LGEE	13680	14488.8	5.9	13813	14430.5	4.5
60557	[TYNER 161]	EKPC	5595	5922.9	5.9	4989	5213.1	4.5
478	[BEAR TRA69.0]	LGEE	4996.4	5279.6	5.7	4271.2	4457.6	4.4
59133	[JKSMITH 138]	EKPC	11800	12416.5	5.2	14639.4	15283.1	4.4
57881	[BEATTYVL69.0]	EKPC	6161.8	6465.5	4.9	6987.1	7290.3	4.3
479	[BTTYV KU69.0]	LGEE	6153.8	6457.1	4.9	6960.6	7262.1	4.3
477	[RICHMD E69.0]	LGEE	10241.2	10732.6	4.8	9429	9756.9	3.5
59917	[POWELLCO 161]	EKPC	4803.5	5028.9	4.7	4471.9	4614.8	3.2
480	[BTTY 64969.0]	LGEE	5633.9	5887.3	4.5	5875.4	6089	3.6
60485	[THREEFKJ 138]	EKPC	12097.3	12632.4	4.4	11178.6	11504.7	2.9
59921	[POWELLCO 138]	EKPC	6505.1	6777.4	4.2	6053.2	6223.2	2.8
60489	[THREEFKS 138]	EKPC	11178.1	11633.3	4.1	9900.8	10155.8	2.6
58389	[DALE 138]	EKPC	13325.5	13837.7	3.8	13991.3	14374.3	2.7
518	[FAWKES 69.0]	LGEE	13750.6	14278.3	3.8	15160.5	15615.6	3.0
564	[RICHMOND69.0]	LGEE	10953.1	11365.7	3.8	9536.5	9768.1	2.4
57869	[BEATTYVD69.0]	EKPC	4645.5	4816	3.7	4307.1	4420.5	2.6
558	[BEREA T 69.0]	LGEE	8983.1	9309.2	3.6	7206.4	7366.7	2.2
557	[OKONITE 69.0]	LGEE	8765.9	9068.5	3.5	6914.1	7057.2	2.1
1901	[RICH IND69.0]	LGEE	8613.7	8898.2	3.3	6709.8	6840.3	1.9
471	[BG ORDN 69.0]	LGEE	7695.3	7933.4	3.1	5797.9	5901.2	1.8
568	[RICHMD J69.0]	LGEE	8679	8937.5	3.0	6718.2	6832.7	1.7
569	[RICHMD S69.0]	LGEE	9221	9495.6	3.0	7344.2	7471.3	1.7

Bus	Bus name	Area	I3_BC	I3_OP2	%I3	I1_BC	I1_OP2	%I1
566	[RICHMD 369.0]	LGEE	8917.1	9181.2	3.0	6985.4	7104.4	1.7
565	[RICHMD 269.0]	LGEE	8484.7	8730	2.9	6530.5	6638.2	1.6
58021	[BOONESTP 138]	EKPC	12581.3	12944.2	2.9	12311.3	12545.6	1.9
58037	[BOONSB N 138]	EKPC	12447.7	12802.7	2.9	12141.8	12369.6	1.9
59897	[PITTSBRG 161]	EKPC	5636.6	5797.3	2.9	5465.5	5574.1	2.0
567	[RICHMD 469.0]	LGEE	7541.1	7734.3	2.6	5557.4	5635.1	1.4
60641	[W.BEREA 138]	EKPC	5625.4	5758.9	2.4	4980.6	5053.3	1.5
59925	[POWELLCO69.0]	EKPC	8246	8428.3	2.2	9067.6	9221.4	1.7
60361	[STANTON 69.0]	EKPC	8158.3	8336.2	2.2	8833.2	8978.6	1.6

Table (4.9) Fault current under Option 1, without G218 (contd. on next page)

Bus	Bus name	Area	I3_OP1	X_I3_OP1	I1_OP1	X_I1_OP1
434	[DELVINTA 161]	LGEE	7500.8	7485.4	6579.1	6506.6
435	[LK REB T 161]	LGEE	7460.5	7443.4	7436.6	7361.9
438	[W IRVINE 161]	LGEE	7377.7	7365	7906.6	7183.9
439	[W IRVN T 161]	LGEE	7613.1	7599.1	7871.1	7282.9
452	[FAWK TAP 138]	LGEE	14455.4	14383.6	14392.5	14324.7
455	[FAWKS KU 138]	LGEE	14488.7	14416.4	14433.6	14365.7
458	[LK REB T 138]	LGEE	11867.7	11825	11872	11772.4
459	[LK REBA 138]	LGEE	10272.1	10239.9	9943.1	9864.4
471	[BG ORDN 69.0]	LGEE	7933.4	7922.8	5902.1	5883.9
477	[RICHMD E69.0]	LGEE	10732.8	10714.1	9760.8	9687.4
478	[BEAR TRA69.0]	LGEE	5279.8	5276.7	4462.7	4283
479	[BTTYV KU69.0]	LGEE	6457.2	6452.4	7265.1	7219.2
480	[BTTY 64969.0]	LGEE	5887.4	5883.5	6091.1	6059
509	[ESTL STO69.0]	LGEE	5152.9	5150	3819.3	2891.4
518	[FAWKES 69.0]	LGEE	14278.4	14238.9	15617.1	15572.8
531	[IRVINE 69.0]	LGEE	7040	7034.6	6177.7	3173.5
539	[LK REBA 69.0]	LGEE	13347.2	13318	14417.4	14256.5
557	[OKONITE 69.0]	LGEE	9068.6	9054.6	7058.4	7034
558	[BEREA T 69.0]	LGEE	9309.3	9294.6	7368.2	7339.6
564	[RICHMOND69.0]	LGEE	11365.8	11342.5	9769.7	9737.7
565	[RICHMD 269.0]	LGEE	8730.1	8716.4	6638.9	6624.2
566	[RICHMD 369.0]	LGEE	9181.3	9166	7105.1	7090.1
567	[RICHMD 469.0]	LGEE	7734.3	7723.6	5635.7	5625.1
568	[RICHMD J69.0]	LGEE	8937.5	8923.2	6833.4	6818.1
569	[RICHMD S69.0]	LGEE	9495.7	9479.1	7472	7456.7
589	[WACO 69.0]	LGEE	7591.9	7584.2	5676.5	4611.7
593	[W IRVINE69.0]	LGEE	9317.9	9308.1	11002.3	3553.4
1043	[MILLR CR69.0]	LGEE	4789.3	4786.8	3542.6	3076.1
1054	[RICE STA69.0]	LGEE	7974.2	7966.9	7164.4	3565.6
1055	[RICE TAP69.0]	LGEE	8032.4	8024.9	7240.6	3584.5
1901	[RICH IND69.0]	LGEE	8898.3	8884.7	6841.4	6820.1

Bus	Bus name	Area	I3_OP1	X_I3_OP1	I1_OP1	X_I1_OP1
1906	[DARKHOLL69.0]	LGEE	7922.7	7915.8	7702.9	3327.7
57869	[BEATTYVD69.0]	EKPC	4816.1	4813.5	4421.5	4405.4
57877	[BEATTYVJ 161]	EKPC	6307	6296	5554.3	5516.8
57881	[BEATTYVL69.0]	EKPC	6465.6	6460.8	7293.3	7248
58021	[BOONESTP 138]	EKPC	12944.1	12885.3	12545.7	12508.3
58037	[BOONSB N 138]	EKPC	12802.7	12745.2	12369.6	12333.3
58389	[DALE 138]	EKPC	13837.6	13775.5	14374.6	14328.1
58569	[FAWKESEK 138]	EKPC	14482.6	14410.6	14432.5	14364.9
58825	[GRNHALL 161]	EKPC	6193.4	6182.2	5128.5	5099.6
58833	[GRNHALLJ 161]	EKPC	6455.7	6443.6	5438	5405.5
59133	[JKSMITH 138]	EKPC	12416.4	12373.7	15283.5	15237.5
59897	[PITTSBRG 161]	EKPC	5797.3	5784.8	5574.4	5565.1
59917	[POWELLCO 161]	EKPC	5028.9	5021.5	4615.4	4607.6
59921	[POWELLCO 138]	EKPC	6777.4	6765.6	6223.8	6213.5
59925	[POWELLCO69.0]	EKPC	8428.3	8419.4	9221.7	9212.6
60361	[STANTON 69.0]	EKPC	8336.2	8327.6	8978.9	8970.3
60485	[THREEFKJ 138]	EKPC	12632.3	12579	11505.6	11470.1
60489	[THREEFKS 138]	EKPC	11633.3	11588.1	10156.6	10128.9
60557	[TYNER 161]	EKPC	5922.9	5911.8	5215.1	5198.2
60569	[UNION CY 138]	EKPC	11124.6	11087.4	10580.8	10512.3
60641	[W.BEREA 138]	EKPC	5758.8	5747.3	5053.4	5046.7

Table (4.10) Fault current under Option 2, without G218 (contd. on next page)

Bus	Bus name	Area	I3_OP2	X_I3_OP2	I1_OP2	X_I1_OP2
434	[DELVINTA 161]	LGEE	7500.8	7485.4	6567.5	6559.7
435	[LK REB T 161]	LGEE	7460.5	7443.4	7425.1	7413.8
438	[W IRVINE 161]	LGEE	7377.5	7364.9	7800.1	7790.7
439	[W IRVN T 161]	LGEE	7612.9	7598.9	7784.1	7774.5
452	[FAWK TAP 138]	LGEE	14455.5	14383.7	14389.3	14342.1
455	[FAWKS KU 138]	LGEE	14488.8	14416.5	14430.5	14382.8
458	[LK REB T 138]	LGEE	11867.7	11825.1	11859.3	11831.1
459	[LK REBA 138]	LGEE	10272.2	10240	9934.5	9914.6
471	[BG ORDN 69.0]	LGEE	7933.4	7922.7	5901.2	5897.3
477	[RICHMD E69.0]	LGEE	10732.6	10713.9	9756.9	9746.7
478	[BEAR TRA69.0]	LGEE	5279.6	5276.5	4457.6	4456.1
479	[BTTYV KU69.0]	LGEE	6457.1	6452.3	7262.1	7258
480	[BTTY 64969.0]	LGEE	5887.3	5883.4	6089	6086.2
509	[ESTL STO69.0]	LGEE	5152.4	5149.6	3796.6	3795.6
518	[FAWKES 69.0]	LGEE	14278.3	14238.8	15615.6	15583.9
531	[IRVINE 69.0]	LGEE	7038.9	7033.5	6075.1	6072.4
539	[LK REBA 69.0]	LGEE	13346.9	13317.8	14408.8	14386.2
557	[OKONITE 69.0]	LGEE	9068.5	9054.5	7057.2	7051.5
558	[BEREA T 69.0]	LGEE	9309.2	9294.5	7366.7	7360.6

Bus	Bus name	Area	I3_OP2	X_I3_OP2	I1_OP2	X_I1_OP2
564	[RICHMOND69.0]	LGEE	11365.7	11342.4	9768.1	9756.7
565	[RICHMD 269.0]	LGEE	8730	8716.4	6638.2	6632.9
566	[RICHMD 369.0]	LGEE	9181.2	9165.9	7104.4	7098.3
567	[RICHMD 469.0]	LGEE	7734.3	7723.6	5635.1	5631.4
568	[RICHMD J69.0]	LGEE	9495.6	8923.2	7471.3	6827.1
569	[RICHMD S69.0]	LGEE	8937.5	9479.1	6832.7	7464.5
589	[WACO 69.0]	LGEE	7591.4	7583.7	5650.7	5647.9
593	[W IRVINE69.0]	LGEE	9316.2	9306.5	10604.7	10596.3
1043	[MILLR CR69.0]	LGEE	4789	4786.5	3531.7	3530.8
1054	[RICE STA69.0]	LGEE	7973	7965.6	7037.2	7033.4
1055	[RICE TAP69.0]	LGEE	8031.1	8023.6	7110.7	7106.8
1901	[RICH IND69.0]	LGEE	8898.2	8884.6	6840.3	6835
1906	[DARKHOLL69.0]	LGEE	7921.4	7914.5	7526.6	7522.4
57869	[BEATTYVD69.0]	EKPC	4816	4813.4	4420.5	4419
57877	[BEATTYVJ 161]	EKPC	6307	6296	5548.8	5543.1
57881	[BEATTYVL69.0]	EKPC	6465.5	6460.7	7290.3	7286.2
58021	[BOONESTP 138]	EKPC	12944.2	12885.4	12545.6	12508.9
58037	[BOONSB N 138]	EKPC	12802.7	12745.2	12369.6	12333.8
58389	[DALE 138]	EKPC	13837.7	13775.6	14374.3	14329.7
58569	[FAWKESEK 138]	EKPC	14482.7	14410.8	14429.4	14381.9
58825	[GRNHALL 161]	EKPC	6193.4	6182.2	5124.2	5119.2
58833	[GRNHALLJ 161]	EKPC	6455.7	6443.6	5433.2	5427.5
59133	[JKSMITH 138]	EKPC	12416.5	12373.8	15283.1	15239.9
59897	[PITTSBRG 161]	EKPC	5797.3	5784.8	5574.1	5566.4
59917	[POWELLCO 161]	EKPC	5028.9	5021.5	4614.8	4610.7
59921	[POWELLCO 138]	EKPC	6777.4	6765.6	6223.2	6216.6
59925	[POWELLCO69.0]	EKPC	8428.3	8419.4	9221.4	9214.3
60361	[STANTON 69.0]	EKPC	8336.2	8327.6	8978.6	8971.9
60485	[THREEFKJ 138]	EKPC	12632.4	12579.1	11504.7	11475.4
60489	[THREEFKS 138]	EKPC	11633.3	11588.1	10155.8	10133
60557	[TYNER 161]	EKPC	5922.9	5911.8	5213.1	5207.4
60569	[UNION CY 138]	EKPC	11124.6	11087.5	10572.6	10550.4
60641	[W.BEREA 138]	EKPC	5758.9	5747.4	5053.3	5047.4

Short Circuit Results show that the three existing breakers at W.Irvine 69 kV bus are not capable of handling increased fault current level. The three breakers need to be upgraded for the proposed interconnection, irrespective of the G218 system upgrades. If the project goes online before G218 upgrades are implemented, there are no additional upgrades (other than the three 69kV breakers) required for this generator to connect, as far as short circuit capability of breakers is concerned.

4.5 Transient Stability Analysis

The purpose of transient stability analysis is to evaluate the ability of the system to remain in synchronism after the disturbances in the system near the point of interconnection. Three phase faults with normal clearing and with breaker failure were simulated around the point of interconnection. Critical Clearing Time (CCT) was also determined for all these scenarios. A list of all the fault scenarios run for this study has been presented in Table (4.11). Voltage and rotor angle were monitored on all the Generators in LG&E ENERGY and EKPC area.

The system was found stable after running 3-phase fault at all the locations listed in the table below. There was no event of instability observed even if the proposed unit connects before implementing the system upgrades identified in G218 study. However, the protection scheme at West Irvine will require breaker-failure protection to maintain clearing times within the critical values identified in this analysis.

Critical Clearing Time (CCT) for a 3-phase fault at W.Irvine 161kV bus was found to be **16.0 cycles**. CCT for a 3-phase fault at the same bus without G218 upgrades was found to be **15.5 cycle.** Results showing the CCT for each fault scenario, with and without project G218 have been reported in Table (4.11).

Table (4.11) List of fault scenarios run in the stability study

Fault No.	Faulted bus	Line opened to clear the fault From	To	Normal clearing time (Cycles)	Critical Clearing Time (CCT) (Cycles)	CCT without G218 (Cycles)
1	W Irvine161	W Irvine161	Delvin161	7	17.5	17.0
2	W Irvine161	W Irvine161	W Irvine69	7	18	17.0
3	W Irvine161	W Irvine161	LRtap161	7	16	15.5
4	Delvin161	Delvin161	W Irvine161	7	39.0	37.0
5	Delvin161	Delvin161	GRNHLJ161	7	37.5	35.0
6	LRtap161	LRtap161	LRtap138	7	30.0	29.0
7	LRtap138	LRtap138	LK Reb138	7	30.5	29.5
8	LRtap138	LRtap138	JK Smit138	7	30.5	29.5
9	JKSmit 138	JKSmit 138	Powell138	7	18.5	18.0
10	JKSmit 138	JKSmit 138	LRtap138	7	18	18.0
11	JKSmit 138	JKSmit 138	Spenc138	7	18	18.0
12	JKSmit 138	JKSmit 138	Dale 138	7	18	17.5

5. Conclusion

5.1 Evaluation Study Results

Results of the Evaluation Study for Project G243 show thermal overloads caused by the proposed generator. This study addressed the overloads at the injection facilities and identified two solutions to alleviate these overloads. These solutions are:

Option 1: Double circuit the line from W.Irvine to W.Irvine tap and upgrade the 161/69kV transformer at W.Irvine
Estimated cost – **$3.5 millions** (2003 cost based on Rule of thumb estimate)

Option 2: Double circuit the line from W.Irvine to W.Irvine tap and add a parallel 161/69kV transformer at W.Irvine
Estimated cost – **$3.8 millions** (2003 cost based on Rule of thumb estimate)

Results show under the assumptions made in this study, the system is capable of handling 120 MW of injection after implementing either of the upgrade options listed above. According to Section 2.3 in Attachment R of MISO OATT, which says that an Interconnection Study is not applicable to the delivery portion of transmission service, the results may vary in the delivery study of this generator, because of the system conditions and prior reservations. N-2 analysis did not show any cascading outage problem caused by the proposed interconnection.

Short circuit analysis showed the need to replace the three existing 69 kV breakers at West Irvine. Cost to replace these three breakers was estimated as **$0.3 million** (2003 cost based on Rule of thumb estimate). Results indicated that the new generator did not cause the fault currents to increase significantly in EKPC's system.

There were no identified significant impacts on the stability of other units in the area due to interconnection of the proposed generator. However, the protection scheme at West Irvine will require breaker-failure protection to maintain clearing times within the critical values identified in this study. Critical Clearing Time for a three-phase fault at West Irvine 161kV substation was found to be 16.0 cycle.

Based on the Evaluation Study Results, more detailed and accurate estimate of the cost to implement one of these system upgrades will be done in the Facility Study under the MISO process of Generation Interconnection. A schedule of construction, related to the interconnection of the proposed generator will also be determined in the Facility Study.

APPENDIX – A
Additional Load Flow Runs

Additional load flow runs were made to honor LG&E ENERGY's planning criteria. LG&E ENERGY Energy's planning guidelines specify testing the adequacy of the transmission system with a single element outaged in conjunction with a generation unit outage. The following worst-case generation dispatch scenarios were considered as advised by LG&E ENERGY:

- Maximum generation in the Brown area
- Minimum generation in the Brown area.

N-1 analysis was performed in conjunction with the above scenario. Because of time constraint, the additional runs were made only under upgrade option 1. Since MISO process of Generation Interconnection does not assure deliverability from the plant, the purpose of these additional runs is to provide an indication of the thermal problems, the proposed generator could cause (during periods when LG&E ENERGY is operating under these dispatch scenarios) when delivering power out from this plant.

A.1 Maximum Generation in Brown Area

Setting Brown units at their maximum output, N-1 analysis was performed. After comparing base case with the case containing G243 and system upgrades, Delvinta to WI tap was found to be overloaded to nearly 107 %. The elements with the largest differences (>3%) caused by G243 are listed in Table (A.1) and (A.2) for North and South dispatch respectively.

Table (A.1) Thermal overloads for maximum generation at Brown (North dispatch)

Element	Rating MVA	overload without G243&upgrade	overload with G243&upgrade	Contingency
27023 11DELVIN 161 27045 11WI TAP 161 1 LN	201	N/A	106.6%	29387 20JKSMIT 138 29501 20POWELL 138 1

Table (A.2) Thermal overloads for maximum generation at Brown (South dispatch)

Element	Rating MVA	overload without G243&upgrade	overload with G243&upgrade	Contingency
27023 11DELVIN 161 27045 11WI TAP 161 1 LN	201	N/A	107.3%	29387 20JKSMIT 138 29501 20POWELL 138 1
27108 11LEBANO 138 27118 11MERCR 138 1 LN	181	N/A	100.4%	27002 11ALCALD 345 27004 11BRWN N 345 1

A.2 Minimum Generation in Brown Area

Setting the Brown units at minimum (unit 1with 48 MW and unit 2 with 89MW), N-1 analysis was performed. Base case was compared with the case containing G243 and system upgrades, elements with the largest differences (>3%) are listed in Table (A.3) and (A.4). The only noticeable element is the line 27088 (11FAWKES 138) to 27334 (11FAWK T 138), which is not overloaded in base case, but could be overloaded up to 106.5% when G243 is included.

Table (A.3) Thermal overloads for minimum generation at Brown (North dispatch)

Element	Rating MVA	loading without G243&upgrade	overload with G243&upgrade	Contingency
27088 11FAWKES 138 27334 11FAWK T 138 1 LN	179	N/A	106.5%	27111 11LK REB 138 27243 11LK REB69.0 1

Table (A.4) Thermal overloads for minimum generation at Brown (South dispatch)

Element	Rating MVA	loading without G243&upgrade	overload with G243&upgrade	Contingency
27088 11FAWKES 138 27334 11FAWK T 138 1 LN	179	N/A	100.2%	27023 11DELVIN 161 27045 11WI TAP 161 1
27088 11FAWKES 138 27334 11FAWK T 138 1 LN	179	N/A	106.5%	27111 11LK REB 138 27243 11LK REB69.0 1

Finding solutions to the thermal overloading problems identified here under Brown maximum and a minimum dispatch scenario was not included in this study. Under Section 2.3 in Attachment R of MISO OATT, this study is not applicable to the delivery portion of transmission service. If a delivery or operating study identifies any system constraints, the delivery/operating study will identify a solution (required upgrade or an operating guideline) before granting of any type of transmission service out of the plant. If a long-term transmission service request is not submitted for this generator, an operating study would be required to address this issue before the project is allowed to deliver power into the grid.

