System Impact Study Report
Offsite Nuclear Analysis
PID 203
1522 MW (1612 MW Gross) Plant,
Grand Gulf, MS

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Report on the Offsite Study for G. Gulf Unit #3 (PID-203) 1522 MW (1612 MW Gross)

FINAL REPORT

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Executive Summary

Southwest Power Pool (SPP) has commissioned ABB Inc. to conduct an offsite power analysis of the proposed new nuclear unit (PID-203) at G. Gulf 500 kV. Offsite power is the preferred power source for nuclear power stations. The true capability of offsite power cannot be verified through direct readings of plant switchyard or safety bus voltages, but through analyses of grid and plant conditions considering the occurrence of severe contingencies representing the partial loss of grid support. The objective of this analysis is to identify if the Entergy System configuration will comply with the Code of Federal Regulations (CFR) specifically with respect to the grid voltage performance and the reliability of the Offsite Power Supply for G. Gulf Unit #3 (PID-203).

The steady-state analysis was conducted to determine the voltage levels at G. Gulf 500 kV and 115 kV buses following various outage contingencies on the transmission system during projected 2012 summer peak and 2012 off-peak load conditions. The System Impact Study for PID-203 was performed on summer peak 2012 load conditions. The results of the stability analysis for the summer peak 2012 system conditions from System Impact Study are also applicable for this offsite analysis. Hence, stability analysis was performed only on 2012 off-peak load conditions. Critical Clearing Time assessment was performed to determine the critical clearing times for faults at the G. Gulf 500 kV and adjacent substations.

Per the '*Nuclear Management Manual ENS-DC-199 Rev-2*' the acceptable steady-state post-contingency voltage range at G. Gulf 115 kV is 0.975 p.u to 1.05 p.u. The results of the off-site analysis study indicate that the voltage at G. Gulf 115 kV was lowest with both G. Gulf units online and the Port Gibson Capacitor bank (30.5 MVAR) switched off. The voltage at G. Gulf 115 kV was 0.9674 p.u. for 2012 summer peak system conditions and 0.9740 p.u. for 2012 off-peak system conditions. Hence, there is a violation of the voltage criterion for Off-site Power supply for G. Gulf nuclear units. For comparison, the similar contingency was simulated on Pre-Project case. The results indicated that the voltage violation at G. Gulf 115 kV also existed in Pre-Project case. Entergy

Transmission Planning and G. Gulf substation personnel are addressing a solution for this situation.

Per the '*Nuclear Management Manual ENS-DC-199 Rev-2*' the acceptable steady-state post-contingency voltage range at G. Gulf 500 kV is 0.9820 p.u to 1.05 p.u. The results of the off-site analysis study indicate that the voltage at G. Gulf 500 kV was below the voltage criterion following two contingencies: 1) loss of G. Gulf - B. Wilson and G. Gulf – R. Braswell 500 kV lines and 2) loss of G. Gulf – B. Wilson and G. Gulf – Franklin 500 kV lines, with G. Gulf Unit #3 (PID-203) off-line and with GG Unit #1 either online or offline. The loss of two lines is considered strictly to obtain an insight as to robustness of the system under such severe conditions (multiple concurrent line contingencies).

The results of the offsite analysis study indicate that there are no stability criteria violations associated with the Proposed PID-203 G. Gulf Unit # 3.

The G. Gulf Unit #3 (PID-203) does not have any significant impact on the Critical Clearing times at the G. Gulf, B. Wilson R. Braswell and Franklin 500 kV substations.

The results of this study are based on available data and assumptions made at the time this study was conducted. The results included in this report may not apply if any of the data and/or assumptions made in developing the study models change.

Rev No.	Revision Description	Date	Authored by	Reviewed by	Approved by
0	Draft Report	6/22/2007	A. Kekare	W. Quaintance	W. Wong
1	Updated Per Entergy's Comments	7/6/2007	A. Kekare	W. Quaintance	W. Wong
2	Final Report	7/18/2007	A. Kekare	W. Quaintance	W. Wong

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1 INTRODUCTION

Southwest Power Pool (SPP) has commissioned ABB Inc. to conduct the offsite analysis of the proposed new nuclear unit (PID-203) at G. Gulf 500 kV. Offsite power is the preferred power source for nuclear power stations. The true capability of offsite power cannot be verified through direct readings of plant switchyard or safety bus voltages, but through analyses of grid and plant conditions considering the occurrence of severe contingencies representing the partial loss of grid support. The objective of this analysis is to identify if the Entergy System configuration will comply with the Code of Federal Regulations (CFR) specifically with respect to the grid voltage performance and the reliability of the Offsite Power Supply for G. Gulf Unit #3 (PID-203)[1].

Entergy proposes to install a nuclear unit facility with a maximum capacity of 1933 MVA. The gross power output of the generator is 1612 MW. An auxiliary/host load of approximately 90 MW is expected at this site. PID-203 will inject a net power of approximately 1522 MW into the Entergy transmission system. The proposed in-service date for this facility is January 2015. Figure 1-1 shows the bus configuration at G. Gulf 500 kV after interconnection of G. Gulf Unit #3 (PID-203). The following upgrades/changes identified for PID-203 were included in the study models (see Figure 1-3 for details).

- Add a 48 mile 500 kV transmission line from Grand Gulf 500 kV to Ray Braswell 500 kV.
- Remove the existing Baxter Wilson to Ray Braswell 500 kV line from Ray Braswell substation, and extend this line 22 miles to Lakeover 500 kV.
- Add a 500 kV line from Big Cajun 2 500 kV to Richard 500 kV, removing the planned 230 kV line
- Add 2nd 500/230 kV transformer at Audubon 230 kV Connecting to Big Cajun 2 500 kV

The steady-state analysis was conducted to determine the voltage levels at G. Gulf 500 kV and 115 kV buses during various outage contingencies on the transmission system at 2012 summer peak and 2012 off-peak load conditions. The System Impact Study for PID-203 was performed on summer peak 2012 load conditions (Refer the report PID-203 System Impact Study). The results of the stability analysis for the summer peak 2012 system conditions from System Impact Study are also applicable for this offsite analysis. Hence, stability analysis was performed only on 2012 off-peak load conditions.

[1] There are no plans for a G. Gulf unit called #2. Unit #2 was previously considered but canceled.

The report is organized as follows

- Section 2 - Model Development
- Section 3 - Steady State analysis
- Section 4 - Stability Analysis
- Section 5 - Critical Clearing Time Analysis
- Section 6 - Conclusions

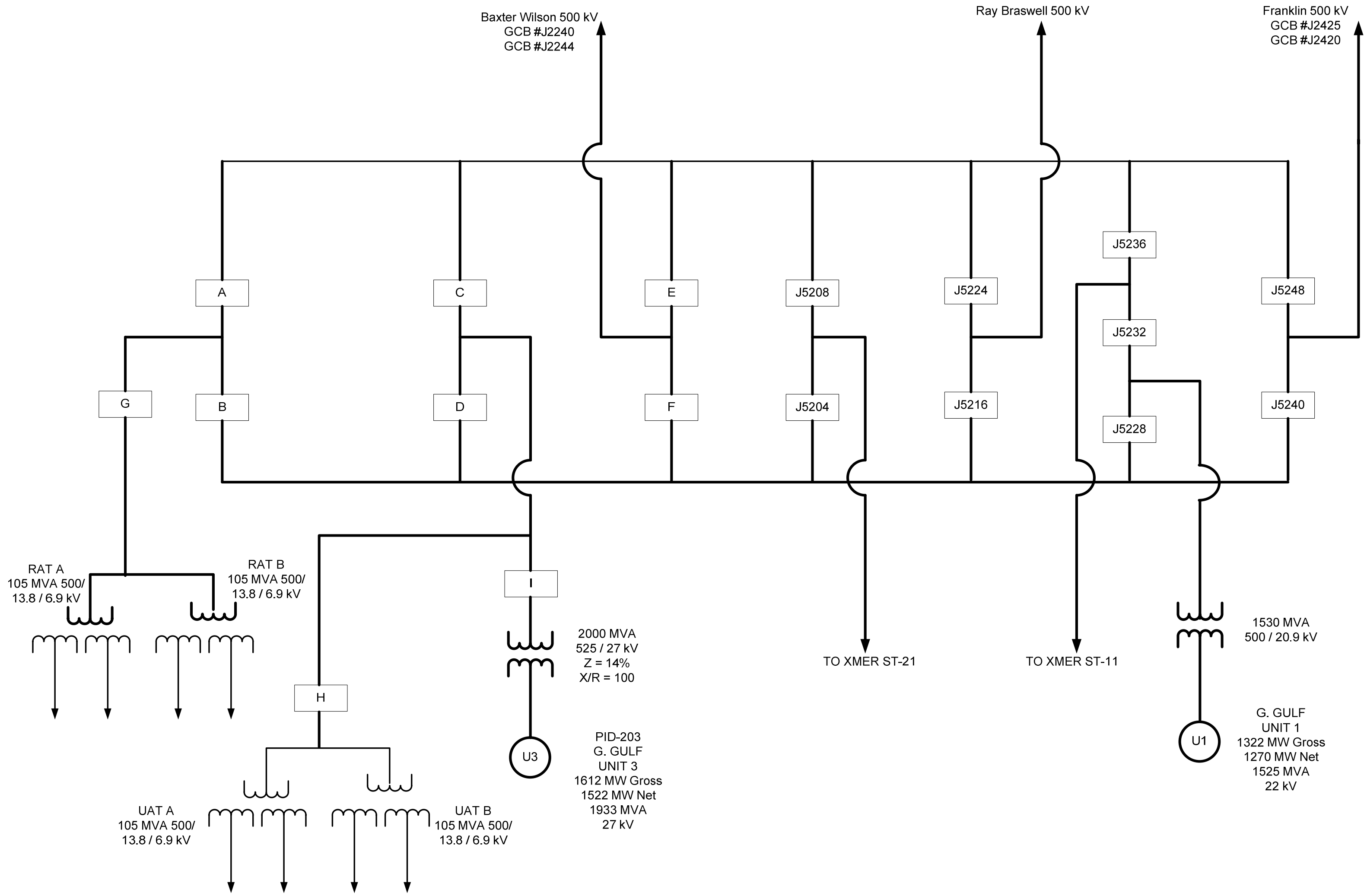

Figure 1-1: Bus Configuration of G. Gulf 500 kV substation after interconnection of G. Gulf Unit #3 (PID-203)

*Note :- Substation Layout diagram for G. Gulf 500 kV substation **without** G. Gulf Unit #3 (PID-203) is included in Appendix IV for reference.*

Figure 1-2

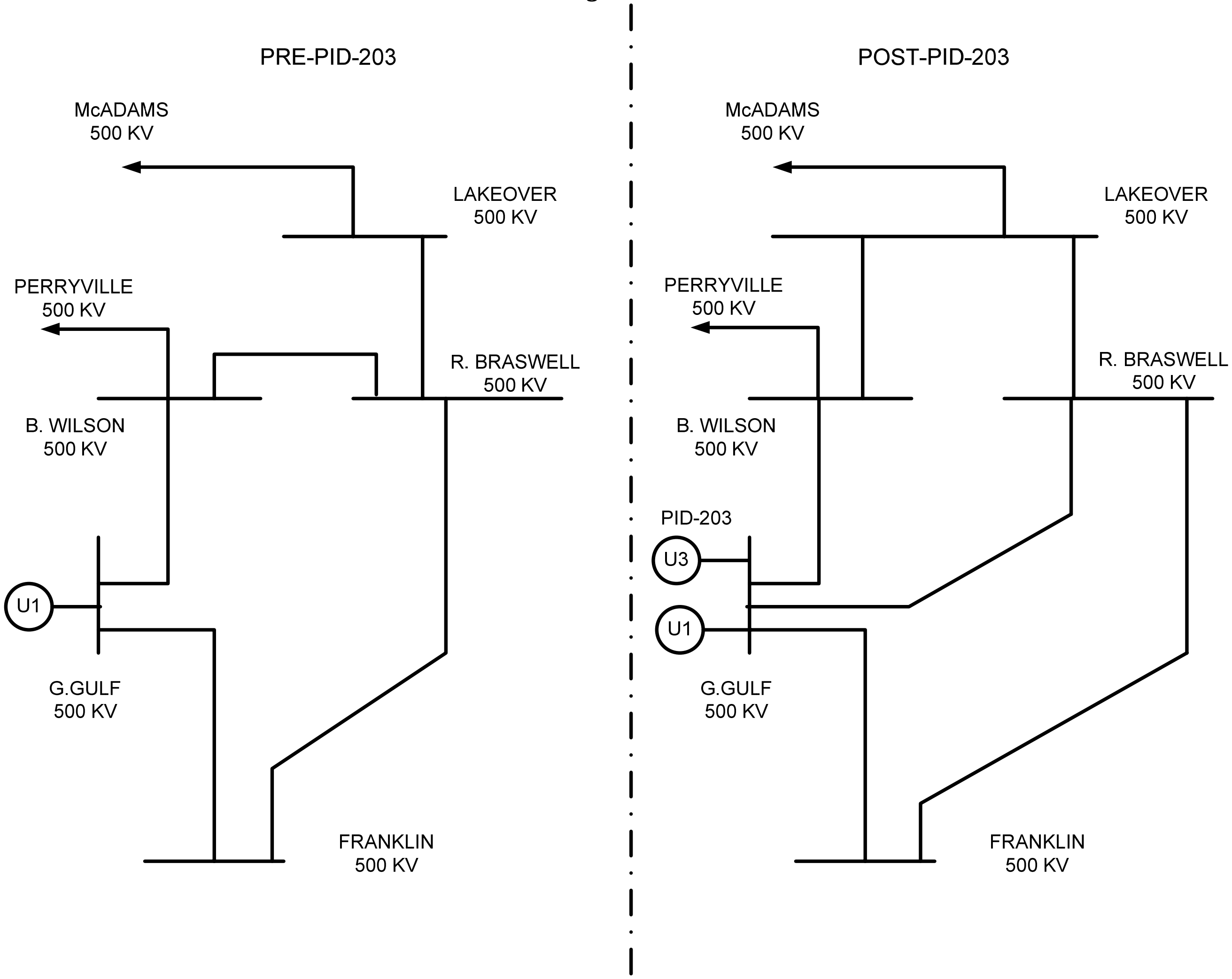

Figure 1-3: Transmission line configuration at G. Gulf 500 kV with and without PID-203

2 STUDY METHODOLOGY & ASSUMPTIONS

2.1 STUDY DATA

Entergy provided 2012 summer peak and 2012 off-peak load condition cases. The dynamic database (snapshot file) used for System Impact Study of PID-203 was used for the stability analysis.

The steady state and dynamic data for G. Gulf Unit #1 and Unit #3 (PID-203) used in offsite analysis is listed in Appendix I for reference.

2.2 STEADY STATE ANALYSIS

In discussion with SPP/ICT, Entergy Transmission Planning, and G. Gulf substation personnel, the following scenarios were considered for steady state analysis

- G. Gulf Unit #1 and Unit #3 (PID-203) on-line
- G. Gulf Unit #3 (PID-203) off-line
- G. Gulf Unit #1 and Unit #3 (PID-203) off-line

SPP provided the list of IPP generators in the Entergy system for dispatching G. Gulf Unit #1 and Unit #3 during steady-state analysis. The list is included in Appendix II for reference.

There are two (2) offsite power supplies for G. Gulf Units – G. Gulf 500 kV and G. Gulf 115 kV. The voltages at G. Gulf 500 kV and G. Gulf 115 kV buses were monitored for system intact and contingency conditions. Table 2-1 lists the contingencies simulated for steady state analysis. This list was provided by Entergy transmission planning group and the G. Gulf substation personnel.

Per the '*Nuclear Management Manual ENS-DC-199 Rev-2*' the steady-state voltage criteria for G. Gulf 500 kV and G. Gulf 115 kV are as follows:

BUS	LOW		HIGH	
	kV	p.u.	kV	p.u.
G. GULF 500 KV	491.0000	0.9820	525.0000	1.0500
G. GULF 115 KV	112.1250	0.9750	120.7500	1.0500

Table 2-1: List of Contingencies for Steady State Analysis

CONTINGENCY NAME	DESCRIPTION	G. GULF		PORT GIBSON CAP
		UNIT #1	UNIT #3 (PID-203)	
	BASE CASE (NORMAL)	ON	ON	ON
	BASE CASE (NORMAL)	ON	ON	OFF
	GGNS U1 OFF	OFF	ON	ON
	GGNS U1 OFF	OFF	ON	OFF
	GGNS U3 OFF	ON	OFF	ON
	GGNS U3 OFF	ON	OFF	OFF
	GGNS U1 & U3 OFF	OFF	OFF	ON
	GGNS U1 & U3 OFF	OFF	OFF	OFF
BW1	BAXTER WILSON UNIT 1	ON	OFF	ON
PT_GIB-S_VIC	PT. GIBSON TO BAXTER WILSON 115 OUT	ON	OFF	ON
PT_GIB-LORMN	PT GIBSON TO NATCHEZ 115 OUT	ON	OFF	ON
BW2	BAXTER WILSON UNIT 2	ON	OFF	ON
BW_500-115	BAXTER WILSON 500/115KV AUTO OUT	ON	OFF	ON
BW-PERRY	BAXTER WILSON TO PERRYVILLE 500 OUT	ON	OFF	ON
FRKLN-NTCHZ	FRANKLIN TO NATCHEZ 115KV OUT	ON	OFF	ON
FRKLN-RBRAS	FRANKLIN TO RAY BRASWELL 500 OUT	ON	OFF	ON
RBRAS-LAKEOVER	R. BRASWELL - LAKOVER 500 KV	ON	OFF	ON
BW-LAKOVER	B. WILSON - LAKOVER 500 KV	ON	OFF	ON
BW-GG	BAXTER WILSON TO GGNS 500KV OUT	ON	OFF	ON
RB-GG	RAY BRASWELL TO GGNS 500KV OUT	ON	OFF	ON
FRKLN-GG	FRANKLIN TO GGNS 500KV OUT	ON	OFF	ON
FRANK-MCKT	FRANKLIN TO McKNIGHT 500 kV OUT	ON	OFF	ON
BW-GG&RB-GG	BAXTER WILSON TO GGNS 500KV OUT & RAY BRASWELL TO GGNS 500KV OUT	ON	OFF	ON
BW-GG&FR-GG	BAXTER WILSON TO GGNS 500KV OUT & FRANKLIN TO GGNS 500KV OUT	ON	OFF	ON
RB-GG&FR-GG	RAY BRASWELL TO GGNS 500KV OUT & FRANKLIN TO GGNS 500KV OUT	ON	OFF	ON
FRANK-BOG	FRANKLIN TO ADAMS CREEK 500 kV OUT	ON	OFF	ON
BW-GG	BAXTER WILSON TO GGNS 500KV OUT	OFF	OFF	ON
RB-GG	RAY BRASWELL TO GGNS 500KV OUT	OFF	OFF	ON
FRKLN-GG	FRANKLIN TO GGNS 500KV OUT	OFF	OFF	ON
BW-GG&FR-GG	BAXTER WILSON TO GGNS 500KV OUT & FRANKLIN TO GGNS 500KV OUT	OFF	OFF	ON
RB-GG&FR-GG	RAY BRASWELL TO GGNS 500KV OUT & FRANKLIN TO GGNS 500KV OUT	OFF	OFF	ON
BW-GG&RB-GG	BAXTER WILSON TO GGNS 500KV OUT & RAY BRASWELL TO GGNS 500KV OUT	OFF	OFF	ON

2.3 STABILITY ANALYSIS

The purpose of the stability analysis was to determine whether the system would be stable following selected contingencies. Several generators including both G. Gulf (Unit #1 and Unit #3) were monitored to check for the first swing instability. The unstable generators, if any, were flagged and reported in the stability analysis result.

As previously mentioned the system impact study results for PID-203 for 2012 summer peak system conditions were considered applicable for this offsite analysis. Hence, stability analysis was performed only on 2012 off-peak system condition. All the contingencies simulated in the system impact study for PID-203 were repeated on the off-peak 2012 system condition.

2.4 CRITICAL CLEARING TIME

An evaluation of the critical clearing times was carried out for fault cases at the following substations:

- G. Gulf 500 kV
- Ray Braswell 500 kV
- Baxter Wilson 500 kV
- Franklin 500 kV

Critical Clearing Time assessment was performed on both, 2012 summer peak and 2012 off-peak, system conditions.

Critical Clearing Time (CCT) was calculated for a three-phase stuck-breaker (IPO: 3PH-1PH) fault for each element in the above four (4) substations. The Normal Clearing Time was kept equal to the normal value (5 cycles on 500 kV) and the backup clearing time was varied to find the CCT. All machines in the Entergy system were monitored for angle stability.

3 STEADY STATE ANALYSIS

The contingencies listed in Table 2-1 were simulated on 2012 summer peak and 2012 off-peak load conditions. The voltages at G. Gulf 500 kV and G. Gulf 115 kV were monitored following the contingencies. Figure 3-1 and Figure 3-2 show the power flow diagrams for 2012 summer peak and 2012 off-peak system conditions with both G. Gulf units #1 and #3 (PID-203) on-line.

Table 3-1 lists the voltages at G. Gulf 500 kV and 115 kV buses for all the simulated contingencies.

G. Gulf 115 kV

Per the '*Nuclear Management Manual ENS-DC-199 Rev-2*' the acceptable steady-state post-contingency voltage range at G. Gulf 115 kV is 0.975 p.u to 1.05 p.u. This criterion was violated in 6 scenarios, which are highlighted in red in Table 3-1. The voltage at G. Gulf 115 kV was lowest with both G. Gulf units online and the Port Gibson Capacitor bank (30.5 MVAR) switched off. The voltage at G. Gulf 115 kV was 0.9674 p.u. for 2012 summer peak conditions and 0.9740 p.u. for 2012 off-peak conditions.

For comparison, the worst conditions were repeated in the pre-project 2012 summer peak case, with the following results.

DESCRIPTION	G. GULF UNIT #1	PORT GIBSON CAP	G. GULF 115 kV VOLTGAE (in p.u.)
BASE CASE (NORMAL)	ON	OFF	0.9702
	OFF	OFF	0.9723

The voltage violation is observed at G. Gulf 115 kV without PID-203 in-service in the pre-project case. Entergy transmission planning and G. Gulf Substation personnel are addressing this problem. Hence PID-203 does not have a significant impact on G. Gulf 115 kV bus voltage.

G. Gulf 500 kV

Per the '*Nuclear Management Manual ENS-DC-199 Rev-2*' the acceptable steady-state post-contingency voltage range at G. Gulf 500 kV is 0.9820 p.u to 1.05 p.u. The voltage at G. Gulf 500 kV was below the voltage criterion following two contingencies: 1) loss of G. Gulf - B. Wilson and G. Gulf – R. Braswell 500 kV lines and 2) loss of G. Gulf – B. Wilson and G. Gulf – Franklin 500 kV lines, with G. Gulf Unit #3 (PID-203) off-line and with GG Unit #1 either online or offline (see Table 3-1). The loss of two lines is considered strictly to obtain an insight as to robustness of the system under such severe conditions (multiple concurrent line contingencies). Following loss of any two lines, G. Gulf 500 kV is radially connected to the remaining 500 kV substation.

Table 3-1: Results of Steady State Analysis

CONTINGENCY NAME	DESCRIPTION	G. GULF UNIT #1	G. GULF UNIT #3 (PID-203)	PORT GIBSON CAP	VOLTGAE (in p.u.) 2012 SUMMER PEAK G. GULF 115 KV	2012 SUMMER PEAK G. GULF 500 KV	2012 OFF-PEAK G. GULF 115 KV	2012 OFF-PEAK G. GULF 500 KV
	BASE CASE (NORMAL)	ON	ON	ON	0.9969	1.0200	1.0089	1.0200
	BASE CASE (NORMAL)	ON	ON	OFF	**0.9674**	1.0200	**0.9740**	1.0200
	GGNS U1 OFF	OFF	ON	ON	1.0004	1.0200	1.0125	1.0200
	GGNS U1 OFF	OFF	ON	OFF	**0.9699**	1.0200	0.9765	1.0200
	GGNS U3 OFF	ON	OFF	ON	0.9998	1.0128	1.0101	1.0154
	GGNS U3 OFF	ON	OFF	OFF	**0.9685**	1.0128	**0.9744**	1.0152
	GGNS U1 & U3 OFF	OFF	OFF	ON	1.0030	1.0092	1.0130	1.0156
	GGNS U1 & U3 OFF	OFF	OFF	OFF	**0.9716**	1.0092	0.9772	1.0155
BW1	BAXTER WILSON UNIT 1	ON	OFF	ON	1.0084	1.0131	1.0186	1.0161
PT_GIB-S_VIC	PT. GIBSON TO BAXTER WILSON 115 OUT	ON	OFF	ON	1.0167	1.0124	1.0224	1.0150
PT_GIB-LORMN	PT GIBSON TO NATCHEZ 115 OUT	ON	OFF	ON	1.0120	1.0127	1.0305	1.0152
BW2	BAXTER WILSON UNIT 2	ON	OFF	ON	0.9981	1.0087	1.0101	1.0154
BW_500-115	BAXTER WILSON 500/115KV AUTO OUT	ON	OFF	ON	0.9993	1.0127	0.9966	1.0153
BW-PERRY	BAXTER WILSON TO PERRYVILLE 500 OUT	ON	OFF	ON	0.9967	1.0123	1.0103	1.0158
FRKLN-NTCHZ	FRANKLIN TO NATCHEZ 115KV OUT	ON	OFF	ON	0.9925	1.0130	1.0086	1.0155
FRKLN-RBRAS	FRANKLIN TO RAY BRASWELL 500 OUT	ON	OFF	ON	1.0005	1.0113	1.0079	1.0130
RBRAS-LAKEOVER	R. BRASWELL - LAKOVER 500 KV	ON	OFF	ON	0.9993	1.0087	1.0084	1.0117
BW-LAKOVER	B. WILSON - LAKOVER 500 KV	ON	OFF	ON	0.9978	1.0097	1.0086	1.0131
BW-GG	BAXTER WILSON TO GGNS 500KV OUT	ON	OFF	ON	1.0004	0.9937	1.0075	1.0043
RB-GG	RAY BRASWELL TO GGNS 500KV OUT	ON	OFF	ON	0.9987	1.0148	1.0087	1.0151
FRKLN-GG	FRANKLIN TO GGNS 500KV OUT	ON	OFF	ON	0.9976	1.0126	1.0018	1.0133
FRANK-MCKT	FRANKLIN TO McKNIGHT 500 kV OUT	ON	OFF	ON	1.0008	1.0111	1.0075	1.0124
BW-GG&RB-GG	BAXTER WILSON TO GGNS 500KV OUT & RAY BRASWELL TO GGNS 500KV OUT	ON	OFF	ON	1.0023	**0.9733**	1.0065	0.9895
BW-GG&FR-GG	BAXTER WILSON TO GGNS 500KV OUT & FRANKLIN TO GGNS 500KV OUT	ON	OFF	ON	0.9984	**0.9716**	1.0002	**0.9751**
RB-GG&FR-GG	RAY BRASWELL TO GGNS 500KV OUT & FRANKLIN TO GGNS 500KV OUT	ON	OFF	ON	0.9919	1.0185	0.9948	1.0185
FRANK-BOG	FRANKLIN TO ADAMS CREEK 500 kV OUT	ON	OFF	ON	0.9992	1.0138	1.0088	1.0157
BW-GG	BAXTER WILSON TO GGNS 500KV OUT	OFF	OFF	ON	1.0011	0.9854	1.0083	1.0037
RB-GG	RAY BRASWELL TO GGNS 500KV OUT	OFF	OFF	ON	1.0024	1.0113	1.0120	1.0155
FRKLN-GG	FRANKLIN TO GGNS 500KV OUT	OFF	OFF	ON	1.0040	1.0105	1.0107	1.0142
BW-GG&FR-GG	BAXTER WILSON TO GGNS 500KV OUT & FRANKLIN TO GGNS 500KV OUT	OFF	OFF	ON	1.0020	**0.9744**	1.0071	**0.9892**
BW-GG&RB-GG	BAXTER WILSON TO GGNS 500KV OUT & RAY BRASWELL TO GGNS 500KV OUT	OFF	OFF	ON	1.0016	**0.9762**	1.0063	0.9972
RB-GG&FR-GG	RAY BRASWELL TO GGNS 500KV OUT & FRANKLIN TO GGNS 500KV OUT	OFF	OFF	ON	1.0026	1.0160	1.0081	1.0160