APPENDIX-B
Monitored Elements

B.1 LG&E ENERGY's Channel List

Table (B.1) shows the rotor angle and bus voltages monitored in LG&E ENERGY's system for Stability Studies

Table (B.1) LG&E ENERGY's channel list

channel	bus #	Identifier	Descriptor	Machine no.
3	27005	11GHENT 345.0	Rotor Angle	2
4	27005	11GHENT 345.0	Rotor Angle	3
5	27005	11GHENT 345.0	Rotor Angle	4
6	27008	11MIL CK345.0	Rotor Angle	1
7	27008	11MIL CK345.0	Rotor Angle	2
8	27008	11MIL CK345.0	Rotor Angle	3
9	27008	11MIL CK345.0	Rotor Angle	4
10	27013	11TRIMBL345.0	Rotor Angle	1
11	27013	11TRIMBL345.0	Rotor Angle	10
12	27013	11TRIMBL345.0	Rotor Angle	2
13	27013	11TRIMBL345.0	Rotor Angle	5
14	27013	11TRIMBL345.0	Rotor Angle	6
15	27013	11TRIMBL345.0	Rotor Angle	7
16	27013	11TRIMBL345.0	Rotor Angle	8
17	27013	11TRIMBL345.0	Rotor Angle	9
18	27063	11BRWNCT138.0	Rotor Angle	10
19	27063	11BRWNCT138.0	Rotor Angle	11
20	27063	11BRWNCT138.0	Rotor Angle	5
21	27063	11BRWNCT138.0	Rotor Angle	6
22	27063	11BRWNCT138.0	Rotor Angle	7
23	27063	11BRWNCT138.0	Rotor Angle	8
24	27063	11BRWNCT138.0	Rotor Angle	9
25	27064	11BRWN N138.0	Rotor Angle	3
26	27065	11BRWN P138.0	Rotor Angle	1
27	27065	11BRWN P138.0	Rotor Angle	2
28	27071	11CNE RN138.0	Rotor Angle	11
29	27071	11CNE RN138.0	Rotor Angle	4
30	27071	11CNE RN138.0	Rotor Angle	5
31	27072	11CN RN6138.0	Rotor Angle	6
32	27092	11GHENT 138.0	Rotor Angle	1
33	27095	11GR RVR138.0	Rotor Angle	3
34	27095	11GR RVR138.0	Rotor Angle	4
35	27130	11PADDYR138.0	Rotor Angle	13
36	27142	11SMITH 138.0	Rotor Angle	1
37	27142	11SMITH 138.0	Rotor Angle	2
38	27154	11WATRSD138.0	Rotor Angle	7

channel	bus #	Identifier	Descriptor	Machine no.
39	27154	11WATRSD138.0	Rotor Angle	8
40	27180	11CANAL 69.00	Rotor Angle	1
41	27180	11CANAL 69.00	Rotor Angle	2
42	27180	11CANAL 69.00	Rotor Angle	3
43	27180	11CANAL 69.00	Rotor Angle	4
44	27180	11CANAL 69.00	Rotor Angle	5
45	27180	11CANAL 69.00	Rotor Angle	6
46	27180	11CANAL 69.00	Rotor Angle	7
47	27180	11CANAL 69.00	Rotor Angle	8
48	27195	11DIXDAM69.00	Rotor Angle	1
49	27195	11DIXDAM69.00	Rotor Angle	2
50	27195	11DIXDAM69.00	Rotor Angle	3
51	27216	11GR RVR69.00	Rotor Angle	1
52	27216	11GR RVR69.00	Rotor Angle	2
53	27220	11HAEFLN69.00	Rotor Angle	1
54	27220	11HAEFLN69.00	Rotor Angle	2
55	27220	11HAEFLN69.00	Rotor Angle	3
56	27227	11HLCRST69.00	Rotor Angle	1
57	27235	11KU PK 69.00	Rotor Angle	3
58	27289	11TYRONE69.00	Rotor Angle	1
59	27289	11TYRONE69.00	Rotor Angle	2
60	27289	11TYRONE69.00	Rotor Angle	3
61	27313	11PRUN2A14.00	Rotor Angle	1
62	27314	11PRUN2B14.00	Rotor Angle	2
63	27338	11BUCKNR345.0	Rotor Angle	1
64	27338	11BUCKNR345.0	Rotor Angle	2
65	27338	11BUCKNR345.0	Rotor Angle	3
66	27301	ESTILLCO161.0	Rotor Angle	1
67	27005	11GHENT 345.0	Bus Voltage	
68	27008	11MIL CK345.0	Bus Voltage	
69	27013	11TRIMBL345.0	Bus Voltage	
70	27063	11BRWNCT138.0	Bus Voltage	
71	27064	11BRWN N138.0	Bus Voltage	
72	27065	11BRWN P138.0	Bus Voltage	
73	27071	11CNE RN138.0	Bus Voltage	
74	27072	11CN RN6138.0	Bus Voltage	
75	27092	11GHENT 138.0	Bus Voltage	
76	27095	11GR RVR138.0	Bus Voltage	
77	27130	11PADDYR138.0	Bus Voltage	
78	27142	11SMITH 138.0	Bus Voltage	
79	27154	11WATRSD138.0	Bus Voltage	
80	27180	11CANAL 69.00	Bus Voltage	
81	27195	11DIXDAM69.00	Bus Voltage	
82	27216	11GR RVR69.00	Bus Voltage	
83	27220	11HAEFLN69.00	Bus Voltage	

channel	bus #	Identifier	Descriptor	Machine no.
84	27227	11HLCRST69.00	Bus Voltage	
85	27235	11KU PK 69.00	Bus Voltage	
86	27289	11TYRONE69.00	Bus Voltage	
87	27313	11PRUN2A14.00	Bus Voltage	
88	27314	11PRUN2B14.00	Bus Voltage	
89	27338	11BUCKNR345.0	Bus Voltage	
90	27301	ESTILLCO161.0	Bus Voltage	

B.2 EKPC's Channel List

Table (B.2) shows the rotor angle and bus voltages monitored in EKPC's system for Stability Studies

Table (B.2) EKPC's channel list

channel #	bus #	Identifier	Descriptor	Machine no.
338	29278	20CPR1 13.800	Rotor Angle	1
339	29279	20CPR2 20.000	Rotor Angle	2
340	29288	20DALE1 13.800	Rotor Angle	1
341	29290	20DALE2 13.800	Rotor Angle	2
342	29291	20DALE3 13.800	Rotor Angle	3
343	29292	20DALE4 13.800	Rotor Angle	4
344	29382	20JKCT1 13.800	Rotor Angle	1
345	29383	20JKCT2 13.800	Rotor Angle	2
346	29384	20JKCT3 13.800	Rotor Angle	3
347	29396	20LAURHY13.800	Rotor Angle	1
348	29414	20LOVE 138.00	Rotor Angle	1
349	29560	20SPLK1 22.000	Rotor Angle	1
350	29562	20SPLK2 22.000	Rotor Angle	2
351	90003	20SPLK3 18.000	Rotor Angle	3
352	90017	20JKCT4 13.800	Rotor Angle	4
353	90018	20JKCT5 13.800	Rotor Angle	5
354	90019	20JKCT6 13.800	Rotor Angle	6
355	90020	20JKCT7 13.800	Rotor Angle	7
356	90021	20JKCT8 13.800	Rotor Angle	8
357	90022	20JKCT9 13.800	Rotor Angle	9
358	90023	20JKCTA 13.800	Rotor Angle	10
359	29278	20CPR1 13.800	Bus Voltage	
360	29279	20CPR2 20.000	Bus Voltage	
361	29288	20DALE1 13.800	Bus Voltage	
362	29290	20DALE2 13.800	Bus Voltage	
363	29291	20DALE3 13.800	Bus Voltage	
364	29292	20DALE4 13.800	Bus Voltage	

channel	bus #	Identifier	Descriptor	Machine no.
365	29382	20JKCT1 13.800	Bus Voltage	
366	29383	20JKCT2 13.800	Bus Voltage	
367	29384	20JKCT3 13.800	Bus Voltage	
368	29396	20LAURHY13.800	Bus Voltage	
369	29414	20LOVE 138.00	Bus Voltage	
370	29560	20SPLK1 22.000	Bus Voltage	
371	29562	20SPLK2 22.000	Bus Voltage	
372	90003	20SPLK3 18.000	Bus Voltage	
373	90017	20JKCT4 13.800	Bus Voltage	
374	90018	20JKCT5 13.800	Bus Voltage	
375	90019	20JKCT6 13.800	Bus Voltage	
376	90020	20JKCT7 13.800	Bus Voltage	
377	90021	20JKCT8 13.800	Bus Voltage	
378	90022	20JKCT9 13.800	Bus Voltage	
379	90023	20JKCTA 13.800	Bus Voltage	

APPENDIX C
Model Data Sheet

C.1 Generator Data

Model Name	GENROU
T'd0	4.58
T"do	0.021
T'q0	0.43
T"q0	0.046
H	5.80
Damp	0.00
Xd	1.8830
Xq	1.8070
X'd	0.2760
X'q	0.4320
X"d	0.1990
Xl	0.1670
S(1.0)	0.0857
S(1.2)	0.4762

C.2 Exciter Data

Model Name	EXAC2
TR	0.01
TB	1.0
TC	1.0
KA	1000.0
TA	0.010
Vamax	7.90
Vamin	-7.90
KB	1.0
Vrmax	16.1
Vrmin	-16.1
TE	0.78
KL	4.0
KH	0.00
KF	0.05
TF	1.00
KC	0.100
KD	1.040
KE	1.00
VLR	9.880
E1	2.880
S(E1)	0.0100
E2	3.840
S(E2)	0.0100

APPENDIX D
Model Updates

D.1 Changes in EKPC area

Case Comparison Result By PSS/E Software

In the following report, **WORKING CASE** Refers to the case before EKPC updates, and **SAVED CASE** refers to the case after EKPC updates.

PSS/E report starts from here:

PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E THU, JUL 17 2003 17:20
COMPARISON OF THE WORKING CASE AND THE SAVED CASE

BUSES WITH GENERATION DIFFERING BY MORE THAN 0.0 MW OR MVAR:

	IN WORKING CASE		IN SAVED CASE					
X------ BUS -------X	MW	MVAR	MW	MVAR	DELTA MW	%	MVAR	%
29382 [20JKCT1 13.8]	108.9	53.8	108.9	51.1	0.0	0.0	-2.7	5.0
29383 [20JKCT2 13.8]	108.9	54.0	108.9	51.3	0.0	0.0	-2.7	5.0
29384 [20JKCT3 13.8]	108.9	54.1	108.9	51.4	0.0	0.0	-2.7	4.9
29387 [20JKSMIT 138]	271.8	104.0	271.8	58.1	0.0	0.0	-45.9	44.1
29560 [20SPLK1 22.0]	321.8	74.5	321.8	86.8	0.0	0.0	12.4	16.6
29562 [20SPLK2 22.0]	529.7	120.7	529.7	140.7	0.0	0.0	20.1	16.6
29564 [20SPURLK 345]	265.4	61.6	265.4	71.9	0.0	0.0	10.2	16.6

OUTPUT COMPLETED

PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E THU, JUL 17 2003 17:03
COMPARISON OF THE WORKING CASE AND THE SAVED CASE

BUSES WITH SHUNTS DIFFERING BY MORE THAN 0.0 MW OR MVAR:

	IN WORKING CASE		IN SAVED CASE					
X------ BUS -------X	MW	MVAR	MW	MVAR	DELTA MW	%	MVAR	%
29392 [20KEITH 69.0]	0.0	0.0	0.0	8.2	0.0	0.0	8.2	999.9
29418 [20MAGGRD69.0]	0.0	0.0	0.0	12.2	0.0	0.0	12.2	999.9
29444 [20MILBRG69.0]	0.0	6.1	0.0	5.1	0.0	0.0	-1.0	16.7
29448 [20MT OLV69.0]	0.0	7.1	0.0	13.3	0.0	0.0	6.1	85.7
29543 [20SHEPVL69.0]	0.0	0.0	0.0	13.8	0.0	0.0	13.8	999.9
29603 [20TYNER 69.0]	0.0	0.0	0.0	24.5	0.0	0.0	24.5	999.9

OUTPUT COMPLETED

PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E THU, JUL 17 2003 17:03
COMPARISON OF THE WORKING CASE AND THE SAVED CASE

BRANCHES WITH DIFFERENT SERVICE STATUS OR IN ONE CASE ONLY:

			IN WORKING CASE	IN SAVED CASE
X---- FROM BUS ----X	X----- TO BUS -----X	CKT	STATUS	STATUS
27143 [11SPENC 138]	29387 [20JKSMIT 138]	1	1	0
29355 [20HIGHLD69.0]	29410 [20LIBERT69.0]	1	NOT FOUND	0
29395 [20LNCSTR69.0]	29614 [20WBEREA69.0]	1	NOT FOUND	1

OUTPUT COMPLETED

PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E THU, JUL 17 2003 17:03
COMPARISON OF THE WORKING CASE AND THE SAVED CASE

BRANCHES WITH DIFFERENT IMPEDANCE OR CHARGING:

```
                                                          IN WORKING CASE           IN
SAVED CASE
X---- FROM BUS ----X X----- TO BUS -----X CKT        R         X         B           R
X         B
29195 [20ANNVLJ69.0] 29307 [20EBERLJ69.0]  1      0.18900   0.15750   0.00200     0.01910
0.11260   0.00250
29271 [20COLMSV69.0] 29323 [20F OAKJ69.0]  1      0.18640   0.15280   0.00200     0.03020
0.11350   0.00230
29271 [20COLMSV69.0] 29514 [20RENAKR69.0]  1      0.12560   0.10980   0.00150     0.02350
0.08760   0.00180
29280 [20CRESTN69.0] 29490 [20PHIL  69.0]  1      0.05340   0.10660   0.00170     0.04690
0.09370   0.00150
29307 [20EBERLJ69.0] 29423 [20MAPLSJ69.0]  1      0.08970   0.07760   0.00090     0.00910
0.05620   0.00110
29338 [20GRNTLK69.0] 29574 [20SPRKJ269.0]  1      0.24020   0.23960   0.00320     0.04530
0.19050   0.00360
29355 [20HIGHLD69.0] 29410 [20LIBERT69.0]  1              NOT FOUND               0.09710
0.23030   0.00380
29395 [20LNCSTR69.0] 29614 [20WBEREA69.0]  1              NOT FOUND               0.03440
0.22690   0.00390
29460 [20NANCY 69.0] 29622 [20W SOM 69.0]  1      0.10380   0.10690   0.00140     0.02100
0.08130   0.00160
29460 [20NANCY 69.0] 29631 [20WINDSR69.0]  1      0.17430   0.17550   0.00240     0.03530
0.13240   0.00270

OUTPUT COMPLETED


     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      THU, JUL 17 2003  17:03
COMPARISON OF THE WORKING CASE AND THE SAVED CASE

BRANCHES WITH DIFFERENT LINE RATINGS:
                                                          IN WORKING CASE      IN SAVED CASE
X---- FROM BUS ----X X----- TO BUS -----X CKT     RATEA   RATEB   RATEC     RATEA   RATEB
RATEC
29195 [20ANNVLJ69.0] 29307 [20EBERLJ69.0]  1       27.0    32.0     0.0      126.0   143.0
0.0
29227 [20BONNIE69.0] 29452 [20MUNFVL69.0]  1       72.0    72.0     0.0       88.0   108.0
0.0
29230 [20BOONE 69.0] 29299 [20DEVON 69.0]  1       72.0    72.0     0.0      113.0   140.0
0.0
29251 [20BURKSJ69.0] 29584 [20SSHADE69.0]  1       72.0    72.0     0.0       88.0   108.0
0.0
29254 [20CAMPTN69.0] 29352 [20HELCHW69.0]  1       72.0    72.0     0.0       88.0   108.0
0.0
29271 [20COLMSV69.0] 29323 [20F OAKJ69.0]  1       27.0    32.0     0.0       88.0   108.0
0.0
29271 [20COLMSV69.0] 29514 [20RENAKR69.0]  1       27.0    32.0     0.0       88.0   108.0
0.0
29280 [20CRESTN69.0] 29490 [20PHIL  69.0]  1       23.0    23.0     0.0       53.0    53.0
0.0
29299 [20DEVON 69.0] 29600 [20TRKYFJ69.0]  1       72.0    72.0     0.0      113.0   140.0
0.0
29302 [20DURO J69.0] 29572 [20SPRKJ169.0]  1       72.0    72.0     0.0      113.0   140.0
0.0
29302 [20DURO J69.0] 29600 [20TRKYFJ69.0]  1       72.0    72.0     0.0      113.0   140.0
0.0
29307 [20EBERLJ69.0] 29423 [20MAPLSJ69.0]  1       27.0    32.0     0.0      126.0   143.0
0.0
29326 [20FRCKBJ69.0] 29459 [20N SPR 69.0]  1       23.0    23.0     0.0       53.0    53.0
0.0
29326 [20FRCKBJ69.0] 29634 [20WOODLN69.0]  1       23.0    23.0     0.0       53.0    53.0
0.0
29327 [20FRNCHB69.0] 29427 [20MARIBJ69.0]  1       72.0    72.0     0.0       88.0   108.0
0.0
29338 [20GRNTLK69.0] 29574 [20SPRKJ269.0]  1       27.0    32.0     0.0       88.0   108.0
0.0
29411 [20LILYTJ69.0] 29634 [20WOODLN69.0]  1       23.0    23.0     0.0       53.0    53.0
0.0
29427 [20MARIBJ69.0] 29435 [20MAYTNJ69.0]  1       72.0    72.0     0.0       88.0   108.0
0.0
```

```
29460 [20NANCY 69.0] 29622 [20W SOM 69.0]  1       30.0    30.0     0.0      88.0   108.0
0.0
29460 [20NANCY 69.0] 29631 [20WINDSR69.0]  1       31.0    37.0     0.0      88.0   108.0
0.0
29572 [20SPRKJ169.0] 29576 [20S PARK69.0]  1       72.0    72.0     0.0     113.0   140.0
0.0
29584 [20SSHADE69.0] 29618 [20WCOLMJ69.0]  1       72.0    72.0     0.0      88.0   108.0
0.0

OUTPUT COMPLETED
```

D.2 69 kV detail near the point of interconnection

69 kV detail, added to the model near the point of interconnection, has been presented below.