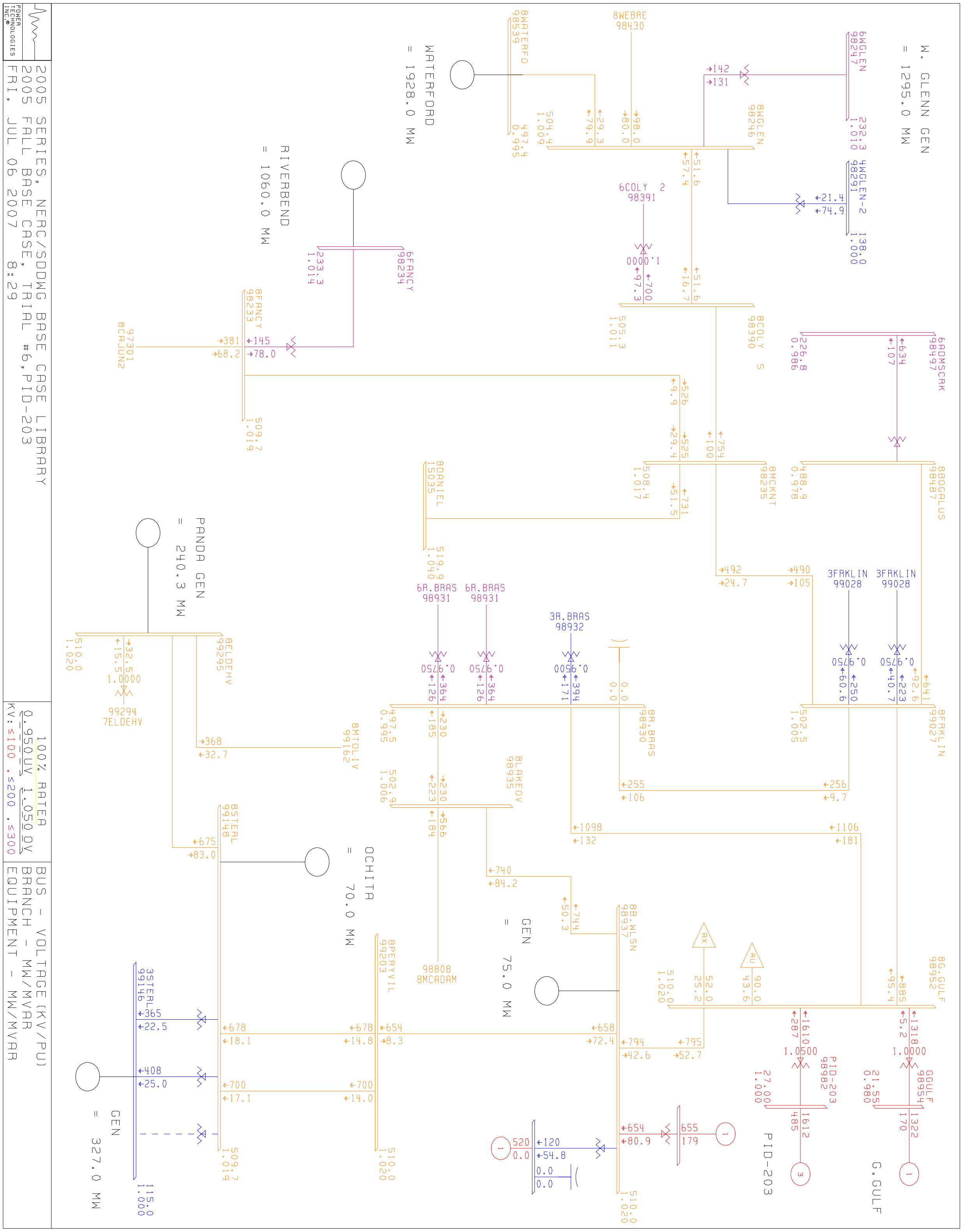

Figure 3-1: Power flow on transmission system near G. Gulf 500 kV – 2012 Summer Peak

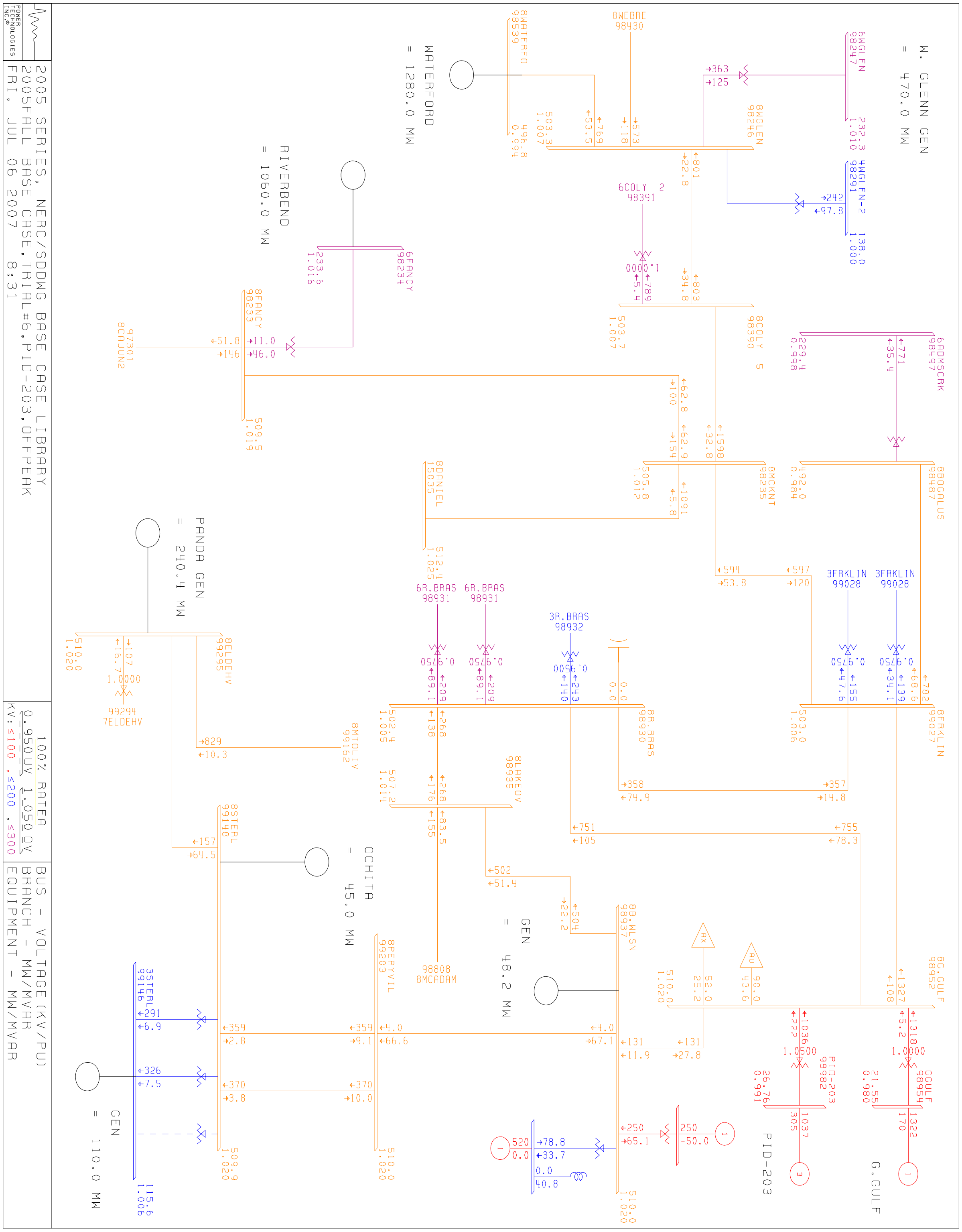

Figure 3-2: Power flow on transmission system near G. Gulf 500 kV – 2012 Off-Peak

4 STABILITY ANALYSIS

As previously mentioned the system impact study results for PID-203 for 2012 summer peak system conditions are applicable for this offsite analysis. Hence, stability analysis for this study was performed only on 2012 off-peak system condition. All the contingencies simulated in the system impact study for PID-203 were repeated on the off-peak 2012 system condition.

The breaker failure scenario was simulated with the following sequence of events:

1) At the normal clearing time for the primary breakers, the faulted line is tripped at the far end from the fault by normal breaker opening.

2) The fault remains in place for three-phase stuck-breakers. For single-phase faults the fault is appropriately adjusted to account for the line trip of step 1). For an IPO breaker, the 3-phase fault is replaced by a line-to-ground fault (2 phases of the faulted-end breaker clear and one phase sticks).

3) The fault is then cleared by back-up clearing. If the system is shown to be unstable for this condition, then stability of the system without the PID-203 plant needs to be verified.

All line trips are assumed to be permanent (i.e. no high speed re-closure).

The stability analysis was performed using the PSS/E dynamics program. The PSS/E dynamics program only simulates the positive sequence network. Unbalanced faults involve the positive, negative, and zero sequence networks. For unbalanced faults, the equivalent fault admittance must be inserted in the PSS/E positive sequence model between the faulted bus and ground to simulate the effect of the negative and zero sequence networks. For a single-line-to-ground (SLG) fault, the fault admittance equals the inverse of the sum of the positive, negative and zero sequence Thevenin impedances at the faulted bus. Since PSS/E inherently models the positive sequence fault impedance, the sum of the negative and zero sequence Thevenin impedances needs to be added and entered as the fault impedance at the faulted bus.

For three-phase faults, a fault admittance of –j2E9 is used (essentially infinite admittance or zero impedance).

Table 4-1 and Table 4-2 list results for all fault cases that were simulated in this study. Fault scenarios were formulated by examining the system configuration and breaker one-line diagrams.

Faults 1 through 17 represent the normal clearing 3-phase faults. Faults 1a through 17a represent the stuck breaker cases with the appropriate delayed back-up clearing times. Additional selected faults were simulated at Big Cajun 2 500 kV, Richard 500 kV and Fancy PT. 500 kV substations to evaluate any impact on the Entergy transmission system after addition of the proposed reinforcements for PID-203. Faults 18 through 22 represent the normal clearing faults related to the reinforcements. Faults 18a through 22b represent the selected stuck breaker fault cases with appropriate delayed back-up clearing times.

For all cases analyzed, the initial disturbance was applied at t = 0.1 seconds. The breaker clearing was applied at the appropriate time following this fault inception.

Table 4-1: 3-phase faults with normal clearing

CASE	LOCATION	TYPE	CLEARING TIME (cycles)	TRIPPED FACILITIES	Stable ?	Acceptable Voltages ?
FAULT-1	G. Gulf - B. Wilson 500 kV	3 PH	5	G. Gulf - B. Wilson 500 kV	YES	YES
FAULT-2	G. Gulf - Ray Braswell 500 kV	3 PH	5	G. Gulf - Ray Braswell 500 kV	YES	YES
FAULT-3	G. Gulf - Franklin 500 kV	3 PH	5	G. Gulf - Franklin 500 kV	YES	YES
FAULT-4	G. Gulf Unit 1	3 PH	5	G. Gulf Generation #1 (Existing)	YES	YES
FAULT-5	Ray Braswell - Lakeover 500 kV	3 PH	5	Ray Braswell - Lakeover 500 kV	YES	YES
FAULT-6	Ray Braswell - Franklin 500 kV	3 PH	5	Ray Braswell - Franklin 500 kV	YES	YES
FAULT-7	Ray Braswell 500/ 230 kV Transformer #1	3 PH	5	Ray Braswell 500/ 230 kV Transformer #1	YES	YES
FAULT-8	Ray Braswell 500/ 115 kV Transformer #1	3 PH	5	Ray Braswell 500/ 115 kV Transformer #1	YES	YES
FAULT-9	B. Wilson - Lakeover 500 kV	3 PH	5	B. Wilson - Lakeover 500 kV	YES	YES
FAULT-10	B. Wilson - Perryville 500 kV	3 PH	5	B. Wilson - Perryville 500 kV	YES	YES
FAULT-11	Franklin - McKnight 500 kV	3 PH	5	Franklin - McKnight 500 kV	YES	YES
FAULT-12	Franklin - Bogalusa 500 kV	3 PH	5	Franklin - Bogalusa 500 kV	YES	YES
FAULT-13	Franklin - Ray Braswell 500 kV	3 PH	5	Franklin - Ray Braswell 500 kV	YES	YES
FAULT-14	Franklin 500 / 115 kV	3 PH	5	Franklin 500 / 115 kV	YES	YES
FAULT-15	B. Wilson 500/115 kV transformer #1	3 PH	5	B. Wilson 500/115 kV transformer #1	YES	YES
FAULT-16	Lakeover - McAdams 500 kV	3 PH	5	Lakeover - McAdams 500 kV	YES	YES
FAULT-17	G. Gulf 500/27 kV (PID-203 GSU)	3 PH	5	G. Gulf 500/27 kV GSU and G. Gulf Unit #3 (PID-203)	YES	YES

** Substation Layout diagrams showing the Fault Locations are included in Appendix IV

Table 4-2: Faults with stuck-breaker[2]

CASE	LOCATION	TYPE	CLEARING TIME (cycles)		SLG FAULT IMPEDANCE (MVA)	STUCK BRK #	PRIMARY BRK TRIP #	SECONDARY BRK TRIP	TRIPPED FACILITIES	Stable ?
			PRIMARY	Back-up						
FAULT-1a	G. Gulf - B. Wilson 500 kV	3PH-1PH	5	9	675.23-j10951.98	BRK F	GCB #J2240, GCB #J2244, BRK E	BRK B, BRK D, J5204, J5216, J5228, J5240	G. Gulf - B. Wilson 500 kV	YES
FAULT-2a	G. Gulf - Ray Braswell 500 kV	3PH-1PH	5	9	756.09-j12420.14	J5216	J5224, BRK @ R. Braswell 500 kV	BRK B, BRK D, BRK F, J5204, J5228, J5240	G. Gulf - Ray Braswell 500 kV	YES
FAULT-3a	G. Gulf - Franklin 500 kV	3PH-1PH	5	9	746.53-j12160.41	J5240	GCB #J2425, GCB #J2420, J5248	BRK B, BRK D, BRK F, J5204, J5228, J5216	G. Gulf - Franklin 500 kV	YES
FAULT-4a	G. Gulf Unit 1	3PH-1PH	5	9	683.12-j10572.93	J5228	J5232	BRK B, BRK D, BRK F, J5204, J5216, J5240	G. Gulf Unit 1	YES
FAULT-5a	R. Braswell - Lakeover 500 kV	3PH-1PH	5	9	613.21-j5486.35	J4908	GCB#J9218, GCB#J9234, J4928	J4904, J4944, J4932	R. Braswell - Lakeover 500 kV	YES
FAULT-6a	R. Braswell - Franklin 500 kV	3PH-1PH	5	9	681.73-j6057.23	J4944	J4914, GCB#J2404, GCB#J2412	J4908, J4904, J4932	R. Braswell - Franklin 500 kV	YES
FAULT-6b	R. Braswell - Franklin 500 kV	3PH-1PH	5	9	681.73-j6057.23	J4914	J4944, GCB#J2404, GCB#J2412	J4952, R. Braswell 500/ 230 kV transformer breakers	R. Braswell - Franklin 500 kV, R. Braswell 500/230 kV transformer	YES
FAULT-7a	R. Braswell 500/230 kV	3PH-1PH	5	9	836.79-j6602.49	J4914	J4952,R. Braswell 500/ 230 kV transformer breakers	J4944, GCB#J2404, GCB#J2412	R. Braswell 500/230 kV transformer, R. Braswell - Franklin 500 kV	YES
FAULT-8a	R. Braswell 500/115 kV	3PH-1PH	5	9	830.71-j6509.82	J4917	J4904, R. Braswell 500/ 115 kV transformer breakers	J4936, J4952	R. Braswell 500/115 kV transformer	YES
FAULT-9a	B. Wilson - Lakeover 500 kV	3PH-1PH	5	9	680.64-j7946.18	J2233	GCB#J4928, GCB#J4920, J2230	GCB#R7372, GCB#R9872, J2218	B. Wilson - Lakeover 500 kV, B. Wilson Perryville 500 kV	YES
FAULT-10a	B. Wilson - Perryville 500 kV	3PH-1PH	5	9	632.86-j7577.59	J2233	GCB#R7372, GCB#R9872, J2218	GCB#J4928, GCB#J4920, J2230	B. Wilson Perryville 500 kV, B. Wilson - Lakeover 500 kV	YES
FAULT-11a	Franklin - McKnight 500 kV	3PH-1PH	5	9	627.61-j4449.69	J2416	GCB#21105, GCB#21110, J2412	GCB#S4402, GCB#S4405, J2420	Franklin - McKnight 500 kV, Franklin - Bogalusa 500 kV	YES

[2] For 3-phase faults with stuck breaker, transient voltage dip criteria are not applicable

CASE	LOCATION	TYPE	CLEARING TIME (cycles)		SLG FAULT IMPEDANCE (MVA)	STUCK BRK #	PRIMARY BRK TRIP #	SECONDARY BRK TRIP	TRIPPED FACILITIES	Stable ?
			PRIMARY	Back-up						
FAULT-11b	Franklin - McKnight 500 kV	3PH-1PH	5	9	627.61-j4449.69	J2412	GCB#21105, GCB#21110, J2416	J2408, Franklin 500/115 kV transformer #2 breakers	Franklin - McKnight 500 kV, Franklin 500/115kV	YES
FAULT-12a	Franklin - Bogalusa 500 kV	3PH-1PH	5	9	756.89-j5320.66	J2416	GCB#S4402, GCB#S4405, J2420	GCB#21105, GCB#21110, J2412	Franklin - McKnight 500 kV, Franklin - Bogalusa 500 kV	YES
FAULT-13a	Franklin - Ray Braswell 500 kV	3PH-1PH	5	9	694.49-j5005.78	J2408	J2404, GCB#J4904, GCB#4908	J2412, Franklin 500/115 kV transformer #2 breakers	Franklin - Ray Braswell 500 kV, Franklin 500/115 kV	YES
FAULT-14a	Franklin 500 / 115 kV	3PH-1PH	5	9	890.5-j5756.85	J2412	500/115 kV transformer breakers, J2408	GCB#21105, GCB#21110, J2416	Franklin 500 / 115 kV, Franklin - McKnight 500 kV	YES
FAULT-14b	Franklin 500 / 115 kV	3PH-1PH	5	9	890.5-j5756.85	J2408	500/115 kV transformer breakers, J2412	GCB#J4904, GCB#4908, J2404	Franklin 500 / 115 kV, Franklin - R. Braswell 500 kV	YES
FAULT-15a	B. Wilson 500/115 kV transformer #1	3PH-1PH	5	9	825.01-j8079.07	J2214	500/115 kV transformer breakers, J2222	J2218, J2252, J2225	B. Wilson 500/115 kV transformer #1	YES
FAULT-16a	Lakeover - McAdams 500 kV	3PH-1PH	5	9	393.96-j3393.78	J9234	J9214, GCB#J3924, GCB#3920	J2918, GCB#4908, GCB#4928	Lakeover - McAdams 500 kV, Lakeover- R. Braswell 500 kV	YES
FAULT-16b	Lakeover - McAdams 500 kV	3PH-1PH	5	9	393.96-j3393.78	J9214	J9234, GCB#J3924, GCB#3920	J9218, J3214,	Lakeover - McAdams 500 kV, Lakeover 500/115 kV transformer	YES
FAUL-17a	G. Gulf 500/27 kV (PID-203 GSU)	3PH-1PH	5	9	860.41-j13556.68	BRK I	BRK H, C, D	Gen trip	G. Gulf 500/27 kV GSU and G. Gulf Unit #3 (PID-203)	YES

** Substation Layout diagrams showing the Fault Locations are included in Appendix IV

4.1 ANALYSIS RESULTS

All of the normally-cleared, three-phase faults simulated were found to be stable. Likewise, all of the 500 kV IPO stuck-breaker faults were found to be stable. The plots are provided in Appendix III.

In addition to criteria for the stability of the machines, Entergy has evaluation criteria for the transient voltage dip as follows:

- 3-phase fault or single-line-ground fault with normal clearing resulting in the loss of a single component (generator, transmission circuit or transformer) or a loss of a single component without fault:
  Not to exceed 20% for more than 20 cycles at any bus
  Not to exceed 25% at any load bus
  Not to exceed 30% at any non-load bus
- 3-phase faults with normal clearing resulting in the loss of two or more components (generator, transmission circuit or transformer), and SLG fault delayed clearing resulted in the loss of one or more components:
  Not to exceed 20% for more than 40 cycles at any bus
  Not to exceed 30% at any load bus

The duration of the transient voltage dip excludes the duration of the fault. The transient voltage dip criteria will not be applied to three-phase faults followed by stuck breaker conditions unless the determined impact is extremely widespread.

The voltages at all buses in the Entergy system (115 kV and above) were monitored during each of the fault cases as appropriate. A slow voltage recovery was observed following Faults 1a, 2a, 3a and 10a. Faults 1a, 2a and 3a involve a 3 phase stuck-breaker (IPO) fault at G. Gulf 500 kV and loss of one (1) 500 kV transmission line connected to G. Gulf 500 kV substation at a time. As these faults are 3 Phase stuck breaker faults the voltage dip criteria are not applicable. The plots for voltages in the local area following Faults 1a, 2a 3a and 10a are shown in Figure 4-1 through Figure 4-4.

No violations of the transient voltage dip criteria were observed among simulated faults.

Plots of relevant parameters (machine angles and speed, the PID-203, G.GULF Unit #1, bus voltages and frequency, etc) are shown in Appendix III.