Change the loads at the following existing busses to the values listed

			MW	MVAR
27292	11W IRVI	69	0	0
27179	11BEATTY	69	4.8	1.4
27243	11LK REB	69	93	28.4

Create the following new load busses with the indicated load values

		MW	MVAR
Dark Hollow	69	5.5	2.5
Irvine	69	10	4.6
Estill Stone	69	0.6	0.3
Millers Creek	69	2.4	0.8
Bear Track	69	0.3	0.1
Rice EK	69	10	2.7
Waco	69	6.4	2.9

Remove the following lines

27292	11W IRVI	69	to	27179 11BEATTY	69
27292	11W IRVI	69	to	27243 11LK REB	69

Add the following lines:

								Normal Rating	Emergency Rating
						R	X	BC		
27292	11W IRVI	69	to	Dark Hollow	69	0.011	0.0207	0.0004	56	68
	Dark Hollow	69		Irvine	69	0.01	0.019	0.0003	56	68
	Irvine	69		Estill Stone	69	0.045	0.0886	0.0015	56	68
	Estill Stone	69		Millers Creek	69	0.037	0.0724	0.0012	56	68
	Millers Creek	69		Bear Track	69	0.049	0.0963	0.0017	56	68
	Bear Track	69		27179 11BEATTY	69	0.031	0.0608	0.001	56	68

27292	11W IRVI	69		Rice EK	69	0.016	0.0327	0.0006	56	68
	Rice EK	69		Waco	69	0.046	0.0922	0.0016	56	68
	Waco	69	27243	11LK REB	69	0.047	0.0937	0.0016	56	68

D.3 Revised branch ratings

Following are revised ratings of the branches used in this study:

A. 27077 11CLARK 138 to 27088 11FAWKES 138 146/172 summer norm/emer
B. 27088 11FAWKES 138 to 27334 11FAWK T 138 179/179 summer norm/emer
C. 27230 11HOPEWL69.0 to 20LAURLC69.0 72/89 summer norm/emer
D. 27285 11SPRNGF69.0 to 20N SPR 69.0 31/31 summer norm/emer
E. 27209 11FAWKES69.0 to 20CROOKJ69.0 72/79 summer norm/emer
F. 27023 11DELVIN 161 to 27045 11WI TAP 161 176/201
G. 27045 11WI TAP 161 to 27044 11W IRVI 161 171/201

D.4 New transformer ratings

Following are the ratings of new 161/69 kV transformers used in Option 1 and 2 in this study

Option 1: Replacement transformer at West Irvine:

R = 0.0028 pu
X = 0.0759 pu
Gmag = 0.0002 pu
Bmag = -0.0006 pu
Ratings = 90 MVA summer normal, 104 MVA summer emergency

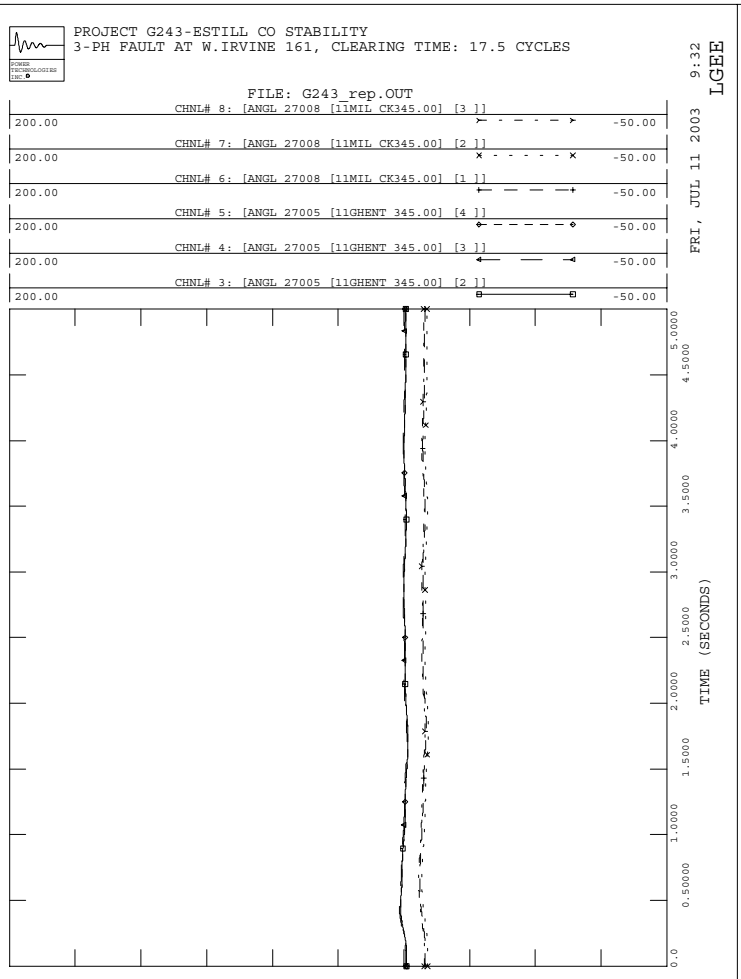
Option 2: Parallel second transformer added at West Irvine:

R = 0.0045 pu
X = 0.1500 pu
Gmag = 0.0004 pu
Bmag = -0.0020 pu
Ratings = 60 MVA summer normal, 69 MVA summer emergency

APPENDIX E
Stability Plots

E.1 3-phase Fault at W.Irvine

Stability plots for a 3-phase fault at West Irvine 161 have been presented in this section. West Irvine to Delvinta 161kV line was opened to clear this fault. Critical Clearing Time was found to be 17.5 cycle. Two scenarios have been reported here - First one shows a stable system when the fault is cleared in 17.5 cycles. Second scenario shows system instability when the fault is cleared in 18.0 cycles.


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 8: [ANGL 27008 [11MIL CK345.00] [3]]
CHNL# 7: [ANGL 27008 [11MIL CK345.00] [2]]
CHNL# 6: [ANGL 27008 [11MIL CK345.00] [1]]
CHNL# 5: [ANGL 27005 [11GHENT 345.00] [4]]
CHNL# 4: [ANGL 27005 [11GHENT 345.00] [3]]
CHNL# 3: [ANGL 27005 [11GHENT 345.00] [2]]
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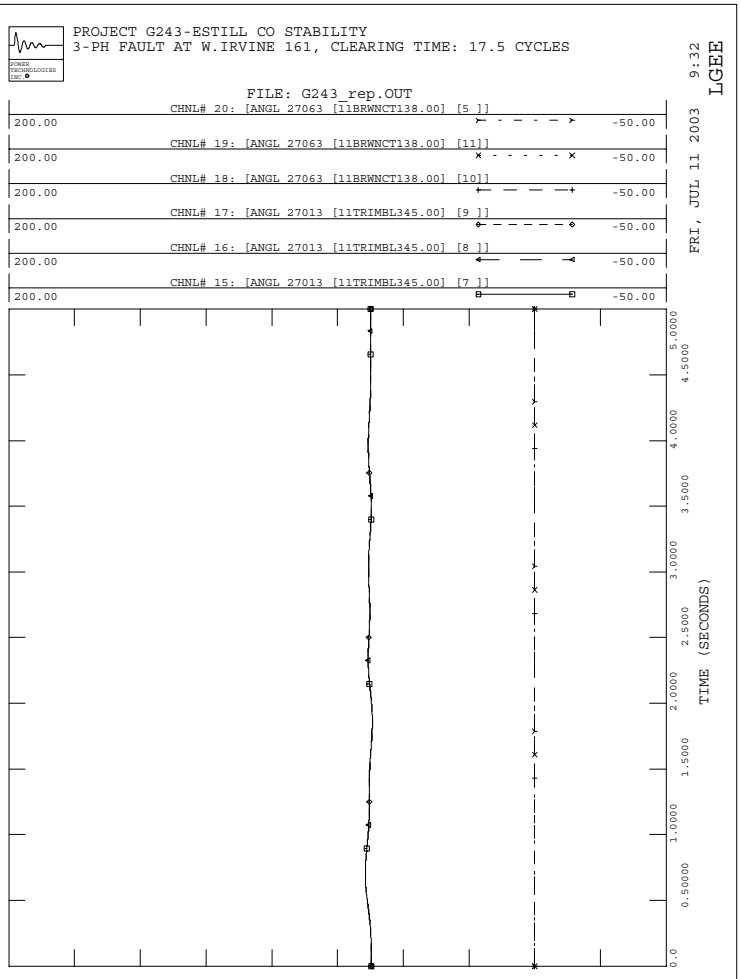
-50.00
TIME (SECONDS)
FRI, JUL 11 2003 9:32
LGEE


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 20: [ANGL 27063 [11BRWNCT138.00] [5]]
CHNL# 19: [ANGL 27063 [11BRWNCT138.00] [11]]
CHNL# 18: [ANGL 27063 [11BRWNCT138.00] [10]]
CHNL# 17: [ANGL 27013 [11TRIMBL345.00] [9]]
CHNL# 16: [ANGL 27013 [11TRIMBL345.00] [8]]
CHNL# 15: [ANGL 27013 [11TRIMBL345.00] [7]]
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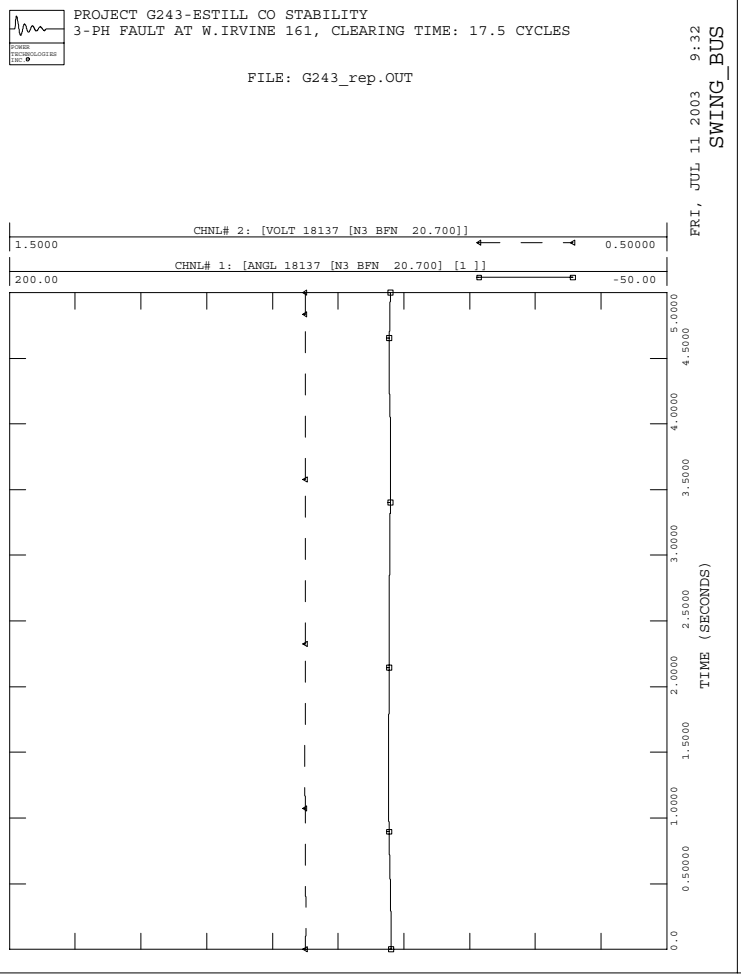
TIME (SECONDS)
FRI, JUL 11 2003 9:32
LGEE


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 2: [VOLT 18137 [N3 BFN 20.700]]
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0.50000
CHNL# 1: [ANGL 18137 [N3 BFN 20.700] [1]]
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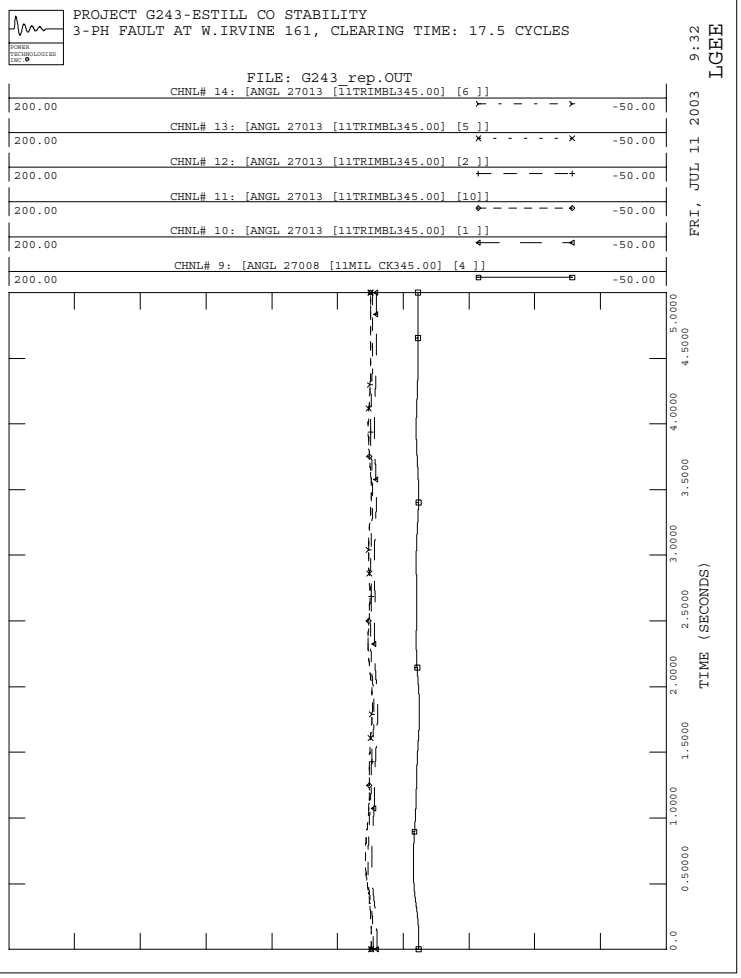
TIME (SECONDS)
FRI, JUL 11 2003 9:32
SWING_BUS


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 14: [ANGL 27013 [11TRIMBL345.00] [6]]
CHNL# 13: [ANGL 27013 [11TRIMBL345.00] [5]]
CHNL# 12: [ANGL 27013 [11TRIMBL345.00] [2]]
CHNL# 11: [ANGL 27013 [11TRIMBL345.00] [10]]
CHNL# 10: [ANGL 27013 [11TRIMBL345.00] [1]]
CHNL# 9: [ANGL 27008 [11MIL CK345.00] [4]]
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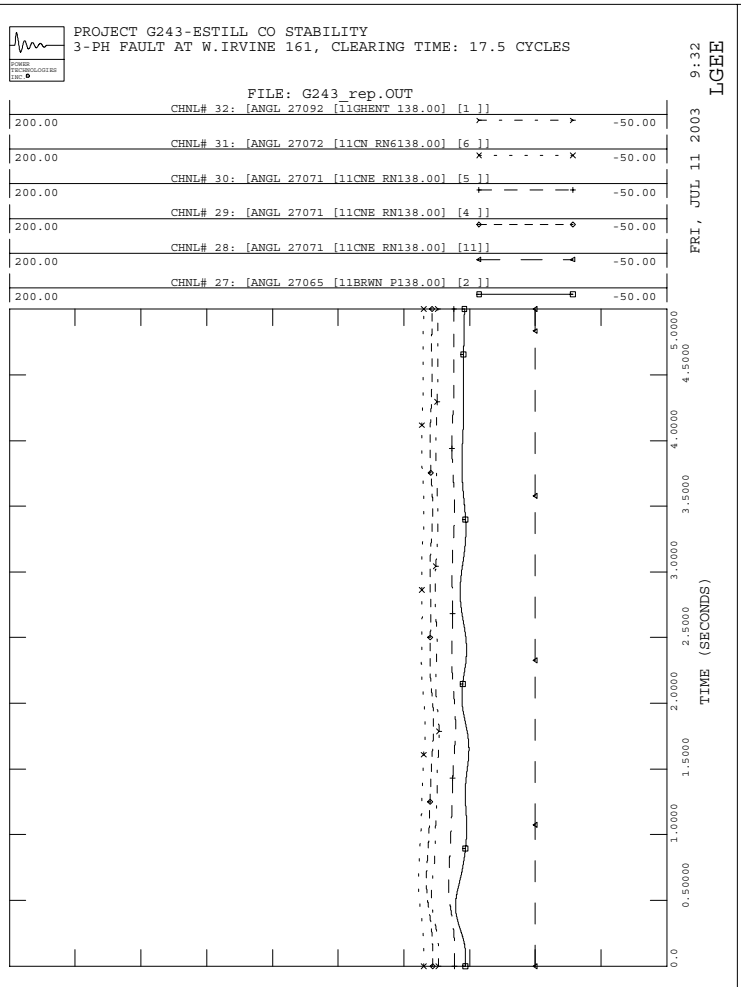
TIME (SECONDS)
FRI, JUL 11 2003 9:32
LGEE


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 32: [ANGL 27092 [11GHENT 138.00] [1]]
CHNL# 31: [ANGL 27072 [11CN RN6138.00] [6]]
CHNL# 30: [ANGL 27071 [11CNE RN138.00] [5]]
CHNL# 29: [ANGL 27071 [11CNE RN138.00] [4]]
CHNL# 28: [ANGL 27071 [11CNE RN138.00] [11]]
CHNL# 27: [ANGL 27065 [11BRWN P138.00] [2]]
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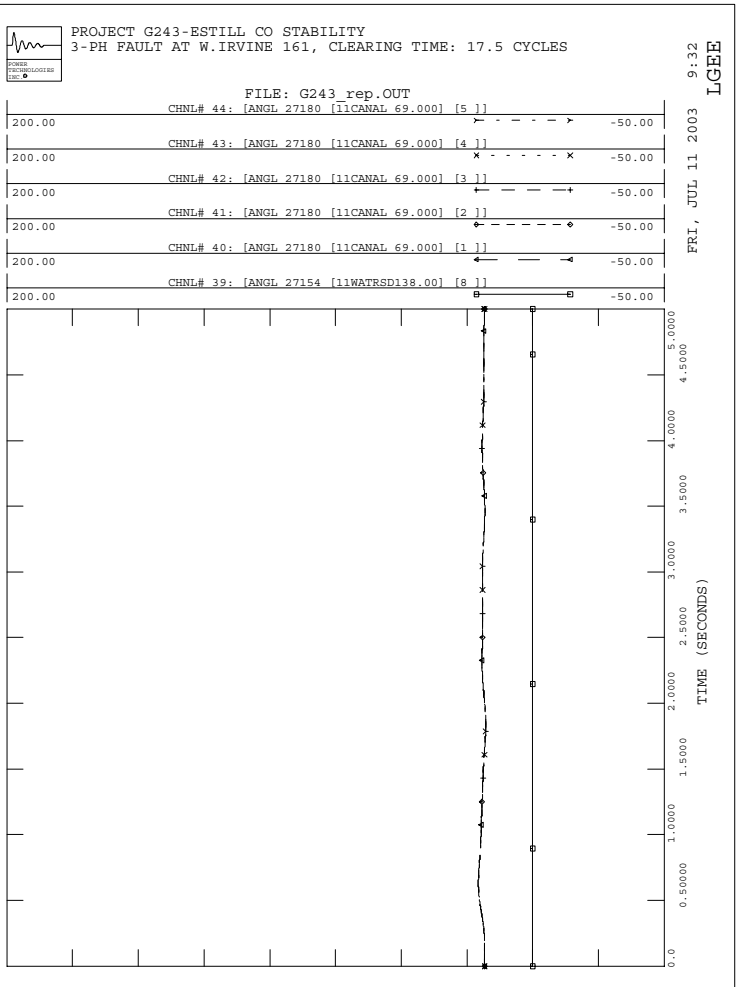
FRI, JUL 11 2003 9:32
LGEE


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 44: [ANGL 27180 [11CANAL 69.000] [5]]
CHNL# 43: [ANGL 27180 [11CANAL 69.000] [4]]
CHNL# 42: [ANGL 27180 [11CANAL 69.000] [3]]
CHNL# 41: [ANGL 27180 [11CANAL 69.000] [2]]
CHNL# 40: [ANGL 27180 [11CANAL 69.000] [1]]
CHNL# 39: [ANGL 27154 [11WATRSD138.00] [8]]
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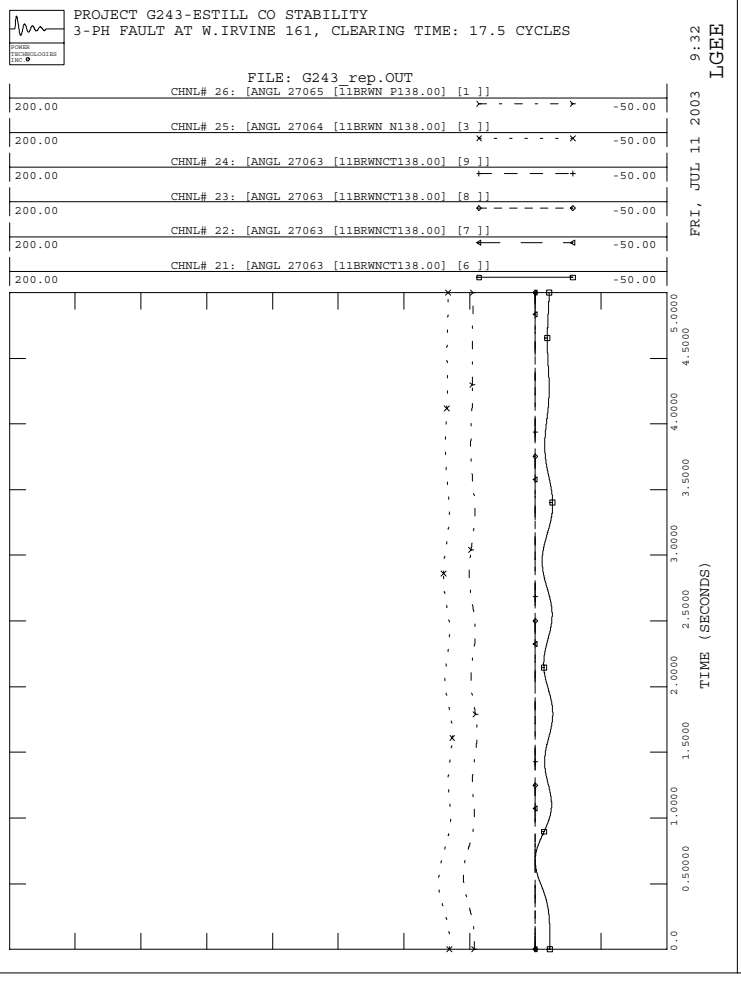
TIME (SECONDS)
FRI, JUL 11 2003 9:32
LGEE