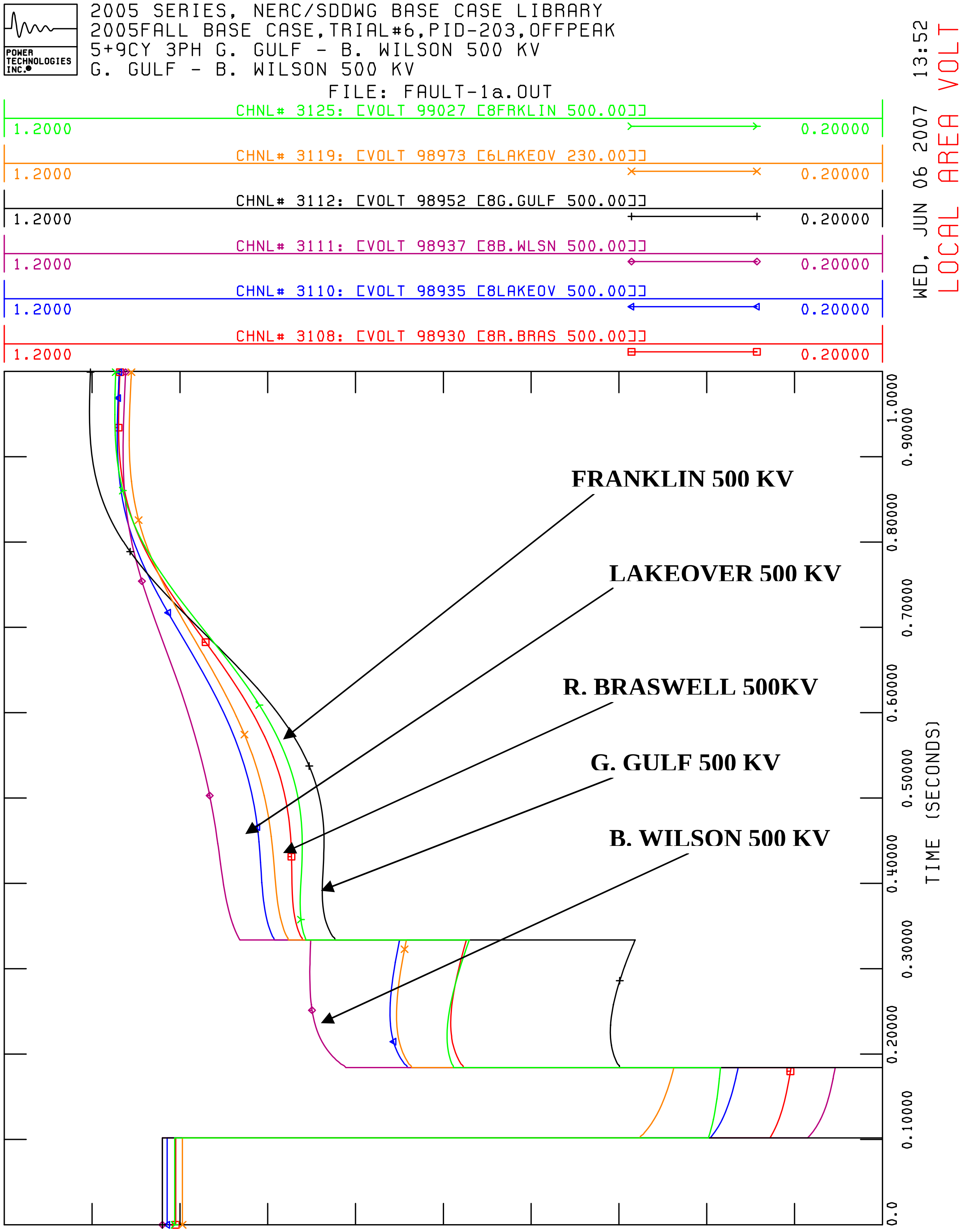

Figure 4-1: Local area voltages following Fault-1a – Off-peak conditions

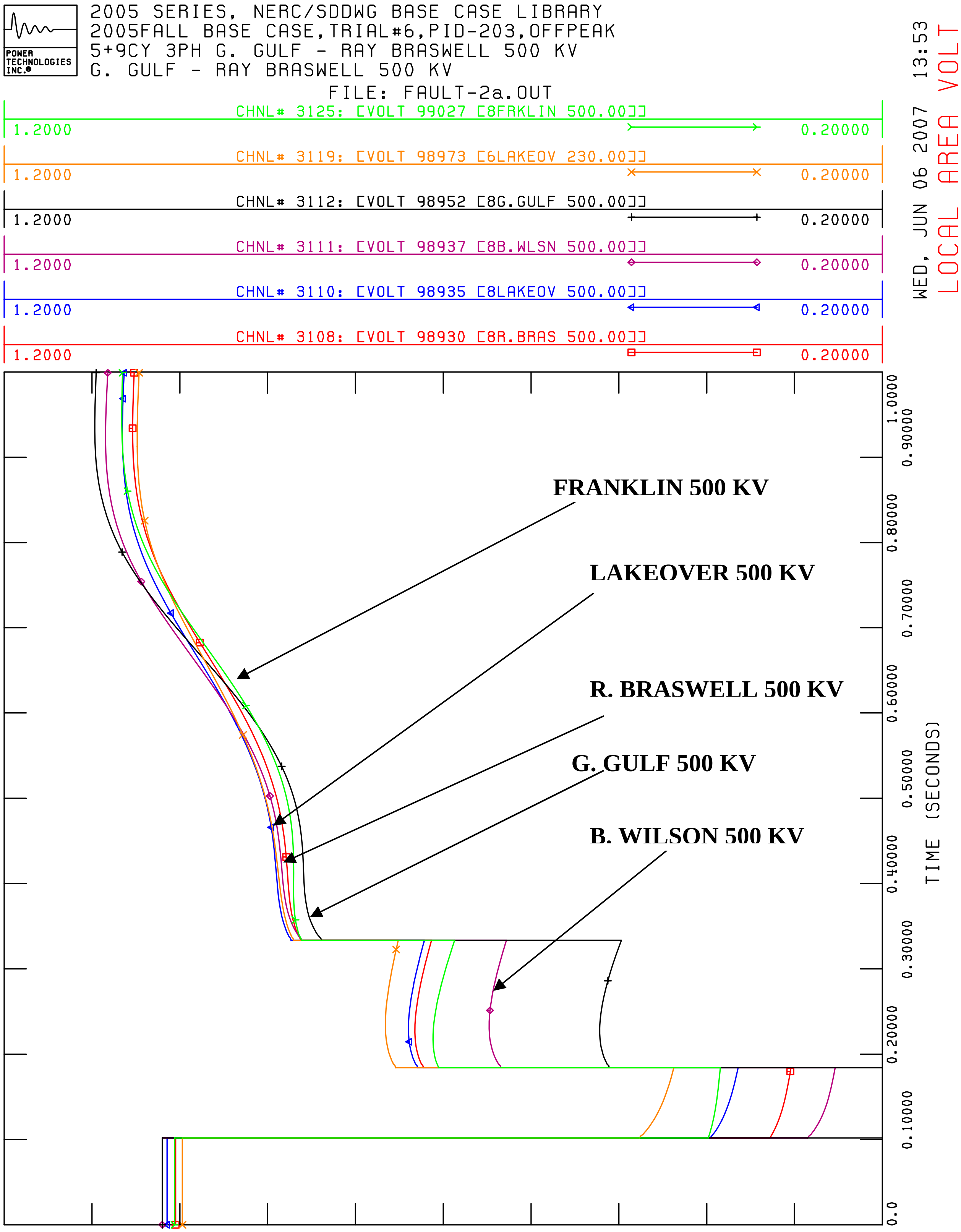

Figure 4-2: Local area voltages following Fault-2a – Off-peak conditions

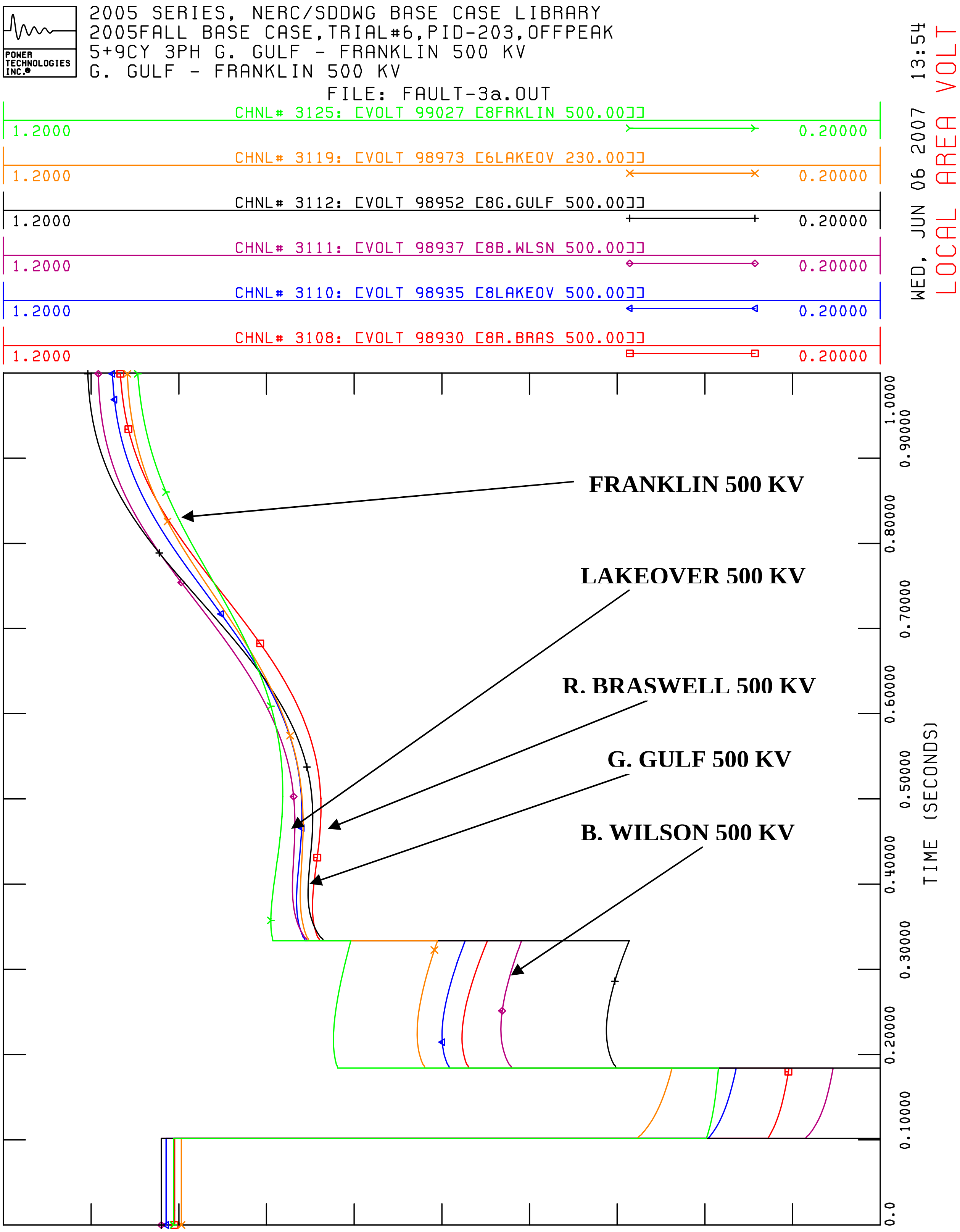

Figure 4-3: Local area voltages following Fault-3a – Off-peak conditions

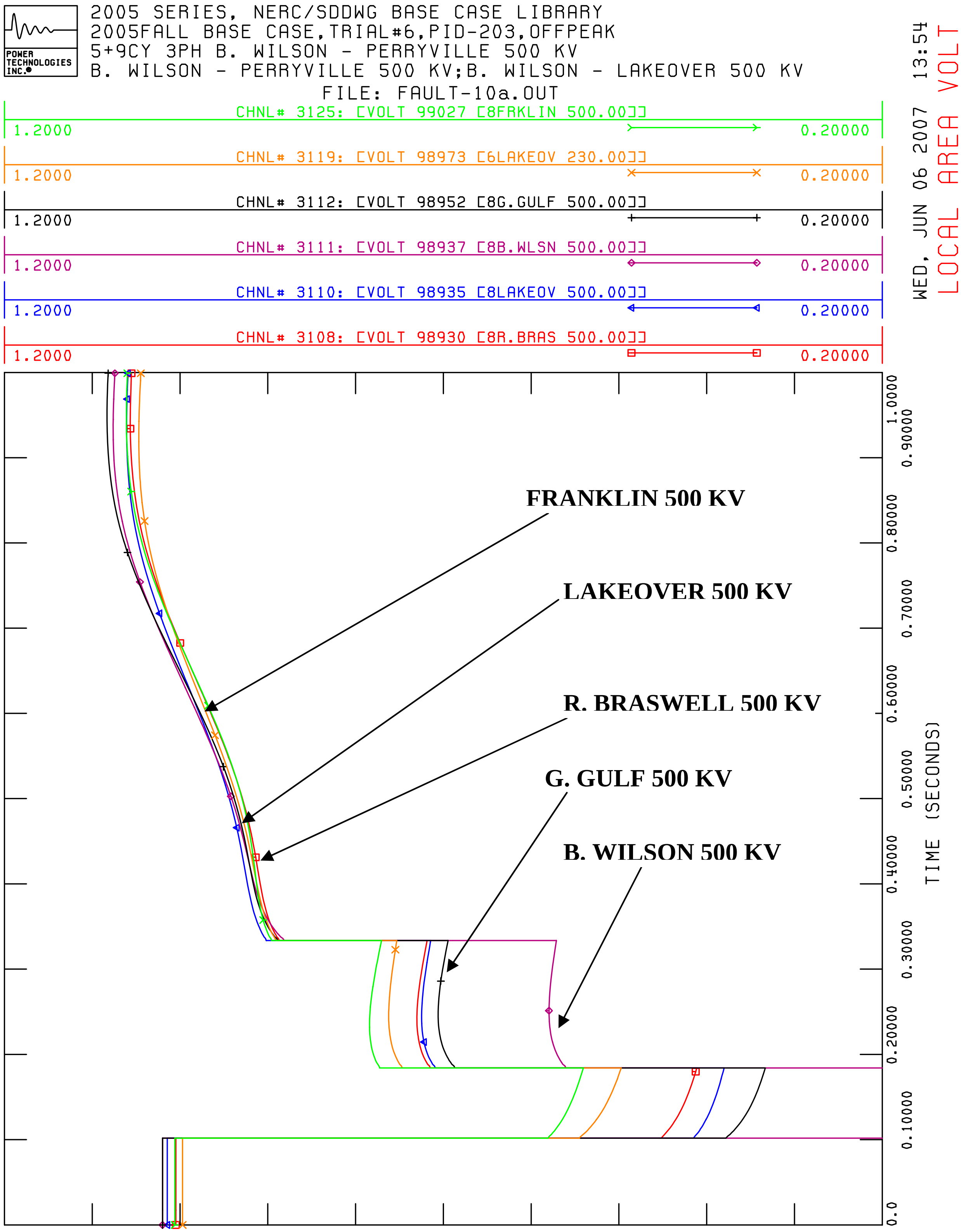

Figure 4-4: Local area voltages following Fault-10a – Off-peak conditions

5 CRITICAL CLEARING TIME ANALYSIS

Evaluation of Critical Clearing Time (CCT) was carried out for faults at the following four (4) substations:

- G. Gulf 500 kV
- Ray Braswell 500 kV
- Baxter Wilson 500 kV
- Franklin 500 kV

Critical Clearing Time Analysis was performed on both 2012 summer peak and 2012 off-peak system conditions.

Table 5-1 shows the list of faults simulated at the above four (4) substations for Critical Clearing Time assessment.

Critical Clearing Time (CCT) was calculated for a three-phase stuck-breaker (IPO: 3PH-1PH) fault for each element in the above four (4) substations. The Normal Clearing Time was kept equal to the normal value (5 cycles on 500 kV) and the backup clearing time was varied to find the CCT. If the system is found to be stable with 5+120 cycles delayed clearing time, then the analysis is stopped and the critical clearing time is listed 5+120 cycles (i.e. 125 cycles).

Table 5-1: List of faults for Critical Clearing Times assessment

CASE	LOCATION	TYPE	SLG FAULT IMPEDANCE (MVA)	STUCK BRK #	PRIMARY BRK TRIP #	SECONDARY BRK TRIP	TRIPPED FACILITIES
FAULT-1a	G. Gulf - B. Wilson 500 kV	3PH-1PH	675.23-j10951.98	BRK F	GCB #J2240, GCB #J2244, BRK E	BRK B, BRK D, J5204, J5216, J5228, J5240	G. Gulf - B. Wilson 500 kV
FAULT-2a	G. Gulf - Ray Braswell 500 kV	3PH-1PH	756.09-j12420.14	J5216	J5224, BRK @ R. Braswell 500 kV	BRK B, BRK D, BRK F, J5204, J5228, J5240	G. Gulf - Ray Braswell 500 kV
FAULT-3a	G. Gulf - Franklin 500 kV	3PH-1PH	746.53-j12160.41	J5240	GCB #J2425, GCB #J2420, J5248	BRK B, BRK D, BRK F, J5204, J5228, J5216	G. Gulf - Franklin 500 kV
FAULT-4a	G. Gulf Unit 1	3PH-1PH	683.12-j10572.93	J5228	J5232	BRK B, BRK D, BRK F, J5204, J5216, J5240	G. Gulf Unit 1
FAULT-5a	R. Braswell - Lakeover 500 kV	3PH-1PH	613.21-j5486.35	J4908	GCB#J9218, GCB#J9234, J4928	J4904, J4944, J4932	R. Braswell - Lakeover 500 kV
FAULT-6a	R. Braswell - Franklin 500 kV	3PH-1PH	681.73-j6057.23	J4944	J4914, GCB#J2404, GCB#J2412	J4908, J4904, J4932	R. Braswell - Franklin 500 kV
FAULT-6b	R. Braswell - Franklin 500 kV	3PH-1PH	681.73-j6057.23	J4914	J4944, GCB#J2404, GCB#J2412	J4952, R. Braswell 500/ 230 kV transformer breakers	R. Braswell - Franklin 500 kV, R. Braswell 500/230 kV transformer
FAULT-7a	R. Braswell 500/230 kV	3PH-1PH	836.79-j6602.49	J4914	J4952,R. Braswell 500/ 230 kV transformer breakers	J4944, GCB#J2404, GCB#J2412	R. Braswell 500/230 kV transformer, R. Braswell - Franklin 500 kV
FAULT-8a	R. Braswell 500/115 kV	3PH-1PH	830.71-j6509.82	J4917	J4904, R. Braswell 500/ 115 kV transformer breakers	J4936, J4952	R. Braswell 500/115 kV transformer
FAULT-9a	B. Wilson - Lakeover 500 kV	3PH-1PH	680.64-j7946.18	J2233	GCB#J4928, GCB#J4920, J2230	GCB#R7372, GCB#R9872, J2218	B. Wilson - Lakeover 500 kV, B. Wilson Perryville 500 kV
FAULT-10a	B. Wilson - Perryville 500 kV	3PH-1PH	632.86-j7577.59	J2233	GCB#R7372, GCB#R9872, J2218	GCB#J4928, GCB#J4920, J2230	B. Wilson Perryville 500 kV, B. Wilson - Lakeover 500 kV
FAULT-11a	Franklin - McKnight 500 kV	3PH-1PH	627.61-j4449.69	J2416	GCB#21105, GCB#21110, J2412	GCB#S4402, GCB#S4405, J2420	Franklin - McKnight 500 kV, Franklin - Bogalusa 500 kV

CASE	LOCATION	TYPE	SLG FAULT IMPEDANCE (MVA)	STUCK BRK #	PRIMARY BRK TRIP #	SECONDARY BRK TRIP	TRIPPED FACILITIES
FAULT-11b	Franklin - McKnight 500 kV	3PH-1PH	627.61-j4449.69	J2412	GCB#21105, GCB#21110, J2416	J2408, Franklin 500/115 kV transformer #2 breakers	Franklin - McKnight 500 kV, Franklin 500/115kV
FAULT-12a	Franklin - Bogalusa 500 kV	3PH-1PH	756.89-j5320.66	J2416	GCB#S4402, GCB#S4405, J2420	GCB#21105, GCB#21110, J2412	Franklin - McKnight 500 kV, Franklin - Bogalusa 500 kV
FAULT-13a	Franklin - Ray Braswell 500 kV	3PH-1PH	694.49-j5005.78	J2408	J2404, GCB#J4904, GCB#4908	J2412, Franklin 500/115 kV transformer #2 breakers	Franklin - Ray Braswell 500 kV, Franklin 500/115 kV
FAULT-14a	Franklin 500 / 115 kV	3PH-1PH	890.5-j5756.85	J2412	500/115 kV transformer breakers, J2408	GCB#21105, GCB#21110, J2416	Franklin 500 / 115 kV, Franklin - McKnight 500 kV
FAULT-14b	Franklin 500 / 115 kV	3PH-1PH	890.5-j5756.85	J2408	500/115 kV transformer breakers, J2412	GCB#J4904, GCB#4908, J2404	Franklin 500 / 115 kV, Franklin - R. Braswell 500 kV
FAULT-15a	B. Wilson 500/115 kV transformer #1	3PH-1PH	825.01-j8079.07	J2214	500/115 kV transformer breakers, J2222	J2218, J2252, J2225	B. Wilson 500/115 kV transformer #1
FAULT-16a	Lakeover - McAdams 500 kV	3PH-1PH	393.96-j3393.78	J9234	J9214, GCB#J3924, GCB#3920	J2918, GCB#4908, GCB#4928	Lakeover - McAdams 500 kV, Lakeover- R. Braswell 500 kV
FAULT-16b	Lakeover - McAdams 500 kV	3PH-1PH	393.96-j3393.78	J9214	J9234, GCB#J3924, GCB#3920	J9218, J3214,	Lakeover - McAdams 500 kV, Lakeover 500/115 kV transformer
FAUL-17a	G. Gulf 500/27 kV (PID-203 GSU)	3PH	860.41-j13556.68	BRK I	BRK H, C, D		G. Gulf 500/27 kV GSU and G. Gulf Unit #3 (PID-203)
FAULT-23a	R. Braswell - G. Gulf 500 kV	3PH-1PH	592.09-j5469.91	J4928	GCB#J2230, GCB#J2233, J4920	GCB#J9218, GCB#9234, J4908	R. Braswell - G. Gulf 500 kV, R. Braswell - Lakeover 500 kV
FAULT-24a	B. Wilson - G. Gulf 500 kV	3PH-1PH	395.69-j6082.41	J2244	GCB#J5224, GCB#J5216, J2240	GCB#52L2, GCB#52L1, J2252	B. Wilson - G. Gulf 500 kV, Warren Power Generation
FAULT-25a	B. Wilson - EPG 500 kV	3PH-1PH	794.41-j8291.24	J2244	GCB#52L2, GCB#52L1, J2244	GCB#J5224, GCB#J5216, J2240	Warren Power Generation, B. Wilson - EPG 500 kV
FAULT-26a	Franklin - G. Gulf 500 kV	3PH-1PH	590.82-j4442.66	J2420	GCB#J5248, GCB#J5240 J2425,	GCB#S4402, GCB#S4405, J2416	Franklin - G. Gulf 500 kV, Franklin - Bogalusa 500 kV
FAULT-26b	Franklin - G. Gulf 500 kV	3PH-1PH	590.82-j4442.66	J2425	GCB#J5248, GCB#J5240, J2420	J2404, Low side BRK for Franklin 115 kV	Franklin - G. Gulf 500 kV, Franklin 500/115 kV transformer #1

The results for critical clearing time assessment are listed in below in Table 5-2.

Table 5-2: Results of Critical Clearing Time assessment

CASE	Critical Clearing Time		
	PRIMARY	Delayed Clearing	
		PEAK	OFF-PEAK
FAULT-1a	5	12	19
FAULT-2a	5	14	22
FAULT-3a	5	11	20
FAULT-4a	5	33	120
FAULT-5a	5	120	120
FAULT-6a	5	120	120
FAULT-6b	5	120	120
FAULT-7a	5	120	120
FAULT-8a	5	120	120
FAULT-9a	5	113	120
FAULT-10a	5	19	120
FAULT-11a	5	120	120
FAULT-11b	5	120	120
FAULT-12a	5	120	120
FAULT-13a	5	120	120
FAULT-14a	5	120	120
FAULT-14b	5	120	120
FAULT-15a	5	120	120
FAULT-16a	5	120	120
FAULT-16b	5	120	120
FAUL-17a	5	18	19
FAULT-23a	5	120	120
FAULT-24a	5	120	120
FAULT-25a	5	120	120
FAULT-26a	5	120	120
FAULT-26b	5	120	120

It can be seen from the above results that the Critical Clearing time is 5+120 (125) cycles for most of the 3 Phase IPO stuck-breaker faults. The lowest CCTs are for faults 3a (5+11 cycles) and 1a (5+12 cycles) during summer peak conditions. These are slightly longer than Entergy's 500 kV standard clearing time of 5+9 cycles.

Critical Clearing times for selected contingencies were calculated for Pre-PID-203 system conditions to identify the impact of the proposed G. Gulf Unit #3 (PID-203). As Critical Clearing Times in summer peak conditions were lower than off-peak system conditions, the selected contingencies were repeated only on summer peak system conditions. Table 5-3 shows the results of the comparison of Critical Clearing Time between PRE and POST PID-203 system conditions.

For Fault-1a, 3 Phase IPO stuck-breaker fault at G. Gulf and cleared by tripping G. Gulf - B. Wilson 500 kV line, the critical clearing time has improved by one (1) cycle with PID-203.

For Fault-3a, 3 Phase IPO stuck-breaker fault at G. Gulf and cleared by tripping G. Gulf - Franklin 500 kV line, the critical clearing time decreased by two (2) cycles with PID-203. As mentioned previously the critical clearing time of 5+11 cycles is longer than Entergy's 500 kV standard 5+9 cycles clearing time.

For Fault-10a, 3 Phase IPO stuck-breaker fault at B. Wilson and cleared by tripping B. Wilson - Perryville 500 kV and B. Wilson – R. Braswell 500 kV line, the critical clearing time decreased by five (5) cycles. It should be noted that the transmission configuration at B. Wilson would be changed after interconnection of PID-203 (see Figure 1-3). Also, the critical clearing time of 5+19 cycles is longer than Entergy's 500 kV standard (5+9 cycle) clearing time.

For Fault-11b, 3 Phase IPO stuck-breaker fault at Franklin 500 kV cleared by tripping Franklin – McKnight 500 kV line and Franklin 500/115 kV transformer, the critical clearing time does not have any impact.

Table 5-3: Critical Clearing Time Comparison Pre and Post PID-203 (summer peak)

CASE	Critical Clearing Time		
	PRIMARY	Delayed Clearing	
		W/O PID-203	WITH PID-203
FAULT-1a	5	11	12
FAULT-3a	5	13	11
FAULT-10a	5	24	19
FAULT-11b	5	120	120

6 CONCLUSIONS

Southwest Power Pool (SPP) has commissioned ABB Inc. to conduct an offsite power analysis of the proposed new nuclear unit (PID-203) at G. Gulf 500 kV. Offsite power is the preferred power source for nuclear power stations. The true capability of offsite power cannot be verified through direct readings of plant switchyard or safety bus voltages, but through analyses of grid and plant conditions considering the occurrence of severe contingencies representing the partial loss of grid support. The objective of this analysis is to identify if the Entergy System configuration will comply with the Code of Federal Regulations (CFR) specifically with respect to the grid voltage performance and the reliability of the Offsite Power Supply for G. Gulf Unit #3 (PID-203).

The steady-state analysis was conducted to determine the voltage levels at G. Gulf 500 kV and 115 kV buses following various outage contingencies on the transmission system during projected 2012 summer peak and 2012 off-peak load conditions. The System Impact Study for PID-203 was performed on summer peak 2012 load conditions. The results of the stability analysis for the summer peak 2012 system conditions from System Impact Study are also applicable for this offsite analysis. Hence, stability analysis was performed only on 2012 off-peak load conditions. Critical Clearing Time assessment was performed to determine the critical clearing times for faults at the G. Gulf 500 kV and adjacent substations.

Per the '*Nuclear Management Manual ENS-DC-199 Rev-2*' the acceptable steady-state post-contingency voltage range at G. Gulf 115 kV is 0.975 p.u to 1.05 p.u. The results of the off-site analysis study indicate that the voltage at G. Gulf 115 kV was lowest with both G. Gulf units online and the Port Gibson Capacitor bank (30.5 MVAR) switched off. The voltage at G. Gulf 115 kV was 0.9674 p.u. for 2012 summer peak system conditions and 0.9740 p.u. for 2012 off-peak system conditions. Hence, there is a violation of the voltage criterion for Off-site Power supply for G. Gulf nuclear units. For comparison, the similar contingency was simulated on Pre-Project case. The results indicated that the voltage violation at G. Gulf 115 kV also existed in Pre-Project case. Entergy Transmission Planning and G. Gulf substation personnel are addressing a solution for this situation.

Per the '*Nuclear Management Manual ENS-DC-199 Rev-2*' the acceptable steady-state post-contingency voltage range at G. Gulf 500 kV is 0.9820 p.u to 1.05 p.u. The results of the off-site analysis study indicate that the voltage at G. Gulf 500 kV was below the voltage criterion following two contingencies: 1) loss of G. Gulf - B. Wilson and G. Gulf – R. Braswell 500 kV lines and 2) loss of G. Gulf – B. Wilson and G. Gulf – Franklin 500 kV lines, with G. Gulf Unit #3 (PID-203) off-line and with GG Unit #1 either online or offline. The loss of two lines is considered strictly to obtain an insight as to robustness of the system under such severe conditions (multiple concurrent line contingencies).

The results of the offsite analysis study indicate that there are no stability criteria violations associated with the Proposed PID-203 G. Gulf Unit # 3.

The G. Gulf Unit #3 (PID-203) does not have any significant impact on the Critical Clearing times at the G. Gulf, B. Wilson R. Braswell and Franklin 500 kV substations.

The results of this study are based on available data and assumptions made at the time this study was conducted. The results included in this report may not apply if any of the data and/or assumptions made in developing the study models change.