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 26: [ANGL 27065 [11BRWN P138.00] [1]]
CHNL# 25: [ANGL 27064 [11BRWN N138.00] [3]]
CHNL# 24: [ANGL 27063 [11BRWNCT138.00] [9]]
CHNL# 23: [ANGL 27063 [11BRWNCT138.00] [8]]
CHNL# 22: [ANGL 27063 [11BRWNCT138.00] [7]]
CHNL# 21: [ANGL 27063 [11BRWNCT138.00] [6]]
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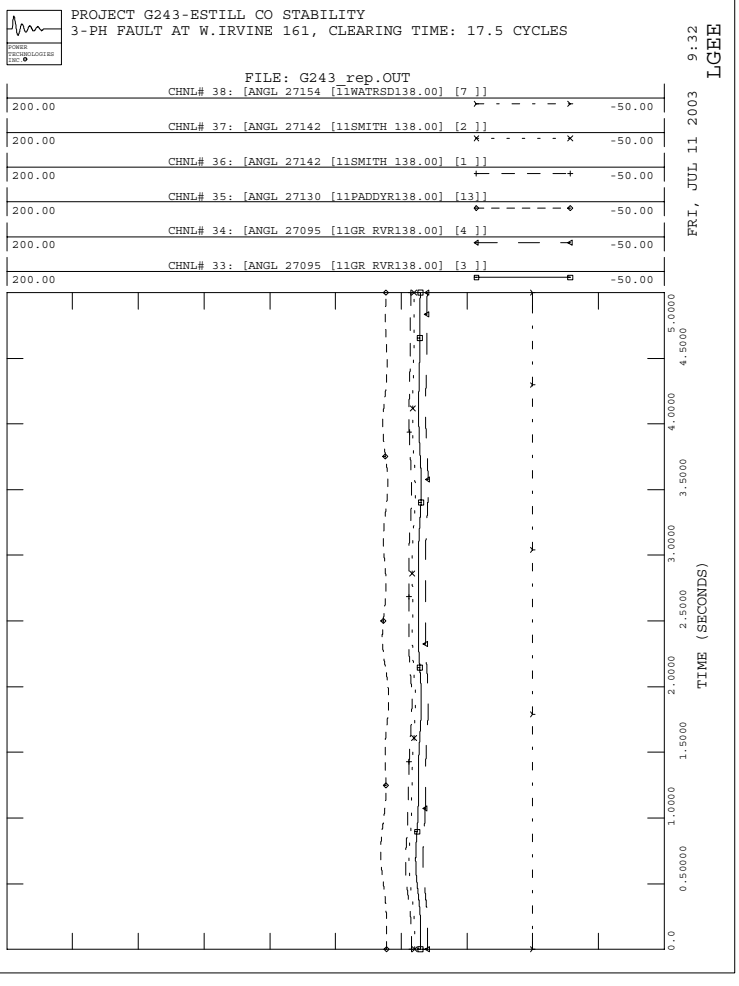
TIME (SECONDS)
FRI, JUL 11 2003 9:32
LGEE


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 38: [ANGL 27154 [11WATRSD138.00] [7]]
CHNL# 37: [ANGL 27142 [11SMITH 138.00] [2]]
CHNL# 36: [ANGL 27142 [11SMITH 138.00] [1]]
CHNL# 35: [ANGL 27130 [11PADDYR138.00] [13]]
CHNL# 34: [ANGL 27095 [11GR RVR138.00] [4]]
CHNL# 33: [ANGL 27095 [11GR RVR138.00] [3]]
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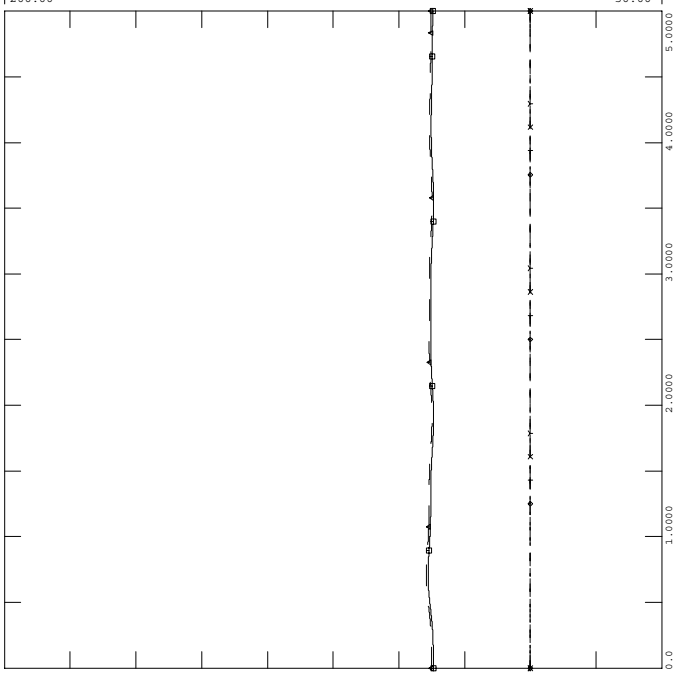
-50.00
TIME (SECONDS)
FRI, JUL 11 2003 9:32
LGEE

PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES

FILE: G243_rep.OUT

9:32 FRI, JUL 11 2003 LGEE

CHNL# 56: [ANGL 27227 [11HLCRST69.000] [1]]
CHNL# 55: [ANGL 27220 [11HAEFLN69.000] [3]]
CHNL# 54: [ANGL 27220 [11HAEFLN69.000] [2]]
CHNL# 53: [ANGL 27220 [11HAEFLN69.000] [1]]
CHNL# 52: [ANGL 27216 [11GR RVR69.000] [2]]
CHNL# 51: [ANGL 27216 [11GR RVR69.000] [1]]

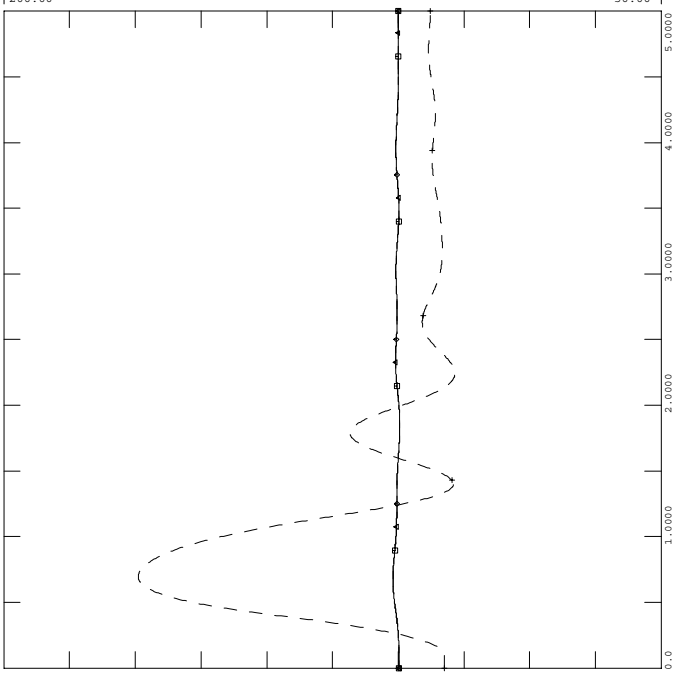


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES

FILE: G243_rep.OUT

9:32 FRI, JUL 11 2003 LGEE

CHNL# 66: [ANGL 27301 [ESTILLCO161.00] [1]]
CHNL# 65: [ANGL 27338 [11BUCKNR345.00] [3]]
CHNL# 64: [ANGL 27338 [11BUCKNR345.00] [2]]
CHNL# 63: [ANGL 27338 [11BUCKNR345.00] [1]]

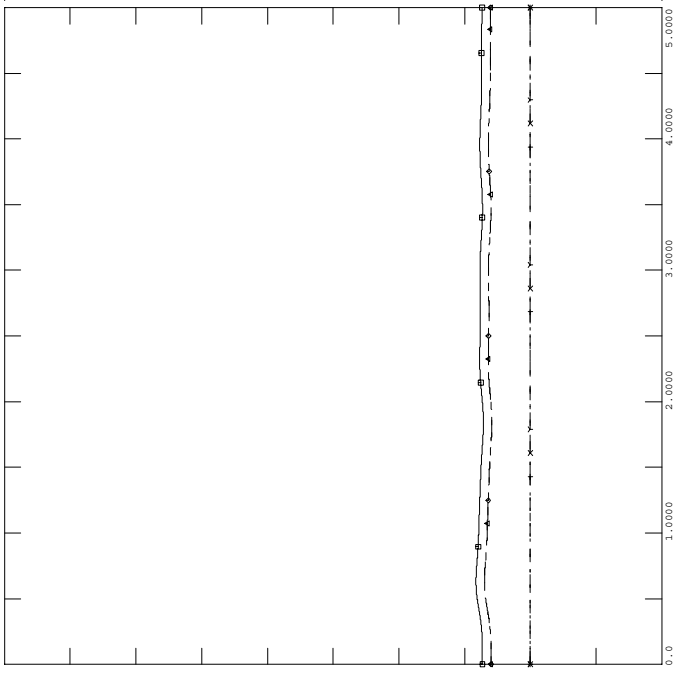


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES

FILE: G243_rep.OUT

9:32 FRI, JUL 11 2003 LGEE

CHNL# 50: [ANGL 27195 [11DIXDAM69.000] [3]]
CHNL# 49: [ANGL 27195 [11DIXDAM69.000] [2]]
CHNL# 48: [ANGL 27195 [11DIXDAM69.000] [1]]
CHNL# 47: [ANGL 27180 [11CANAL 69.000] [8]]
CHNL# 46: [ANGL 27180 [11CANAL 69.000] [7]]
CHNL# 45: [ANGL 27180 [11CANAL 69.000] [6]]

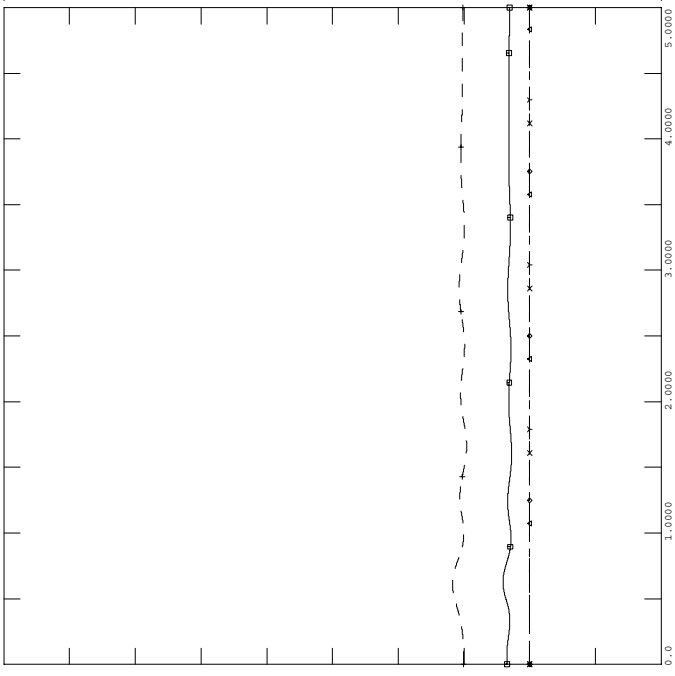


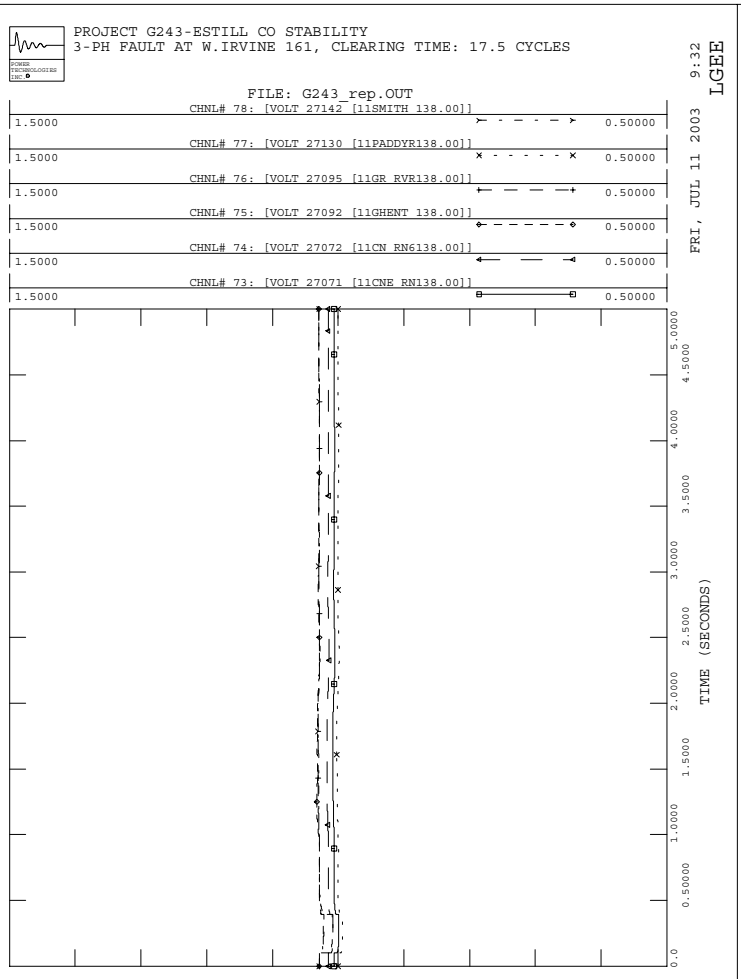
PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES

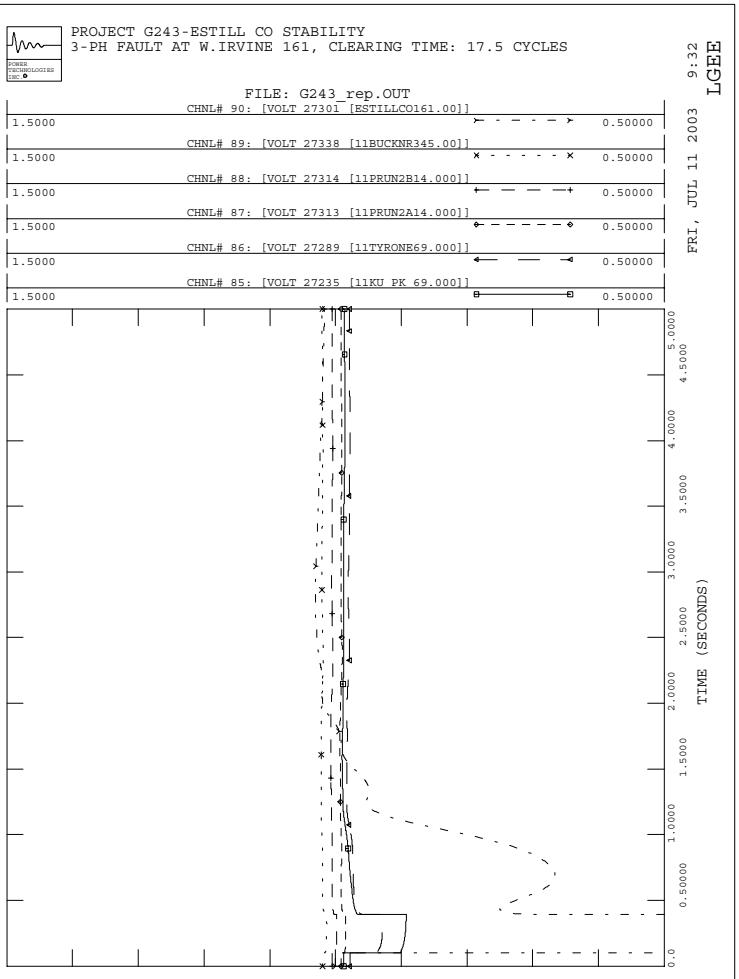
FILE: G243_rep.OUT

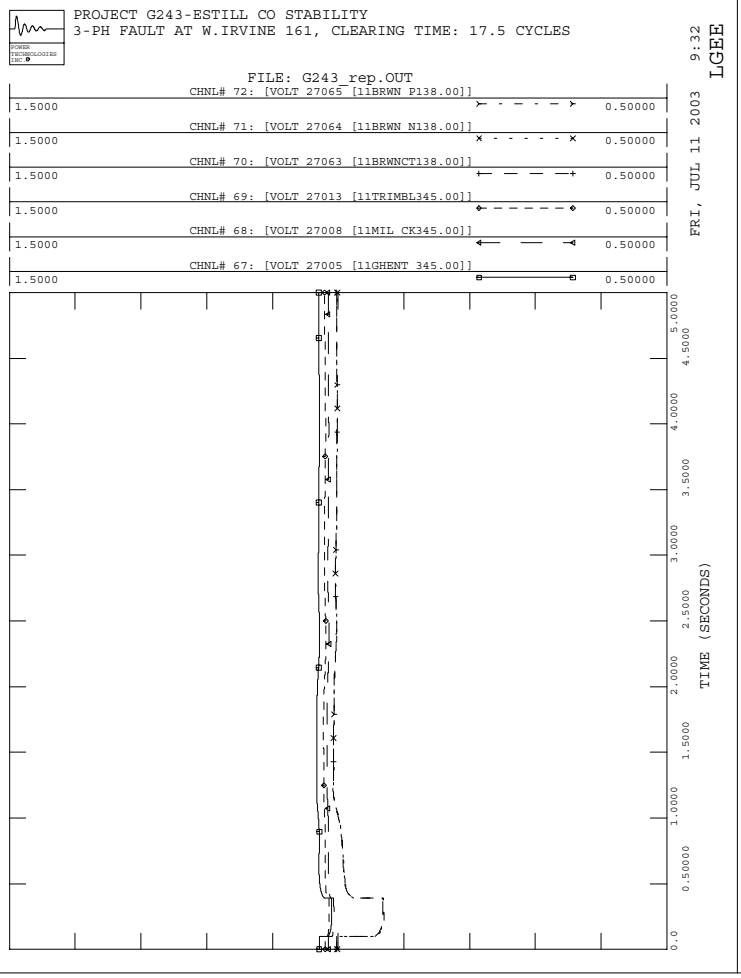
9:32 FRI, JUL 11 2003 LGEE

CHNL# 62: [ANGL 27314 [11PRUN2B14.000] [2]]
CHNL# 61: [ANGL 27313 [11PRUN2A14.000] [1]]
CHNL# 60: [ANGL 27289 [11TYRONE69.000] [3]]
CHNL# 59: [ANGL 27289 [11TYRONE69.000] [2]]
CHNL# 58: [ANGL 27289 [11TYRONE69.000] [1]]
CHNL# 57: [ANGL 27235 [11KU PK 69.000] [3]]




PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 78: [VOLT 27142 [11SMITH 138.00]]
CHNL# 77: [VOLT 27130 [11PADDYR138.00]]
CHNL# 76: [VOLT 27095 [11GR RVR138.00]]
CHNL# 75: [VOLT 27092 [11GHENT 138.00]]
CHNL# 74: [VOLT 27072 [11CN RN6138.00]]
CHNL# 73: [VOLT 27071 [11CNE RN138.00]]
1.5000
0.50000
0.0
0.50000
1.0000
1.5000
2.0000
2.5000
3.0000
3.5000
4.0000
4.5000
5.0000
TIME (SECONDS)
FRI, JUL 11 2003 9:32
LGEE


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 90: [VOLT 27301 [ESTILLCO161.00]]
CHNL# 89: [VOLT 27338 [11BUCKNR345.00]]
CHNL# 88: [VOLT 27314 [11PRUN2B14.000]]
CHNL# 87: [VOLT 27313 [11PRUN2A14.000]]
CHNL# 86: [VOLT 27289 [11TYRONE69.000]]
CHNL# 85: [VOLT 27235 [11KU PK 69.000]]
1.5000
0.50000
0.0
0.50000
1.0000
1.5000
2.0000
2.5000
3.0000
3.5000
4.0000
4.5000
5.0000
TIME (SECONDS)
FRI, JUL 11 2003 9:32
LGEE