APPENDIX I - DATA FOR G. GULF UNIT #1 & PID-203

APPENDIX I.1 LOADFLOW DATA

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98982,'PID-203 ',  27.0000,2,     0.000,     0.000, 151, 151,0.99999,  22.1462,   1
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1,1.0000
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0 / END OF BRANCH DATA, BEGIN TRANSFORMER DATA
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APPENDIX I.2 DYNAMICS DATA

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2005 SERIES, NERC/SDDWG BASE CASE LIBRARY
2005FALL BASE CASE,TRIAL#6,PID-203,OFFPEAK

PLANT MODELS

REPORT FOR ALL MODELS                            BUS 98954 [GGULF   22.000] MODELS


** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
            98954     GGULF    22.000 1   80805-80818   30976-30981

            MBASE     Z S O R C E         X T R A N       GENTAP
           1525.0  0.00000+J 0.30230  0.00000+J 0.00000  1.00000

 T'D0 T''D0  T'Q0 T''Q0     H   DAMP   XD     XQ     X'D    X'Q   X''D    XL
 7.74 0.046  0.86 0.068   4.90  0.00 1.4463 1.4081 0.3855 0.5759 0.3023 0.0000

                               S(1.0)  S(1.2)
                               0.1740  0.5210


** ESAC5A **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     VAR
            98954     GGULF    22.000 1   80865-80879   30992-30996    4004

   TR      KA     TA   VRMAX   VRMIN     KE     TE     KF     TF1    TF2    TF3
 0.200  600.00  0.100  6.400  -6.400   1.000  0.220  0.020  1.000  0.130  0.000

                  E1     S(E1)    E2     S(E2)        KE VAR
                2.8000  0.7300  3.7000  0.7300        0.0000


** IEEEG1 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S
            98954 GGULF        22.000 1   80894-80913   31001-31006    4007-4008

    K      T1      T2      T3     UO      UC    PMAX   PMIN     T4      K1
  12.00   0.000   0.000   0.075  0.600  -0.600 0.9000 0.0000   0.250   0.350

   K2      T5      K3      K4      T6      K5      K6      T7      K7      K8
 0.000   2.750   0.650   0.000   0.000   0.000   0.000   0.000   0.000   0.000

     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      THU, JUN 21 2007  10:56
2005 SERIES, NERC/SDDWG BASE CASE LIBRARY
2005FALL BASE CASE,TRIAL#6,PID-203,OFFPEAK

PLANT MODELS

REPORT FOR ALL MODELS                            BUS 98982 [PID-203 27.000] MODELS


** GENROU **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
            98982     PID-203  27.000 3   80914-80927   31007-31012

            MBASE     Z S O R C E         X T R A N       GENTAP
           1933.0  0.00000+J 0.28000  0.00000+J 0.00000  1.00000

 T'D0 T''D0  T'Q0 T''Q0     H   DAMP   XD     XQ     X'D    X'Q   X''D    XL
11.30 0.038  0.53 0.068   4.84  0.00 2.0600 1.9400 0.3650 0.5500 0.2800 0.2250

                               S(1.0)  S(1.2)
                               0.3750  1.1000


** PSS2A **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C
O N S
```

98982 PID-203 27.000 3 80928-80944 31013-31028 4009-4012 1296-1301

IC1	REMBUS1	IC2	REMBUS2	M	N
1	0	3	0	5	1

TW1	TW2	T6	TW3	TW4	T7	KS2	KS3
2.000	2.000	0.000	2.000	0.000	2.000	0.207	1.000

T8	T9	KS1	T1	T2	T3	T4	VSTMAX	VSTMIN
0.500	0.100	4.000	0.150	0.030	0.150	0.030	0.100	-0.100

** ESST4B **	BUS	X-- NAME --X	BASEKV	MC	C O N S	S T A T E S
	98982	PID-203	27.000	3	80945-80961	31029-31032

TR	KPR	KIR	VRMAX	VRMIN	TA	KPM	KIM	VMMAX	VMMIN
0.000	2.660	2.660	1.000	-0.800	0.010	1.000	0.000	1.000	-0.800

KG	KP	KI	VBMAX	KC	XL	THETAP
0.000	7.530	0.000	9.410	0.300	0.0000	0.000

** IEEEG1 **	BUS	X-- NAME --X	BASEKV	MC	C O N S	S T A T E S	V A R S
	98982	PID-203	27.000	3	80962-80981	31033-31038	4013-4014

K	T1	T2	T3	UO	UC	PMAX	PMIN	T4	K1
20.00	0.000	0.000	0.150	0.120	-0.120	0.8500	0.0000	0.500	0.340

K2	T5	K3	K4	T6	K5	K6	T7	K7	K8
0.000	0.350	0.660	0.000	0.000	0.000	0.000	0.000	0.000	0.000

APPENDIX II - LIST OF IPP GENERATION FOR DISPATCH