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 72: [VOLT 27065 [11BRWN P138.00]]
CHNL# 71: [VOLT 27064 [11BRWN N138.00]]
CHNL# 70: [VOLT 27063 [11BRWNCT138.00]]
CHNL# 69: [VOLT 27013 [11TRIMBL345.00]]
CHNL# 68: [VOLT 27008 [11MIL CK345.00]]
CHNL# 67: [VOLT 27005 [11GHENT 345.00]]
1.5000
0.50000
0.0
0.50000
1.0000
1.5000
2.0000
2.5000
3.0000
3.5000
4.0000
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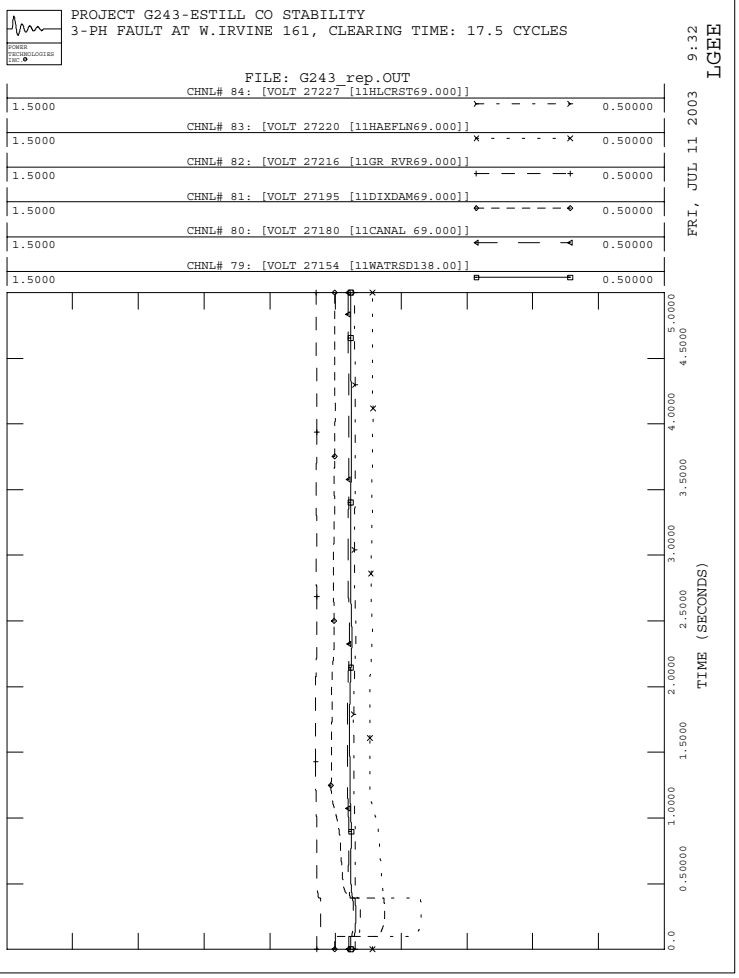
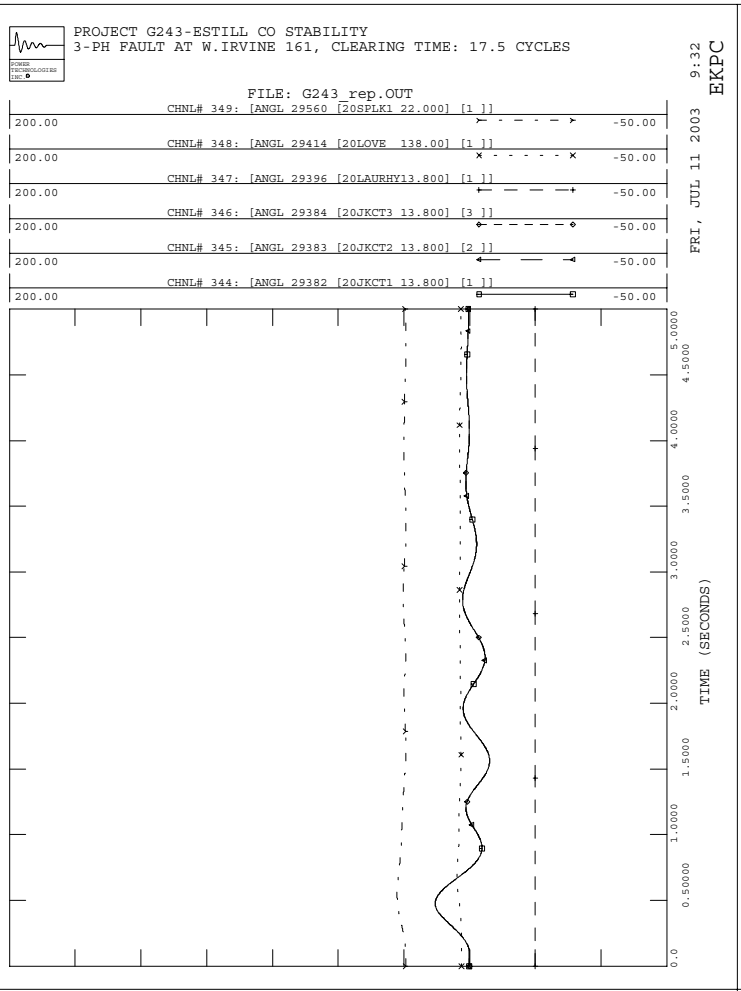
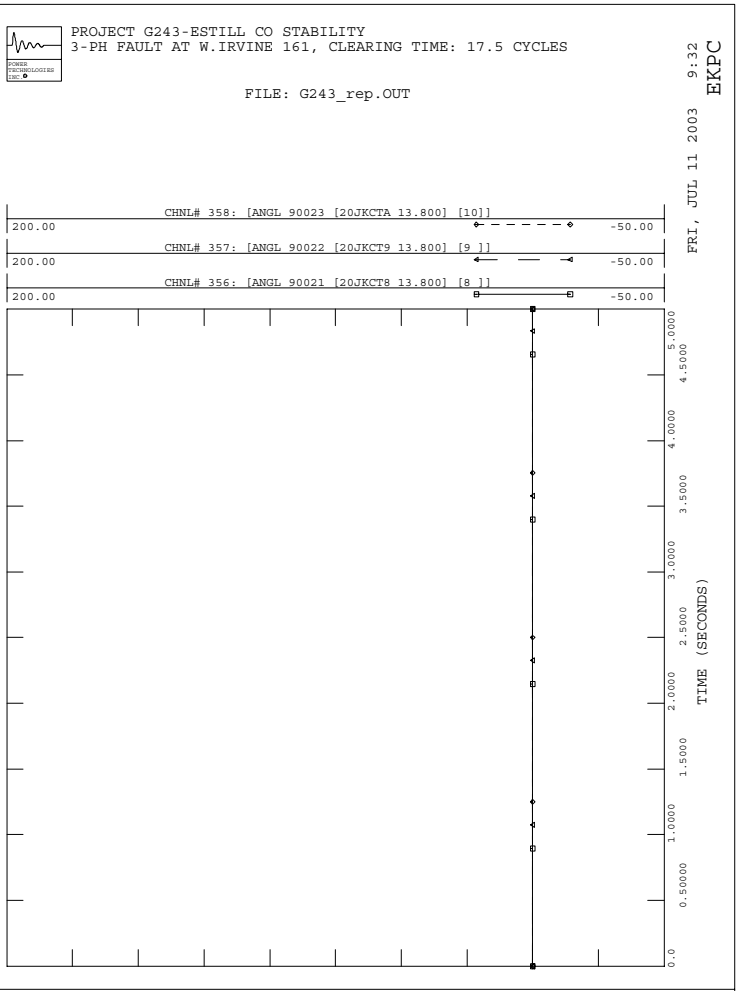
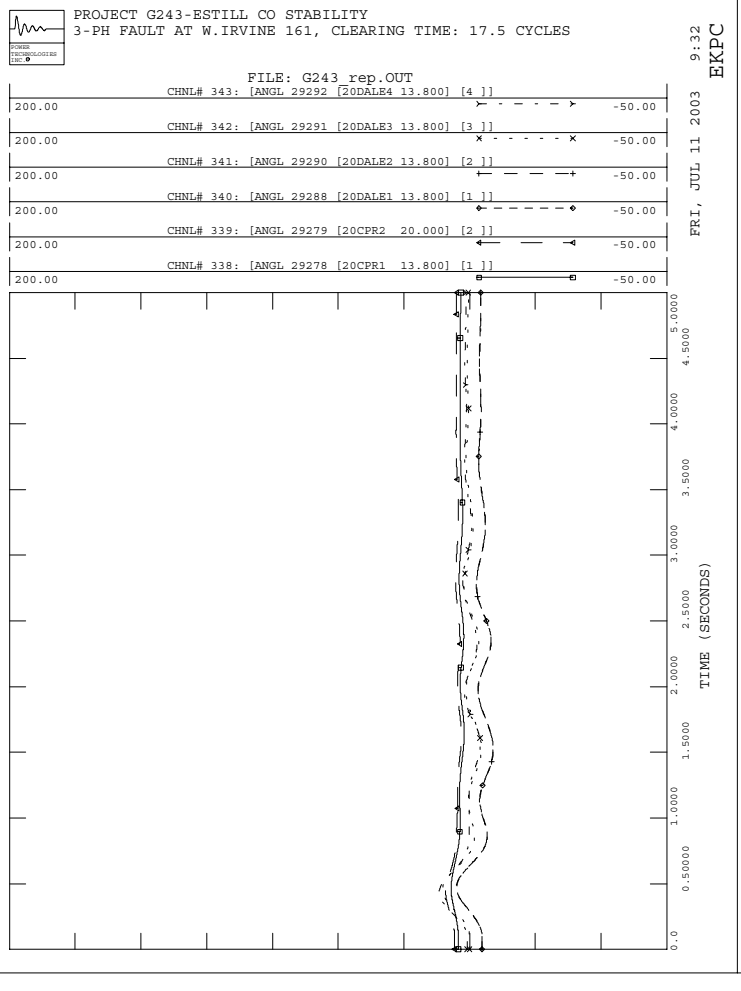
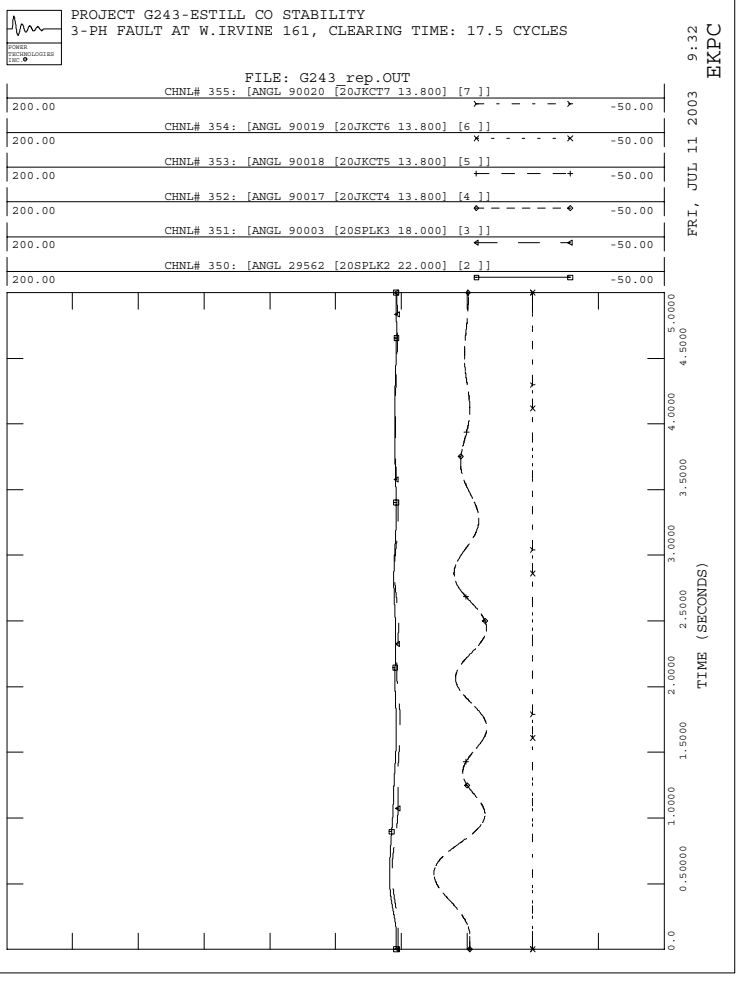
5.0000
TIME (SECONDS)
FRI, JUL 11 2003 9:32
LGEE

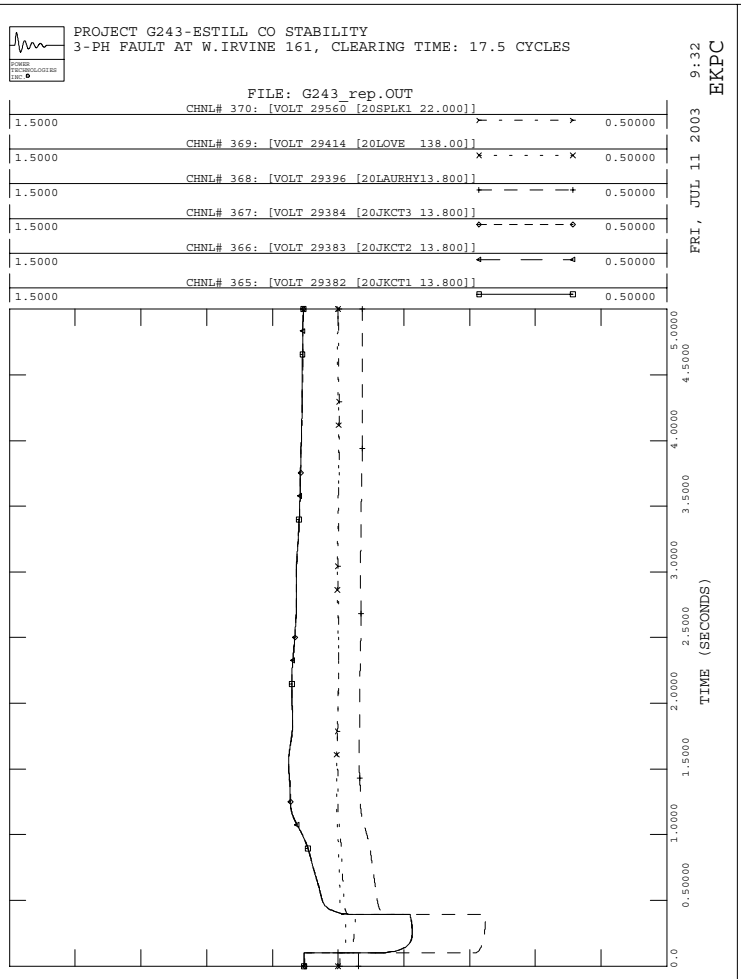

PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 84: [VOLT 27227 [11HLCRST69.000]]
CHNL# 83: [VOLT 27220 [11HAEFLN69.000]]
CHNL# 82: [VOLT 27216 [11GR RVR69.000]]
CHNL# 81: [VOLT 27195 [11DIXDAM69.000]]
CHNL# 80: [VOLT 27180 [11CANAL 69.000]]
CHNL# 79: [VOLT 27154 [11WATRSD138.00]]
1.5000
0.50000
0.0
0.50000
1.0000
1.5000
2.0000
2.5000
3.0000
3.5000
4.0000
4.5000
5.0000
TIME (SECONDS)
FRI, JUL 11 2003 9:32
LGEE

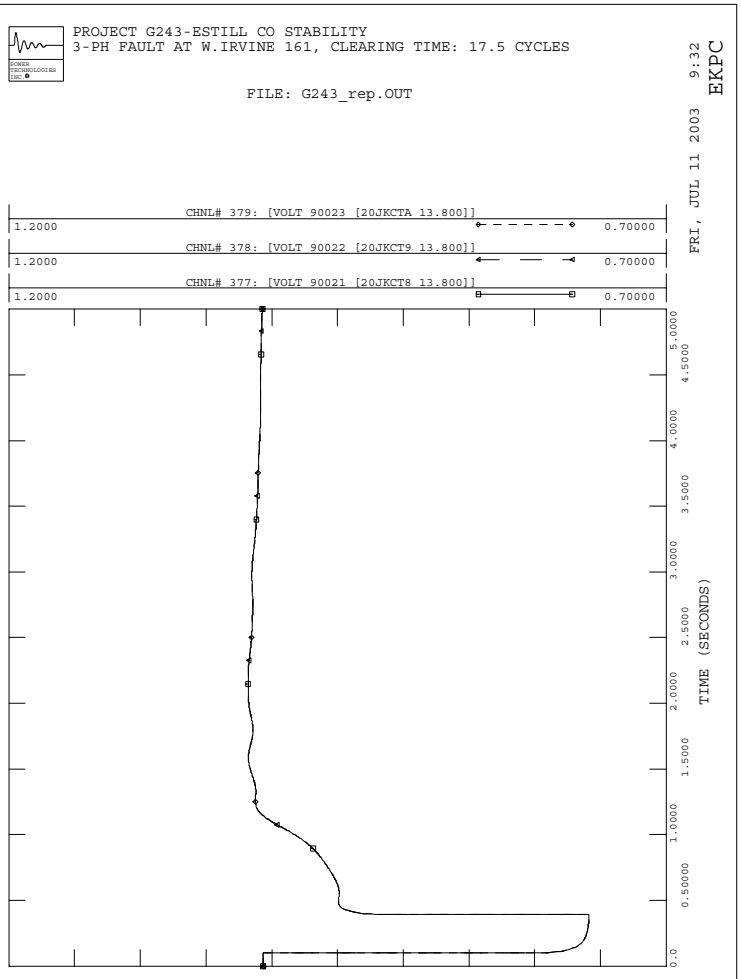

PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 349: [ANGL 29560 [20SPLK1 22.000] [1]]
CHNL# 348: [ANGL 29414 [20LOVE 138.00] [1]]
CHNL# 347: [ANGL 29396 [20LAURHY13.800] [1]]
CHNL# 346: [ANGL 29384 [20JKCT3 13.800] [3]]
CHNL# 345: [ANGL 29383 [20JKCT2 13.800] [2]]
CHNL# 344: [ANGL 29382 [20JKCT1 13.800] [1]]
200.00
-50.00
0.0
0.50000
1.0000
1.5000
2.0000
2.5000
3.0000
3.5000
4.0000
4.5000
5.0000
TIME (SECONDS)
FRI, JUL 11 2003 9:32
EKPC

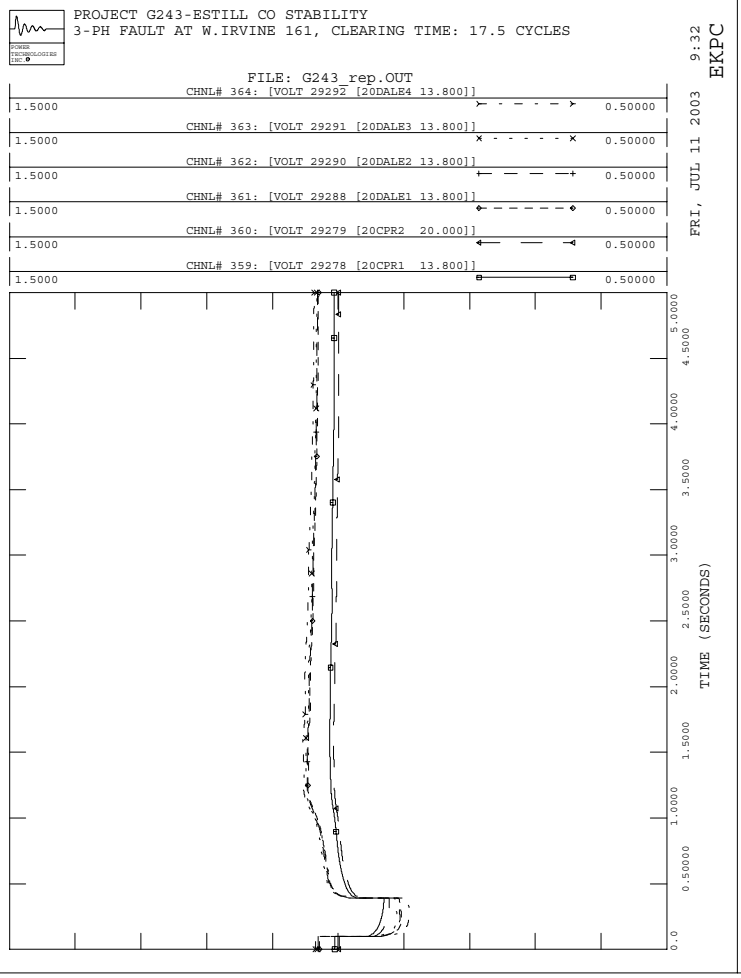

PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 358: [ANGL 90023 [20JKCTA 13.800] [10]]
CHNL# 357: [ANGL 90022 [20JKCT9 13.800] [9]]
CHNL# 356: [ANGL 90021 [20JKCT8 13.800] [8]]
200.00
-50.00
0.0
0.50000
1.0000
1.5000
2.0000
2.5000
3.0000
3.5000
4.0000
4.5000
5.0000
TIME (SECONDS)
FRI, JUL 11 2003 9:32
EKPC


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 343: [ANGL 29292 [20DALE4 13.800] [4]]
CHNL# 342: [ANGL 29291 [20DALE3 13.800] [3]]
CHNL# 341: [ANGL 29290 [20DALE2 13.800] [2]]
CHNL# 340: [ANGL 29288 [20DALE1 13.800] [1]]
CHNL# 339: [ANGL 29279 [20CPR2 20.000] [2]]
CHNL# 338: [ANGL 29278 [20CPR1 13.800] [1]]
200.00
-50.00
0.0
0.50000
1.0000
1.5000
2.0000
2.5000
3.0000
3.5000
4.0000
4.5000
5.0000
TIME (SECONDS)
FRI, JUL 11 2003 9:32
EKPC


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 355: [ANGL 90020 [20JKCT7 13.800] [7]]
CHNL# 354: [ANGL 90019 [20JKCT6 13.800] [6]]
CHNL# 353: [ANGL 90018 [20JKCT5 13.800] [5]]
CHNL# 352: [ANGL 90017 [20JKCT4 13.800] [4]]
CHNL# 351: [ANGL 90003 [20SPLK3 18.000] [3]]
CHNL# 350: [ANGL 29562 [20SPLK2 22.000] [2]]
200.00
-50.00
0.0
0.50000
1.0000
1.5000
2.0000
2.5000
3.0000
3.5000
4.0000
4.5000
5.0000
TIME (SECONDS)
FRI, JUL 11 2003 9:32
EKPC


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 370: [VOLT 29560 [20SPLK1 22.000]]
CHNL# 369: [VOLT 29414 [20LOVE 138.00]]
CHNL# 368: [VOLT 29396 [20LAURHY13.800]]
CHNL# 367: [VOLT 29384 [20JKCT3 13.800]]
CHNL# 366: [VOLT 29383 [20JKCT2 13.800]]
CHNL# 365: [VOLT 29382 [20JKCT1 13.800]]
1.5000
0.50000
TIME (SECONDS)
FRI, JUL 11 2003 9:32
EKPC


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 379: [VOLT 90023 [20JKCTA 13.800]]
CHNL# 378: [VOLT 90022 [20JKCT9 13.800]]
CHNL# 377: [VOLT 90021 [20JKCT8 13.800]]
1.2000
0.70000
TIME (SECONDS)
FRI, JUL 11 2003 9:32
EKPC


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
FILE: G243_rep.OUT
CHNL# 364: [VOLT 29292 [20DALE4 13.800]]
CHNL# 363: [VOLT 29291 [20DALE3 13.800]]
CHNL# 362: [VOLT 29290 [20DALE2 13.800]]
CHNL# 361: [VOLT 29288 [20DALE1 13.800]]
CHNL# 360: [VOLT 29279 [20CPR2 20.000]]
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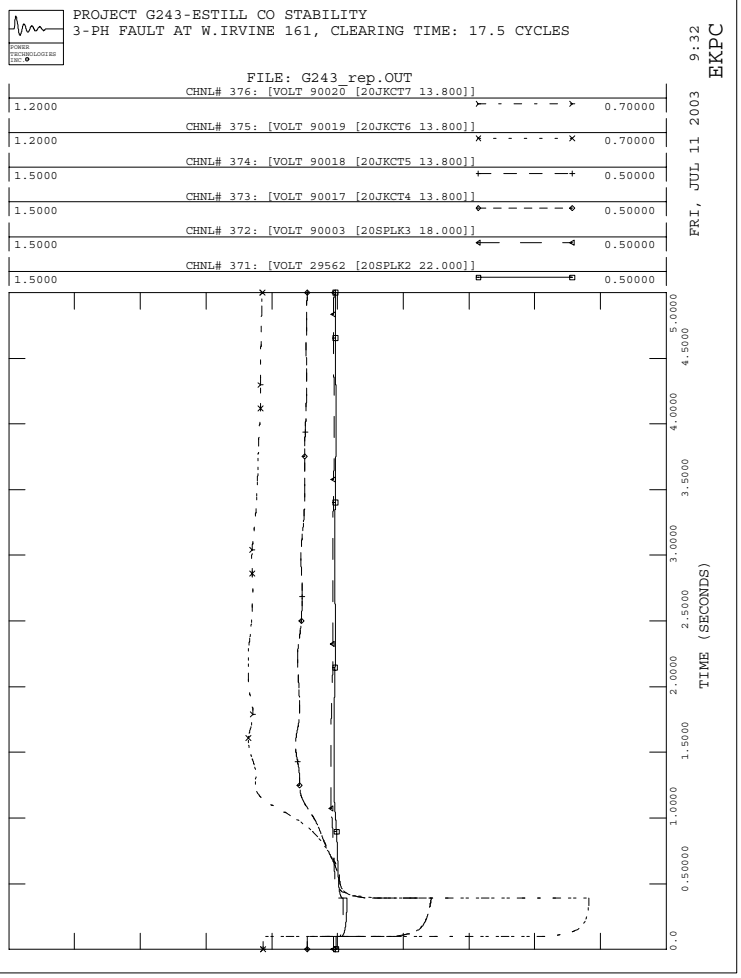
PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 17.5 CYCLES
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CHNL# 376: [VOLT 90020 [20JKCT7 13.800]]
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CHNL# 374: [VOLT 90018 [20JKCT5 13.800]]
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CHNL# 371: [VOLT 29562 [20SPLK2 22.000]]
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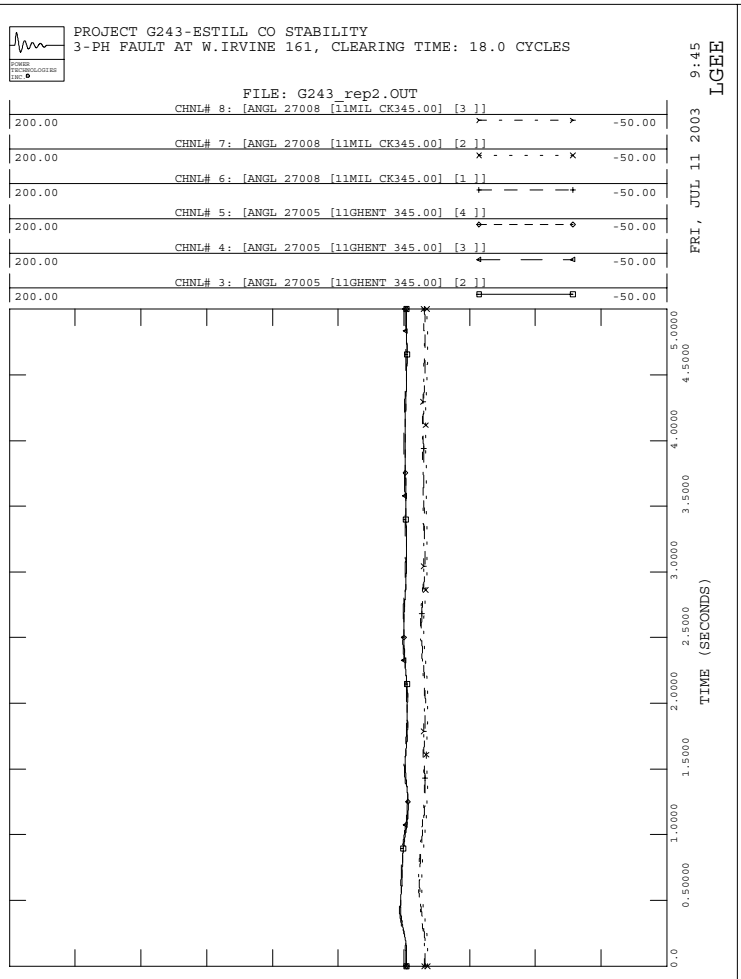
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FILE: G243_rep2.OUT
CHNL# 8: [ANGL 27008 [11MIL CK345.00] [3]]
CHNL# 7: [ANGL 27008 [11MIL CK345.00] [2]]
CHNL# 6: [ANGL 27008 [11MIL CK345.00] [1]]
CHNL# 5: [ANGL 27005 [11GHENT 345.00] [4]]
CHNL# 4: [ANGL 27005 [11GHENT 345.00] [3]]
CHNL# 3: [ANGL 27005 [11GHENT 345.00] [2]]
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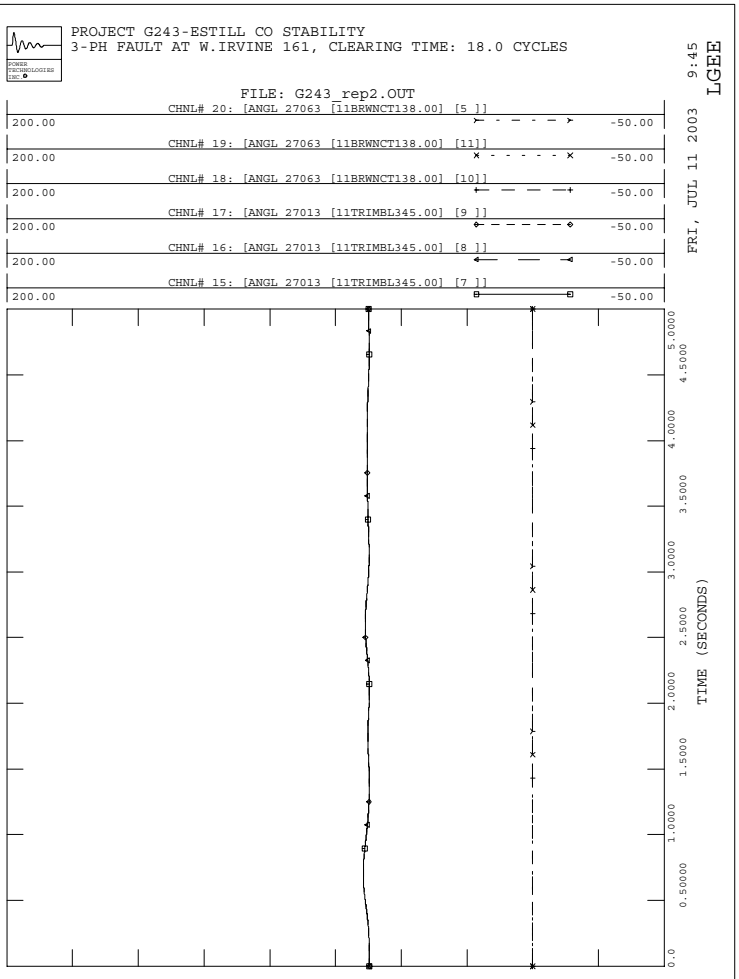
PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
FILE: G243_rep2.OUT
CHNL# 20: [ANGL 27063 [11BRWNCT138.00] [5]]
CHNL# 19: [ANGL 27063 [11BRWNCT138.00] [11]]
CHNL# 18: [ANGL 27063 [11BRWNCT138.00] [10]]
CHNL# 17: [ANGL 27013 [11TRIMBL345.00] [9]]
CHNL# 16: [ANGL 27013 [11TRIMBL345.00] [8]]
CHNL# 15: [ANGL 27013 [11TRIMBL345.00] [7]]
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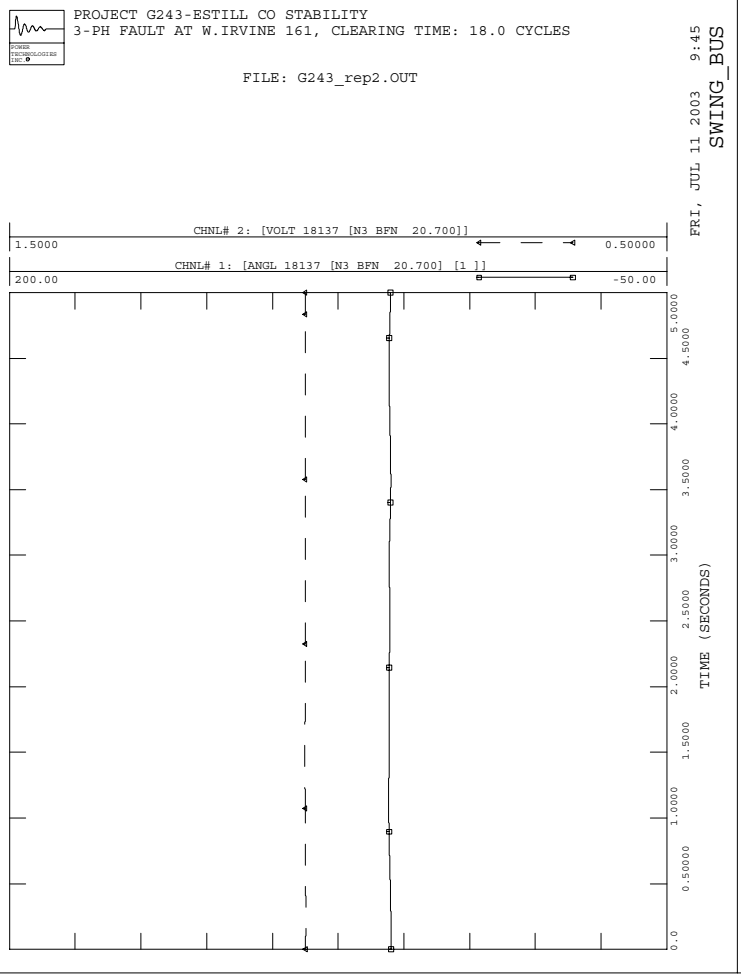
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3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
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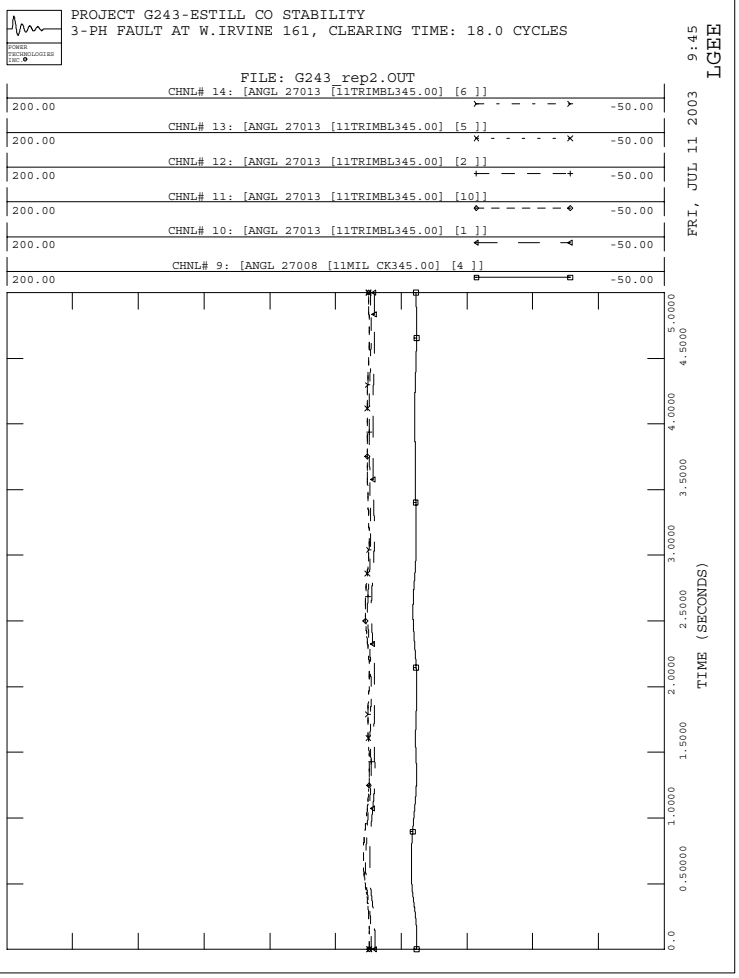
PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
FILE: G243_rep2.OUT
CHNL# 14: [ANGL 27013 [11TRIMBL345.00] [6]]
CHNL# 13: [ANGL 27013 [11TRIMBL345.00] [5]]
CHNL# 12: [ANGL 27013 [11TRIMBL345.00] [2]]
CHNL# 11: [ANGL 27013 [11TRIMBL345.00] [10]]
CHNL# 10: [ANGL 27013 [11TRIMBL345.00] [1]]
CHNL# 9: [ANGL 27008 [11MIL CK345.00] [4]]
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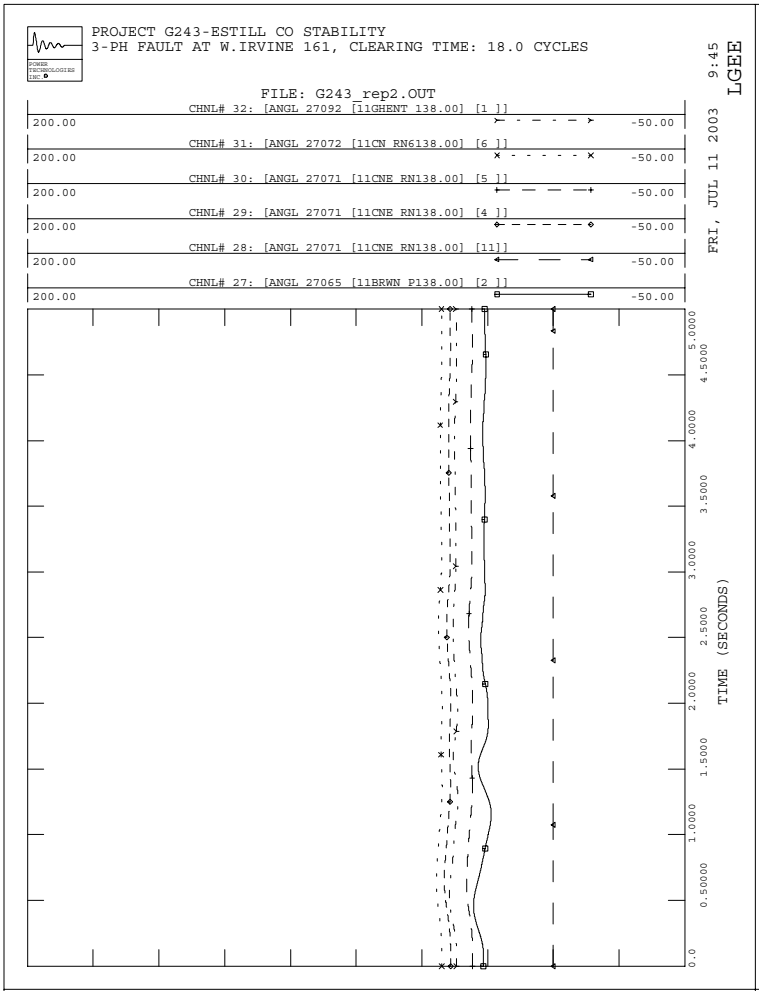
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3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
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LGEE
FRI, JUL 11 2003
CHNL# 32: [ANGL 27092 [11GHENT 138.00] [1]]
CHNL# 31: [ANGL 27072 [11CN RN6138.00] [6]]
CHNL# 30: [ANGL 27071 [11CNE RN138.00] [5]]
CHNL# 29: [ANGL 27071 [11CNE RN138.00] [4]]
CHNL# 28: [ANGL 27071 [11CNE RN138.00] [11]]
CHNL# 27: [ANGL 27065 [11BRWN P138.00] [2]]
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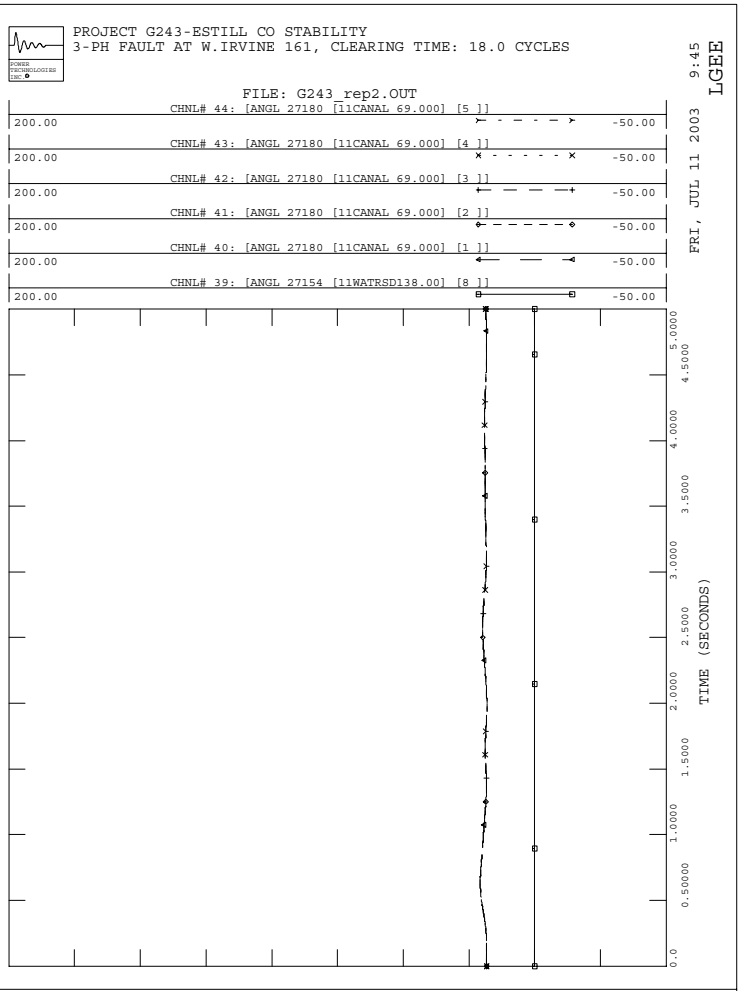
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3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
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LGEE
FRI, JUL 11 2003
CHNL# 44: [ANGL 27180 [11CANAL 69.000] [5]]
CHNL# 43: [ANGL 27180 [11CANAL 69.000] [4]]
CHNL# 42: [ANGL 27180 [11CANAL 69.000] [3]]
CHNL# 41: [ANGL 27180 [11CANAL 69.000] [2]]
CHNL# 40: [ANGL 27180 [11CANAL 69.000] [1]]
CHNL# 39: [ANGL 27154 [11WATRSD138.00] [8]]
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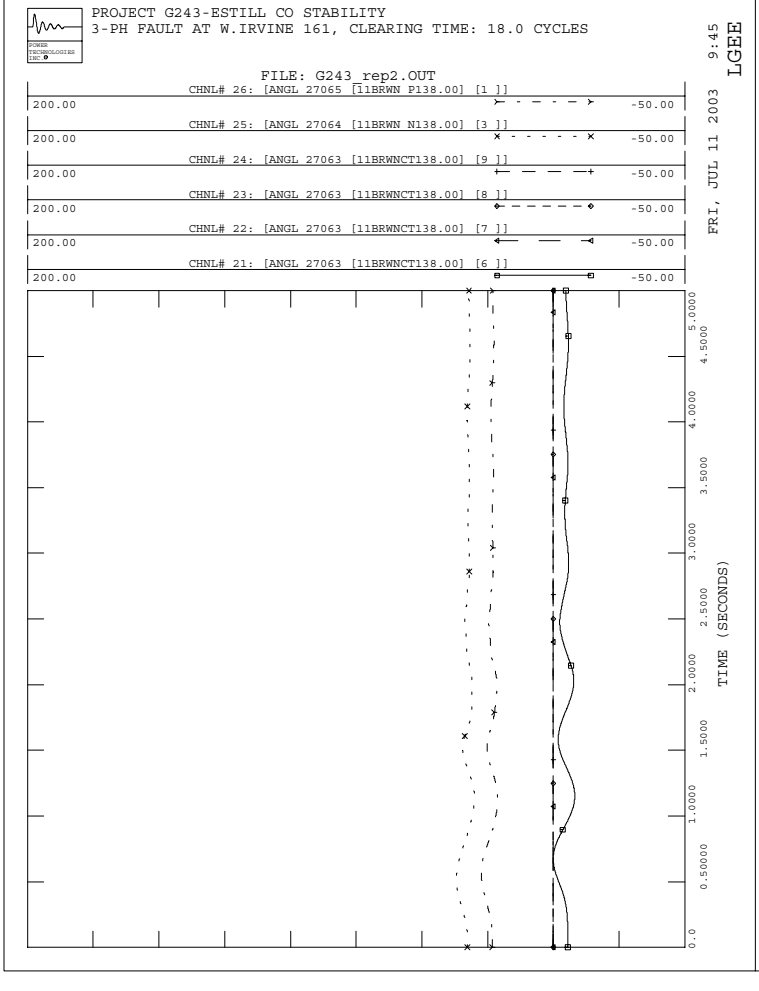
PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
FILE: G243_rep2.OUT
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FRI, JUL 11 2003
CHNL# 26: [ANGL 27065 [11BRWN P138.00] [1]]
CHNL# 25: [ANGL 27064 [11BRWN N138.00] [3]]
CHNL# 24: [ANGL 27063 [11BRWNCT138.00] [9]]
CHNL# 23: [ANGL 27063 [11BRWNCT138.00] [8]]
CHNL# 22: [ANGL 27063 [11BRWNCT138.00] [7]]
CHNL# 21: [ANGL 27063 [11BRWNCT138.00] [6]]
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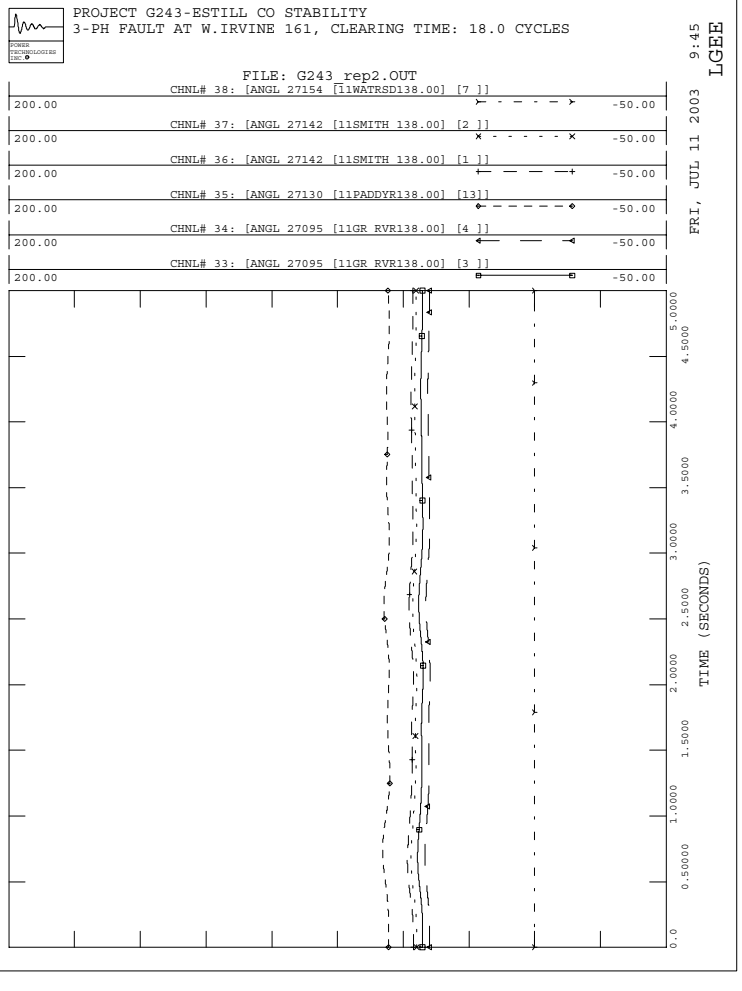
TIME (SECONDS)


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
FILE: G243_rep2.OUT
9:45
LGEE
FRI, JUL 11 2003
CHNL# 38: [ANGL 27154 [11WATRSD138.00] [7]]
CHNL# 37: [ANGL 27142 [11SMITH 138.00] [2]]
CHNL# 36: [ANGL 27142 [11SMITH 138.00] [1]]
CHNL# 35: [ANGL 27130 [11PADDYR138.00] [13]]
CHNL# 34: [ANGL 27095 [11GR RVR138.00] [4]]
CHNL# 33: [ANGL 27095 [11GR RVR138.00] [3]]
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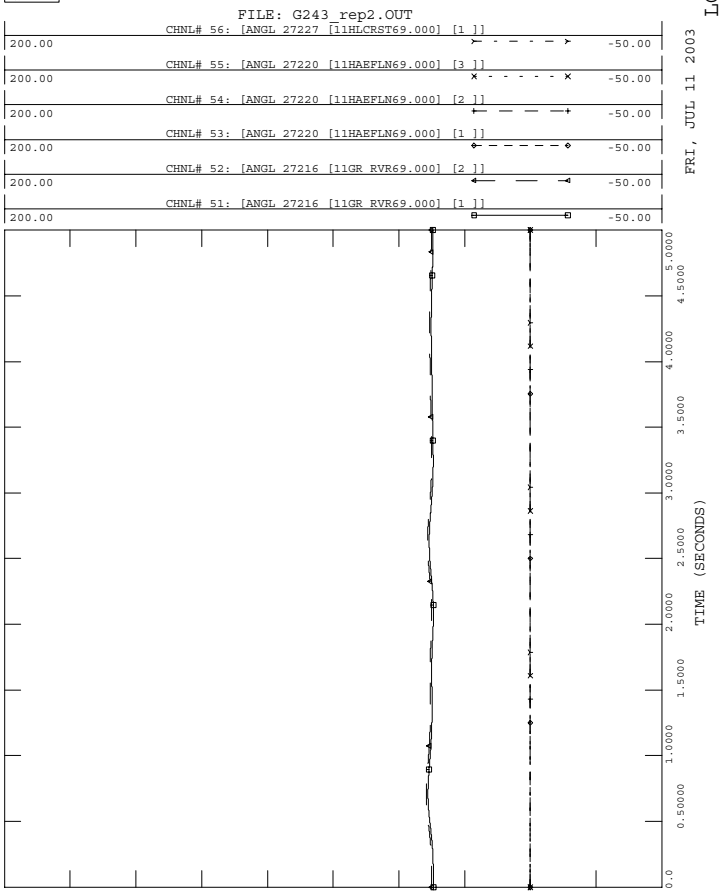
TIME (SECONDS)

PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES

FILE: G243_rep2.OUT

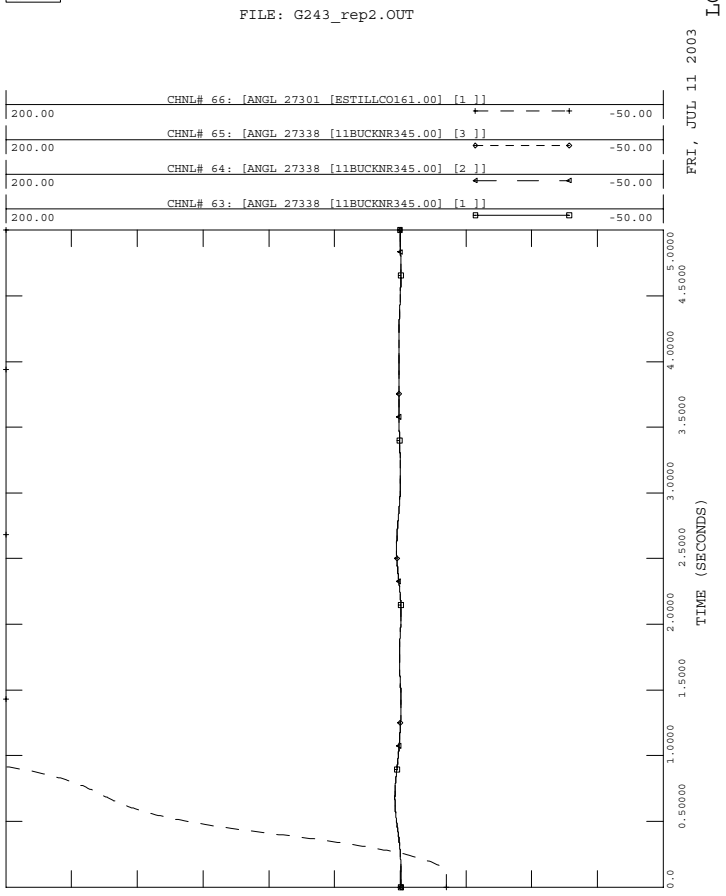
9:45 FRI, JUL 11 2003 LGEE



PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES

FILE: G243_rep2.OUT

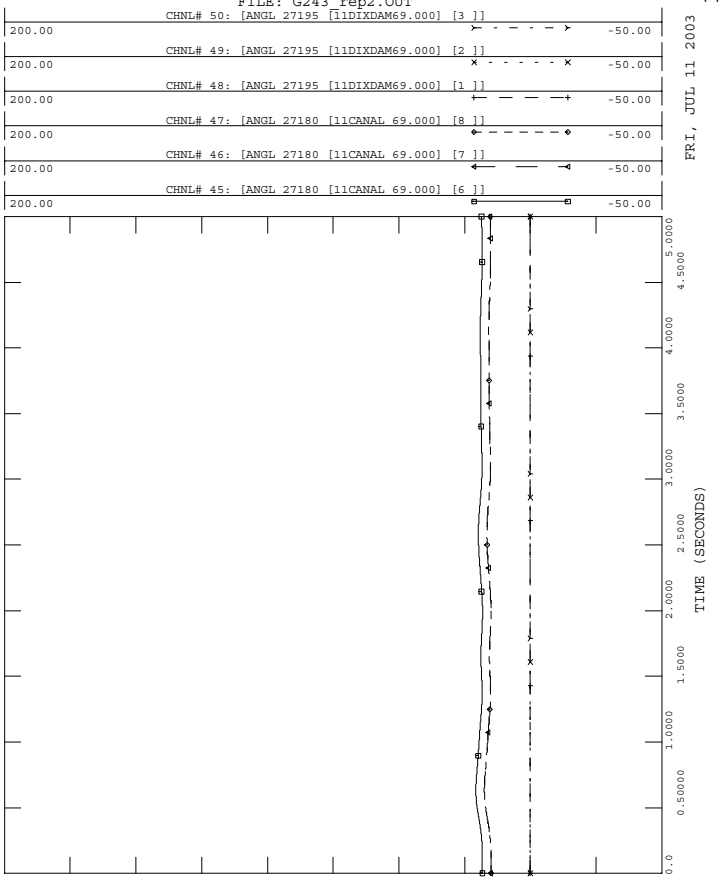
9:45 FRI, JUL 11 2003 LGEE



PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES

FILE: G243_rep2.OUT

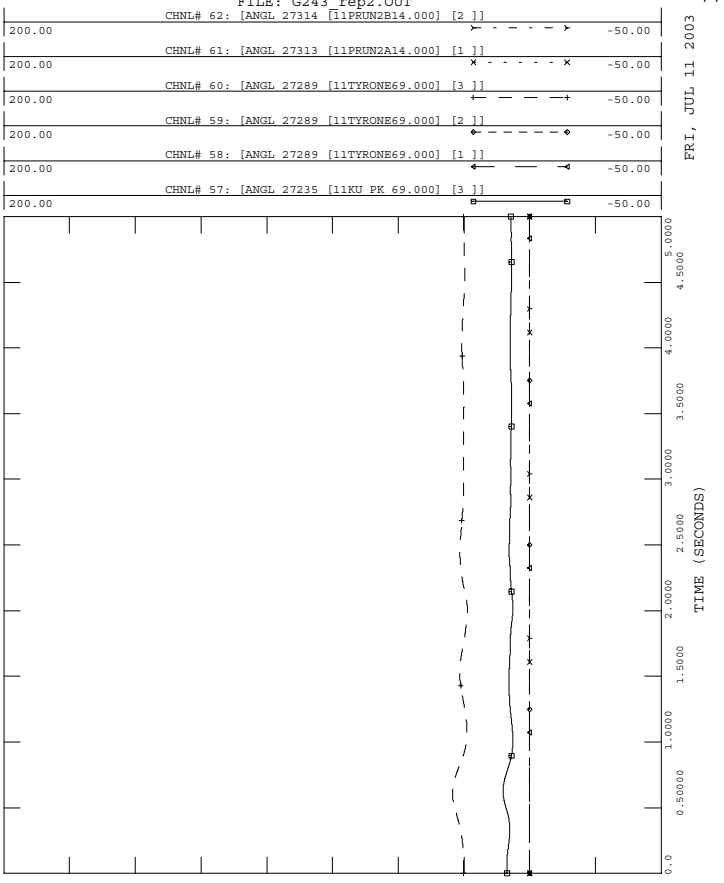
9:45 FRI, JUL 11 2003 LGEE



PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES

FILE: G243_rep2.OUT

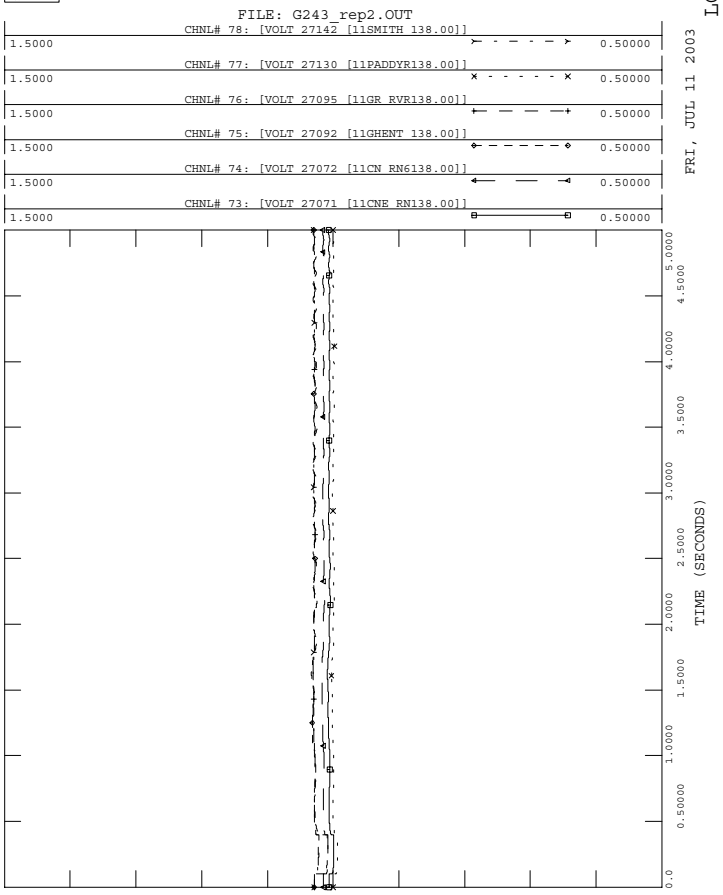
9:45 FRI, JUL 11 2003 LGEE



PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES

FILE: G243_rep2.OUT

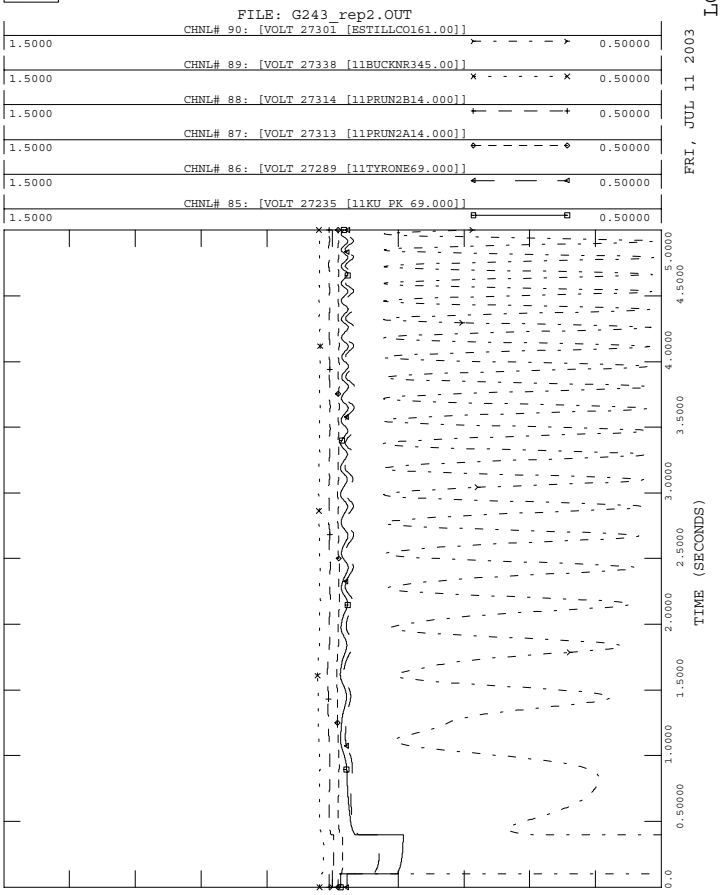
9:45 FRI, JUL 11 2003 LGEE



PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES

FILE: G243_rep2.OUT

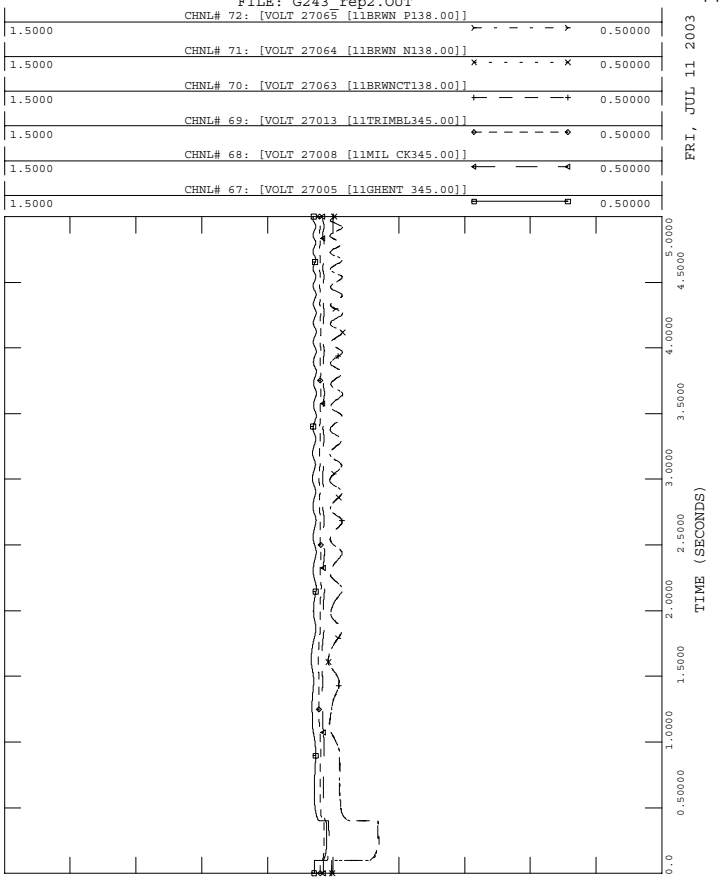
9:45 FRI, JUL 11 2003 LGEE



PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES

FILE: G243_rep2.OUT

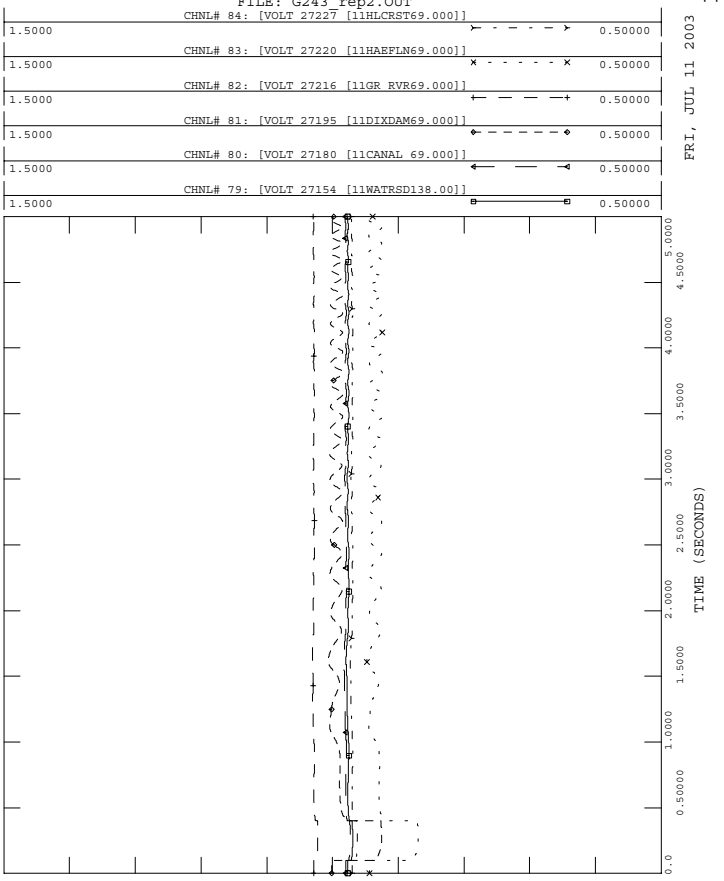
9:45 FRI, JUL 11 2003 LGEE

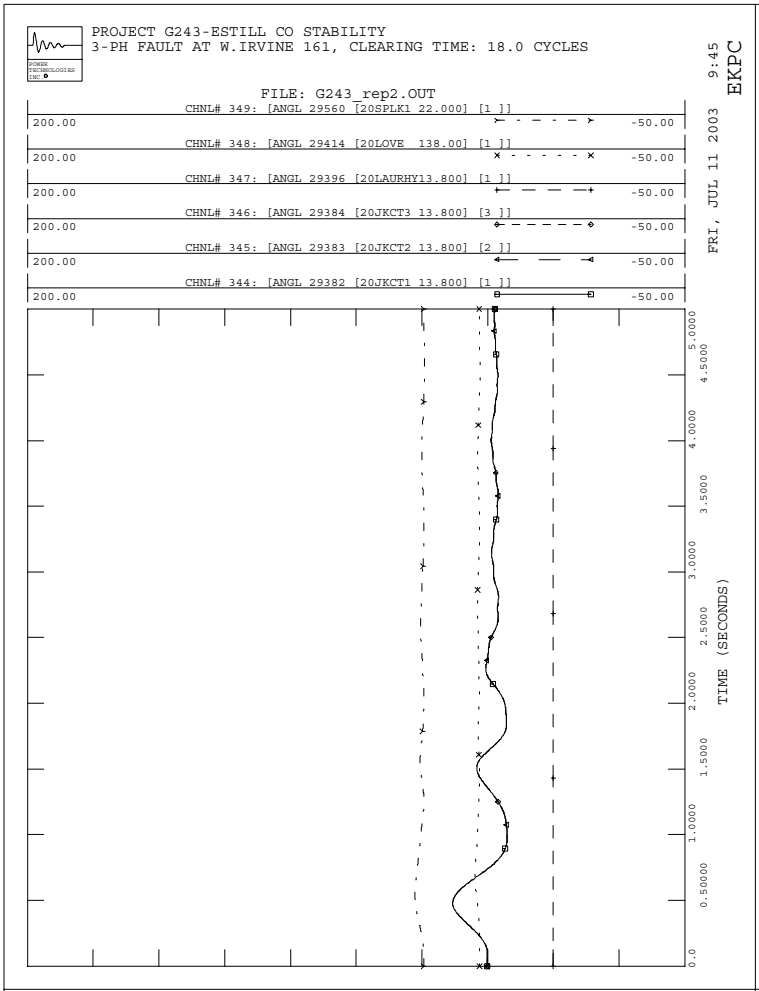


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES

FILE: G243_rep2.OUT

9:45 FRI, JUL 11 2003 LGEE




PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
FILE: G243_rep2.OUT
CHNL# 349: [ANGL 29560 [20SPLK1 22.000] [1]]
CHNL# 348: [ANGL 29414 [20LOVE 138.00] [1]]
CHNL# 347: [ANGL 29396 [20LAURHY13.800] [1]]
CHNL# 346: [ANGL 29384 [20JKCT3 13.800] [3]]
CHNL# 345: [ANGL 29383 [20JKCT2 13.800] [2]]
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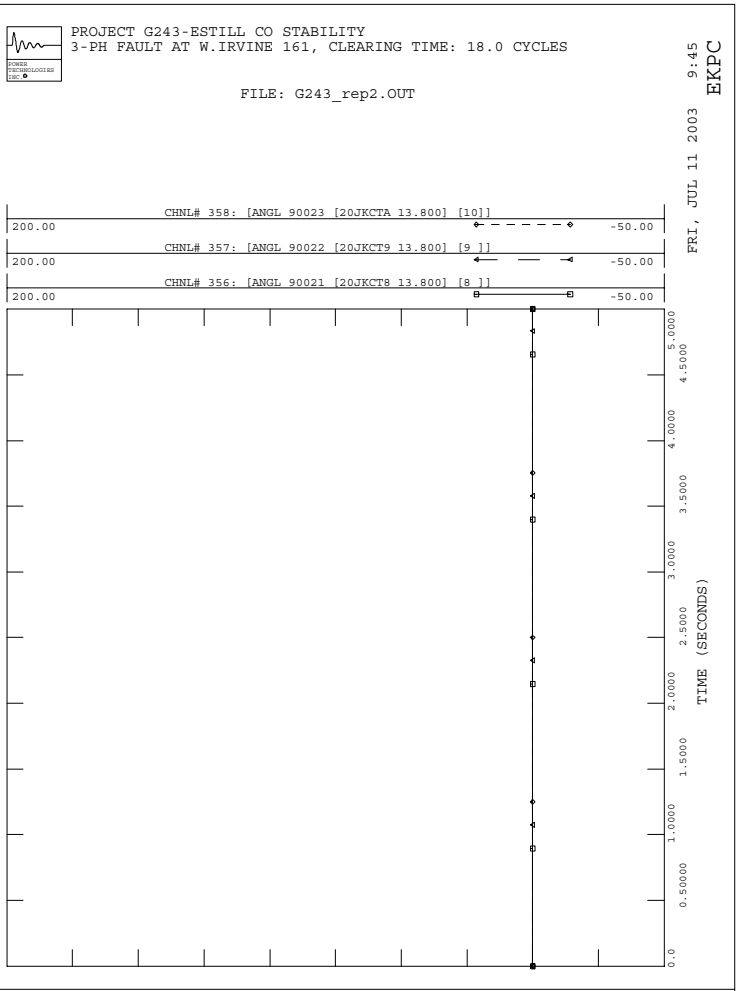
PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
FILE: G243_rep2.OUT
CHNL# 358: [ANGL 90023 [20JKCTA 13.800] [10]]
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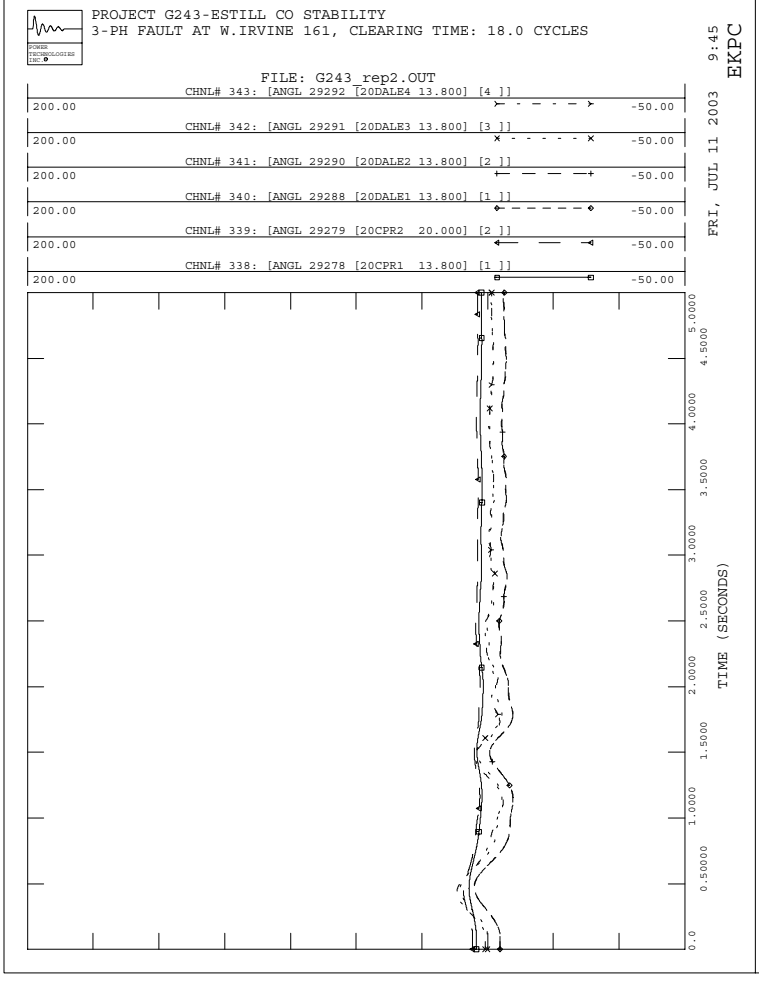
PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
FILE: G243_rep2.OUT
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CHNL# 342: [ANGL 29291 [20DALE3 13.800] [3]]
CHNL# 341: [ANGL 29290 [20DALE2 13.800] [2]]
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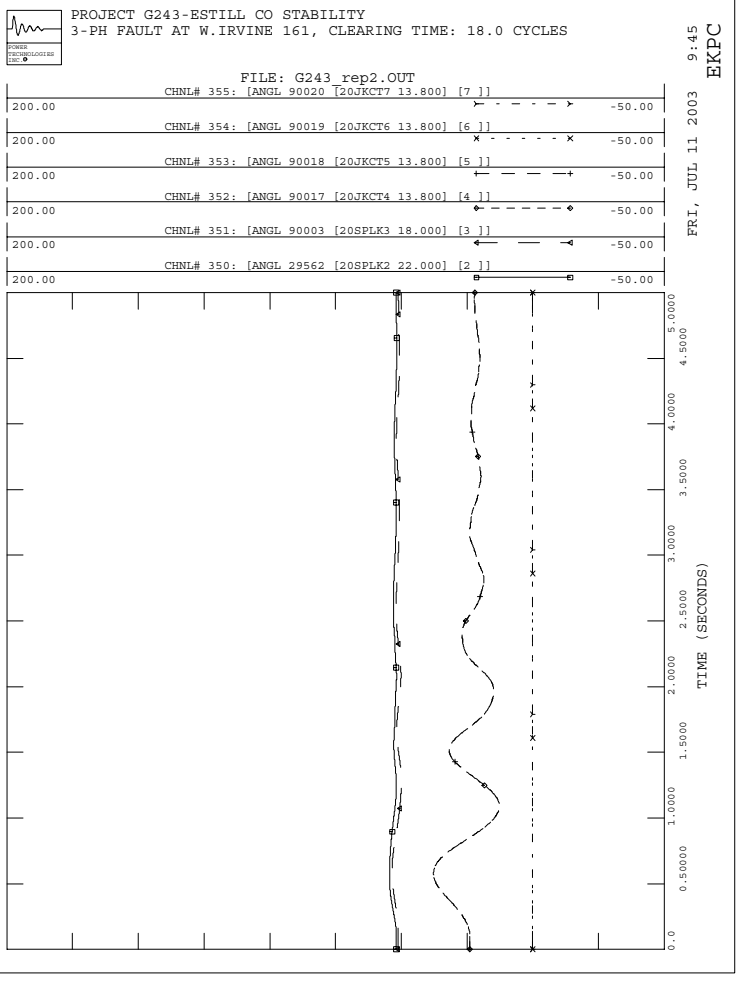
PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
FILE: G243_rep2.OUT
CHNL# 355: [ANGL 90020 [20JKCT7 13.800] [7]]
CHNL# 354: [ANGL 90019 [20JKCT6 13.800] [6]]
CHNL# 353: [ANGL 90018 [20JKCT5 13.800] [5]]
CHNL# 352: [ANGL 90017 [20JKCT4 13.800] [4]]
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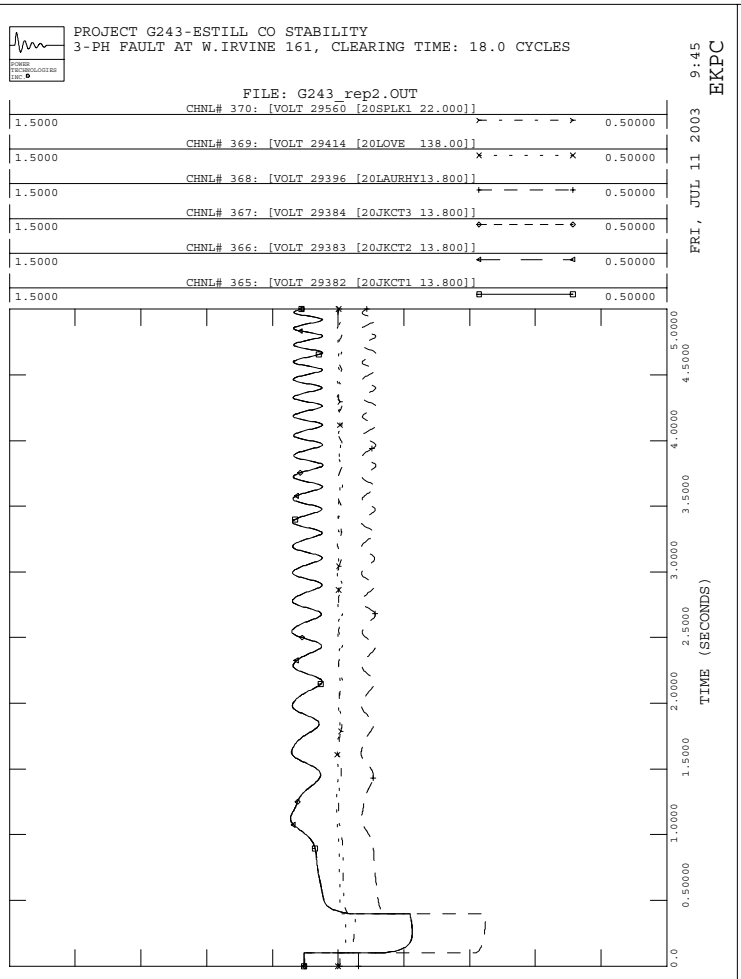
PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
FILE: G243_rep2.OUT
CHNL# 370: [VOLT 29560 [20SPLK1 22.000]]
CHNL# 369: [VOLT 29414 [20LOVE 138.00]]
CHNL# 368: [VOLT 29396 [20LAURHY13.800]]
CHNL# 367: [VOLT 29384 [20JKCT3 13.800]]
CHNL# 366: [VOLT 29383 [20JKCT2 13.800]]
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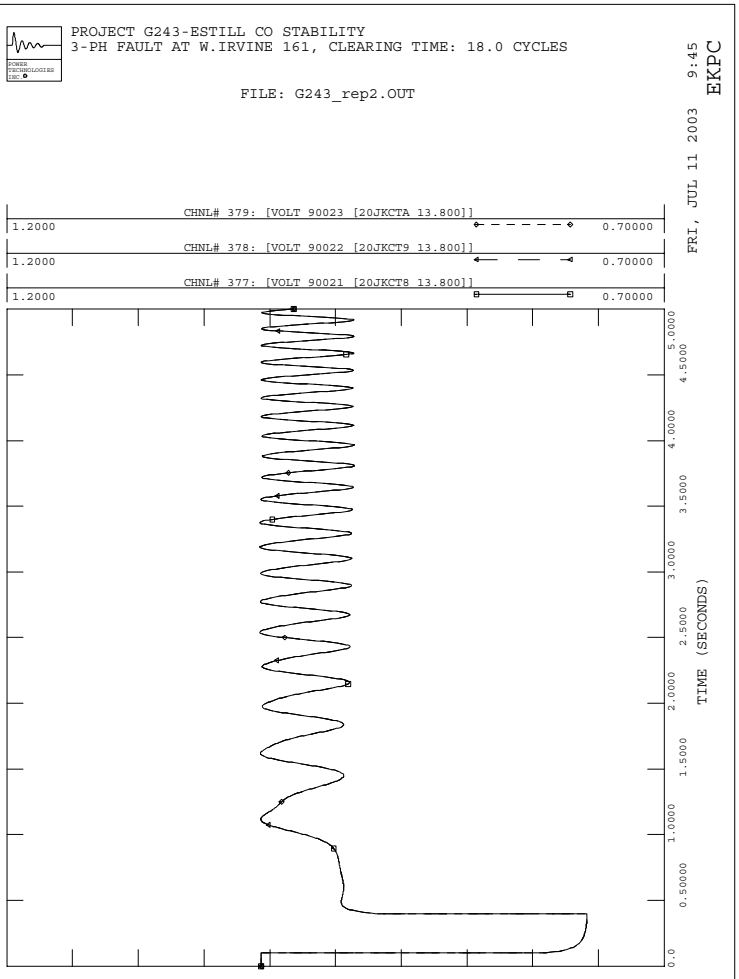
EKPC
FRI, JUL 11 2003


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
FILE: G243_rep2.OUT
CHNL# 379: [VOLT 90023 [20JKCTA 13.800]]
CHNL# 378: [VOLT 90022 [20JKCT9 13.800]]
CHNL# 377: [VOLT 90021 [20JKCT8 13.800]]
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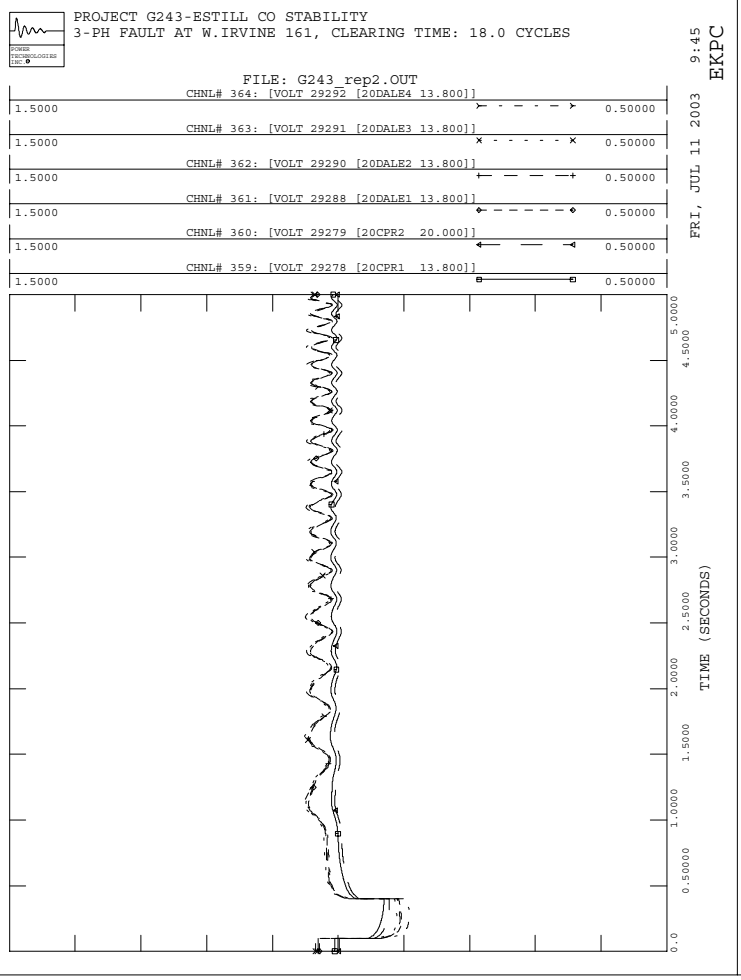
TIME (SECONDS)
9:45
EKPC
FRI, JUL 11 2003


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
FILE: G243_rep2.OUT
CHNL# 364: [VOLT 29292 [20DALE4 13.800]]
CHNL# 363: [VOLT 29291 [20DALE3 13.800]]
CHNL# 362: [VOLT 29290 [20DALE2 13.800]]
CHNL# 361: [VOLT 29288 [20DALE1 13.800]]
CHNL# 360: [VOLT 29279 [20CPR2 20.000]]
CHNL# 359: [VOLT 29278 [20CPR1 13.800]]
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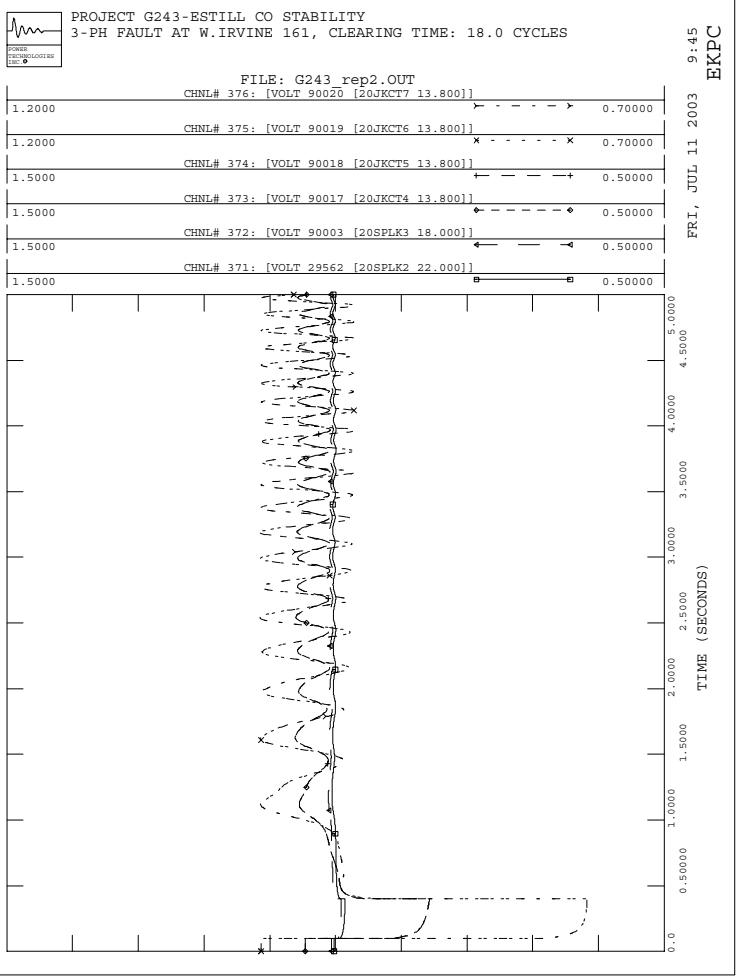
EKPC
FRI, JUL 11 2003


PROJECT G243-ESTILL CO STABILITY
3-PH FAULT AT W.IRVINE 161, CLEARING TIME: 18.0 CYCLES
FILE: G243_rep2.OUT
CHNL# 376: [VOLT 90020 [20JKCT7 13.800]]
CHNL# 375: [VOLT 90019 [20JKCT6 13.800]]
CHNL# 374: [VOLT 90018 [20JKCT5 13.800]]
CHNL# 373: [VOLT 90017 [20JKCT4 13.800]]
CHNL# 372: [VOLT 90003 [20SPLK3 18.000]]
CHNL# 371: [VOLT 29562 [20SPLK2 22.000]]
1.2000
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TIME (SECONDS)
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EKPC
FRI, JUL 11 2003