```
TEXT  ** File created on 8/23/2006 9:29:03 AM
TEXT  ** Excess generation of  1450  MW met by IPPs for 2012 case **
TEXT  ** Total PMAX of all IPPs that participate in matching excess load is  7251.2  MW
**
RDCH
1
0
0
97772,1,41.50,,25.00,,,,,,,,,,1,,41.50,0  /*  BAYOR U1
97773,1,41.50,,25.00,,,,,,,,,,1,,41.50,0  /*  BAYOR U2
97774,1,13.67,,8.47,,,,,,,,,,1,,32.00,0  /*  BAYOR U3
98495,1,96.67,,59.91,,,,,,,,,,1,,255.00,0  /*  S1CALBOG
98494,1,0.00,,0.00,,,,,,,,,,0,,175.00,0  /*  G2CALBOG
98493,1,0.00,,0.00,,,,,,,,,,0,,175.00,0  /*  G1CALBOG
98435,1,96.67,,59.91,,,,,,,,,,1,,187.00,0  /*  IC1CARVL
98436,1,0.00,,0.00,,,,,,,,,,0,,187.00,0  /*  IC2CARVL
98437,1,0.00,,0.00,,,,,,,,,,0,,181.00,0  /*  IS1CARVL
97785,1,96.67,,59.91,,,,,,,,,,1,,185.00,0  /*  G1CONOCO
97786,1,0.00,,0.00,,,,,,,,,,0,,185.00,0  /*  G2CONOCO
98324,1,96.67,,59.91,,,,,,,,,,1,,200.00,0  /*  DOWAEP5
98321,1,0.00,,0.00,,,,,,,,,,0,,177.00,0  /*  DOWAEP2
98322,1,0.00,,0.00,,,,,,,,,,0,,177.00,0  /*  DOWAEP3
98323,1,0.00,,0.00,,,,,,,,,,0,,177.00,0  /*  DOWAEP4
98320,1,0.00,,0.00,,,,,,,,,,0,,177.00,0  /*  DOWAEP1
98840,1,80.00,,40.00,,,,,,,,,,1,,80.00,0  /*  G3DUKEFRPT
98841,1,16.67,,10.33,,,,,,,,,,1,,80.00,0  /*  G4DUKEFRPT
98842,1,0.00,,0.00,,,,,,,,,,0,,80.00,0  /*  G5DUKEFRPT
98843,1,0.00,,0.00,,,,,,,,,,0,,80.00,0  /*  G6DUKEFRPT
98844,1,0.00,,0.00,,,,,,,,,,0,,80.00,0  /*  G7DUKEFRPT
98845,1,0.00,,0.00,,,,,,,,,,0,,80.00,0  /*  G8DUKEFRPT
98970,1,96.67,,59.91,,,,,,,,,,1,,198.00,0  /*  IS1DUKEH
98969,1,0.00,,0.00,,,,,,,,,,0,,176.60,0  /*  IG2DUKEH
98968,1,0.00,,0.00,,,,,,,,,,0,,176.60,0  /*  IG1DUKEH
98095,1,96.67,,59.91,,,,,,,,,,1,,175.00,0  /*  G1DYNEGY
98096,1,0.00,,0.00,,,,,,,,,,0,,175.00,0  /*  G2DYNEGY
98834,1,96.67,,59.91,,,,,,,,,,1,,256.00,0  /*  S1GPMCAD
98833,1,0.00,,0.00,,,,,,,,,,0,,168.50,0  /*  G2GPMCAD
98832,1,0.00,,0.00,,,,,,,,,,0,,168.50,0  /*  G1GPMCAD
97824,1,96.67,,59.91,,,,,,,,,,1,,187.50,0  /*  1G3INTHB
97826,1,0.00,,0.00,,,,,,,,,,0,,187.50,0  /*  1G4INTHB
97819,1,0.00,,0.00,,,,,,,,,,0,,125.00,0  /*  1S1INTHB
97825,1,0.00,,0.00,,,,,,,,,,0,,125.00,0  /*  1S3INTHB
97821,1,0.00,,0.00,,,,,,,,,,0,,125.00,0  /*  1S2INTHB
97827,1,0.00,,0.00,,,,,,,,,,0,,125.00,0  /*  1S4INTHB
98850,1,75.00,,46.48,,,,,,,,,,1,,75.00,0  /* IMEPCLG1
98851,1,21.67,,13.43,,,,,,,,,,1,,75.00,0  /* IMEPCLG2
98852,1,0.00,,0.00,,,,,,,,,,0,,75.00,0  /* IMEPCLG3
98853,1,0.00,,0.00,,,,,,,,,,0,,75.00,0  /* IMEPCLG4
99422,1,96.67,,59.91,,,,,,,,,,1,,180.00,0  /* 1SKY U1
99423,1,0.00,,0.00,,,,,,,,,,0,,50.00,0  /* 1SKY U2
98090,5,96.67,,59.91,,,,,,,,,,1,,185.00,0  /*  RSCO R5
98091,4,0.00,,0.00,,,,,,,,,,0,,80.00,0  /*  RSCO R4
98574,1,96.67,,59.91,,,,,,,,,,1,,170.00,0  /* 1GOXY U1
98575,1,0.00,,0.00,,,,,,,,,,0,,170.00,0  /* 1GOXY U2
98576,1,0.00,,0.00,,,,,,,,,,0,,170.00,0  /* 1GOXY U3
99649,1,96.67,,59.91,,,,,,,,,,1,,544.00,0  /* RITC U2
Q
echo
@end
```

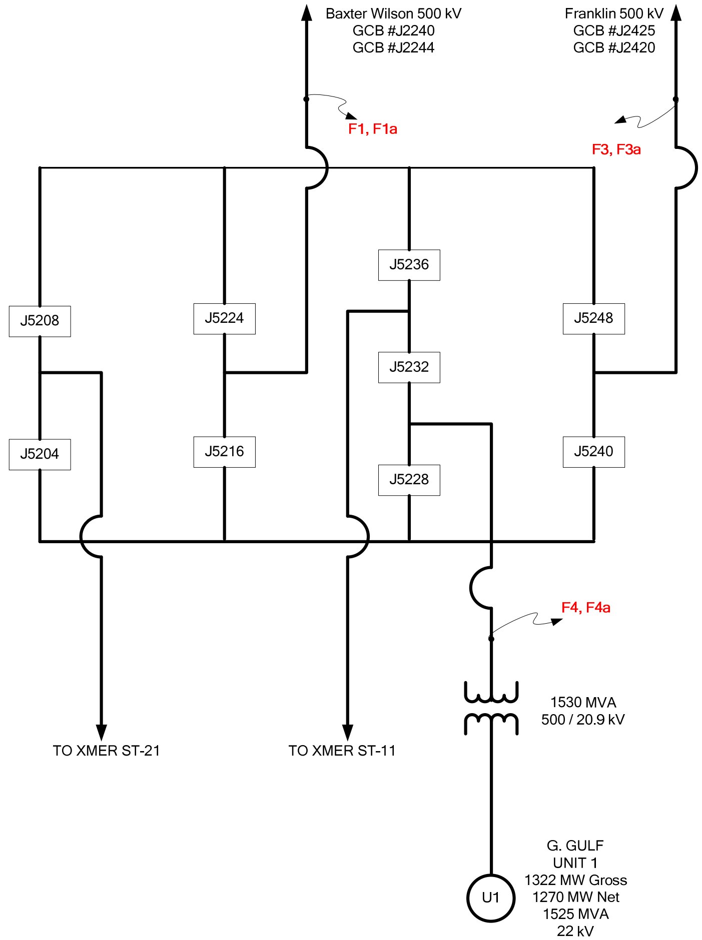
APPENDIX III - PLOTS FOR STABILITY ANALYSIS

Plots illustrating the results from the simulated cases are included in this appendix. For all cases, speed plots are given for representative generators near major 230 kV or 500 kV buses in the area near the proposed PID-203 generation.

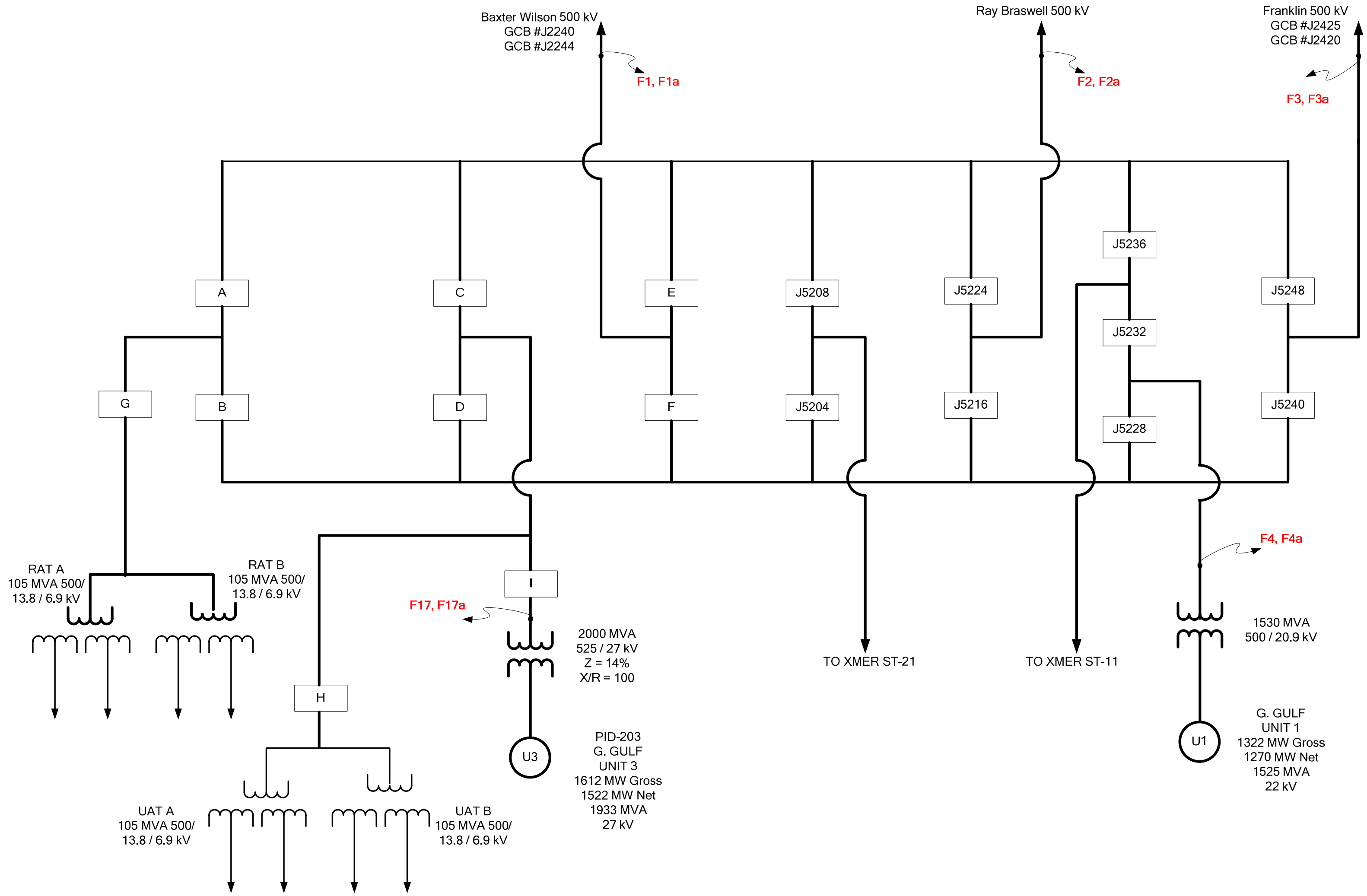
APPENDIX IV - SUBSTATION LAYOUT DIAGRAMS

Substation layout diagrams indicating the Fault Locations are included below (for reference purpose only).

Bus configuration for G. Gulf 500 kV substation PRE-PID-203

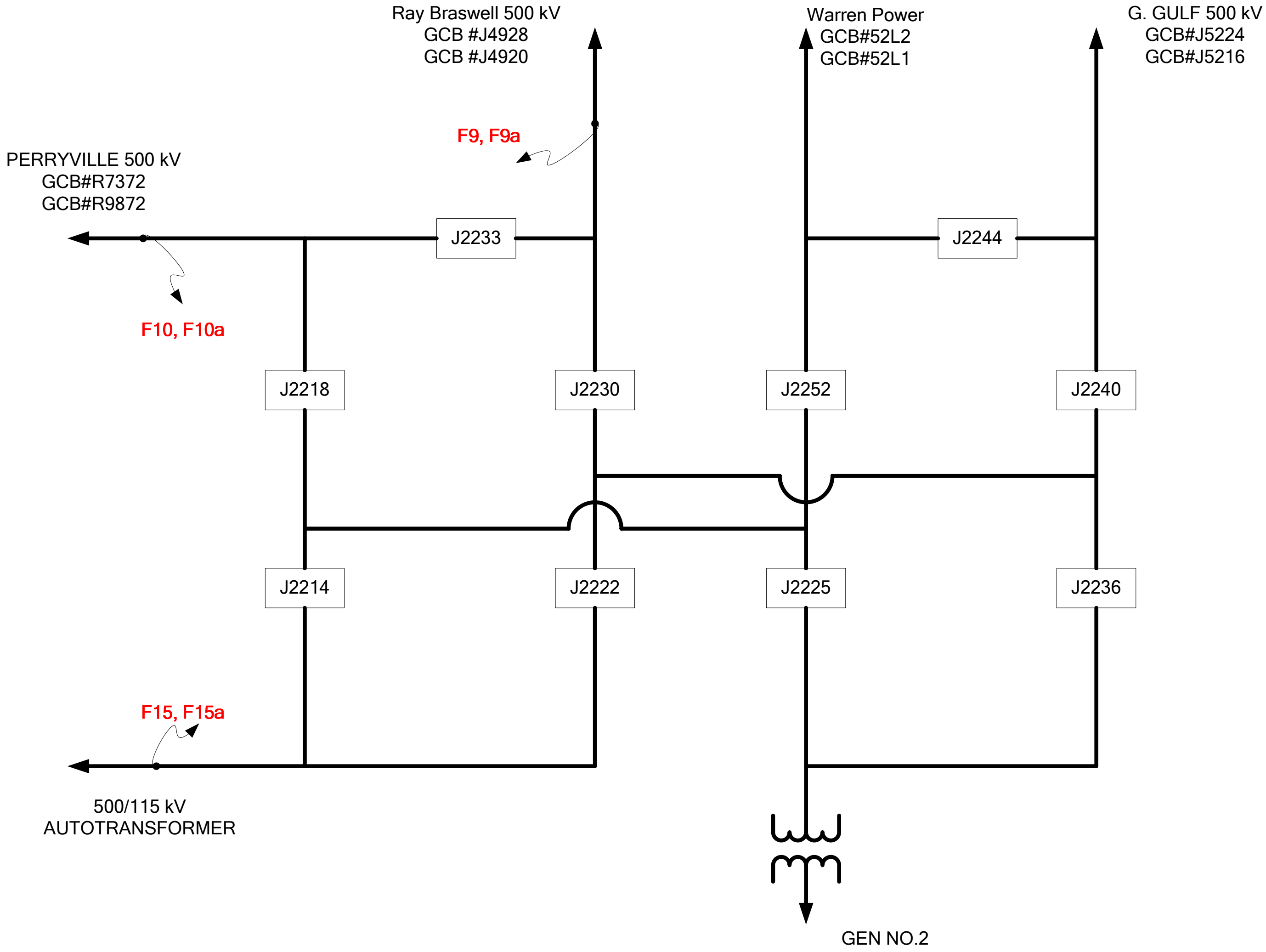


Bus configuration for G. Gulf 500 kV substation POST-PID-203

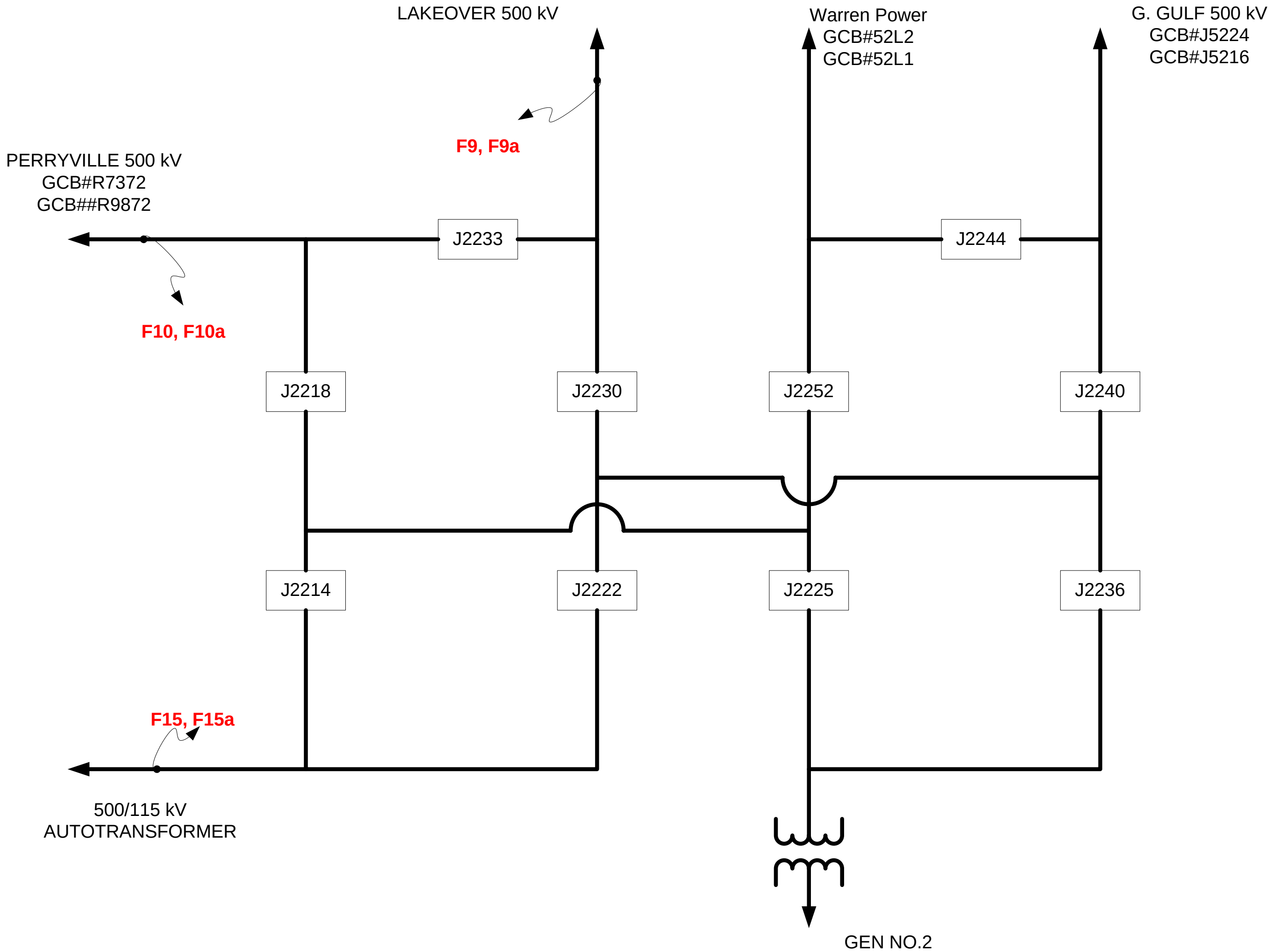


Baxter Wilson 500 kV
GCB #J2240
GCB #J2244
F1, F1a
Ray Braswell 500 kV
F2, F2a
Franklin 500 kV
GCB #J2425
GCB #J2420
F3, F3a
A
C
E
J5208
J5224
J5236
J5248
J5232
G
B
D
F
J5204
J5216
J5228
J5240
RAT A
105 MVA 500/
13.8 / 6.9 kV
RAT B
105 MVA 500/
13.8 / 6.9 kV
I
F17, F17a
2000 MVA
525 / 27 kV
Z = 14%
X/R = 100
TO XMER ST-21
TO XMER ST-11
F4, F4a
1530 MVA
500 / 20.9 kV
H
U3
PID-203
G. GULF
UNIT 3
1612 MW Gross
1522 MW Net
1933 MVA
27 kV
U1
G. GULF
UNIT 1
1322 MW Gross
1270 MW Net
1525 MVA
22 kV
UAT A
105 MVA 500/
13.8 / 6.9 kV
UAT B
105 MVA 500/
13.8 / 6.9 kV

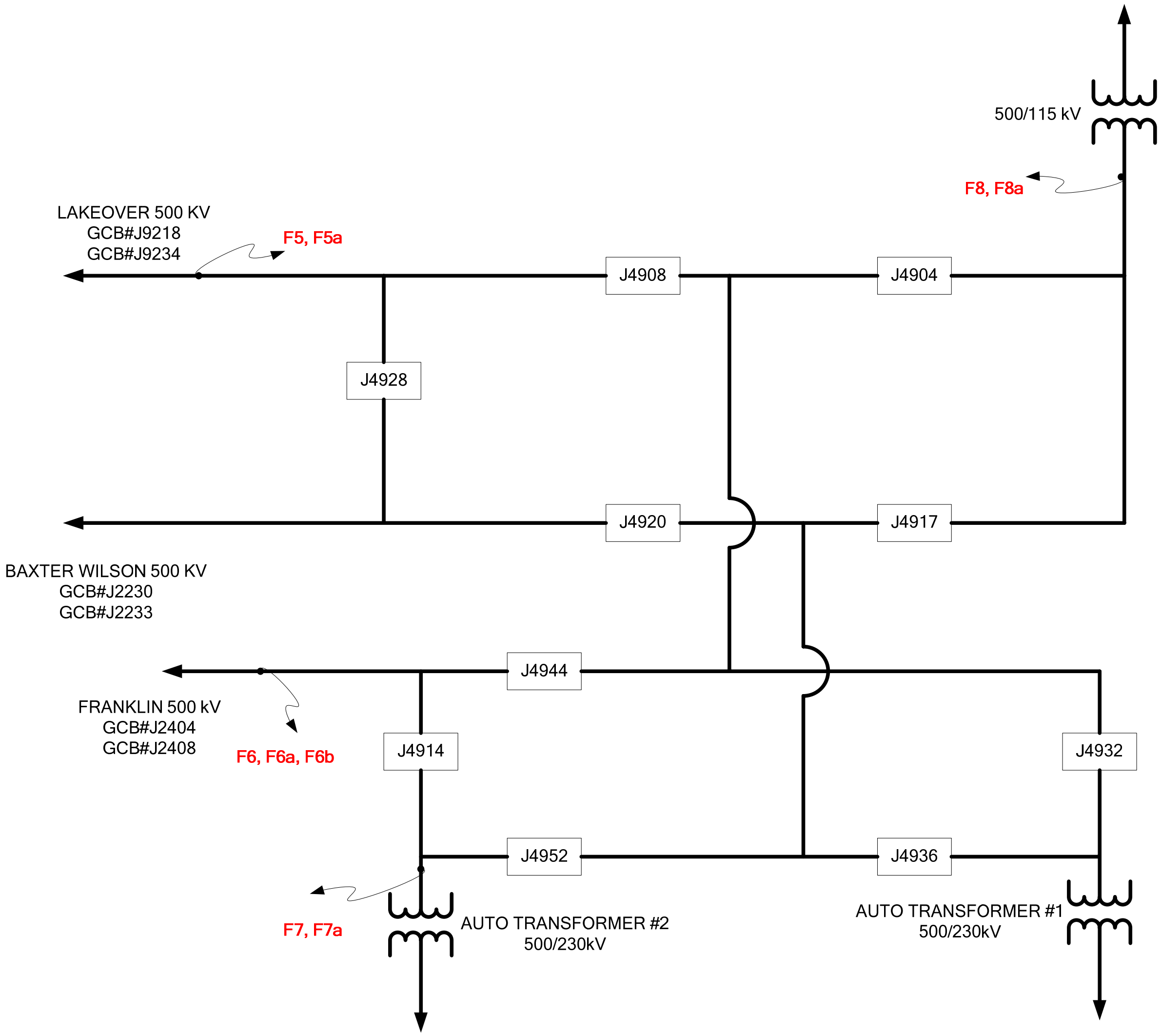
Bus configuration for B. Wilson 500 kV substation PRE-PID-203



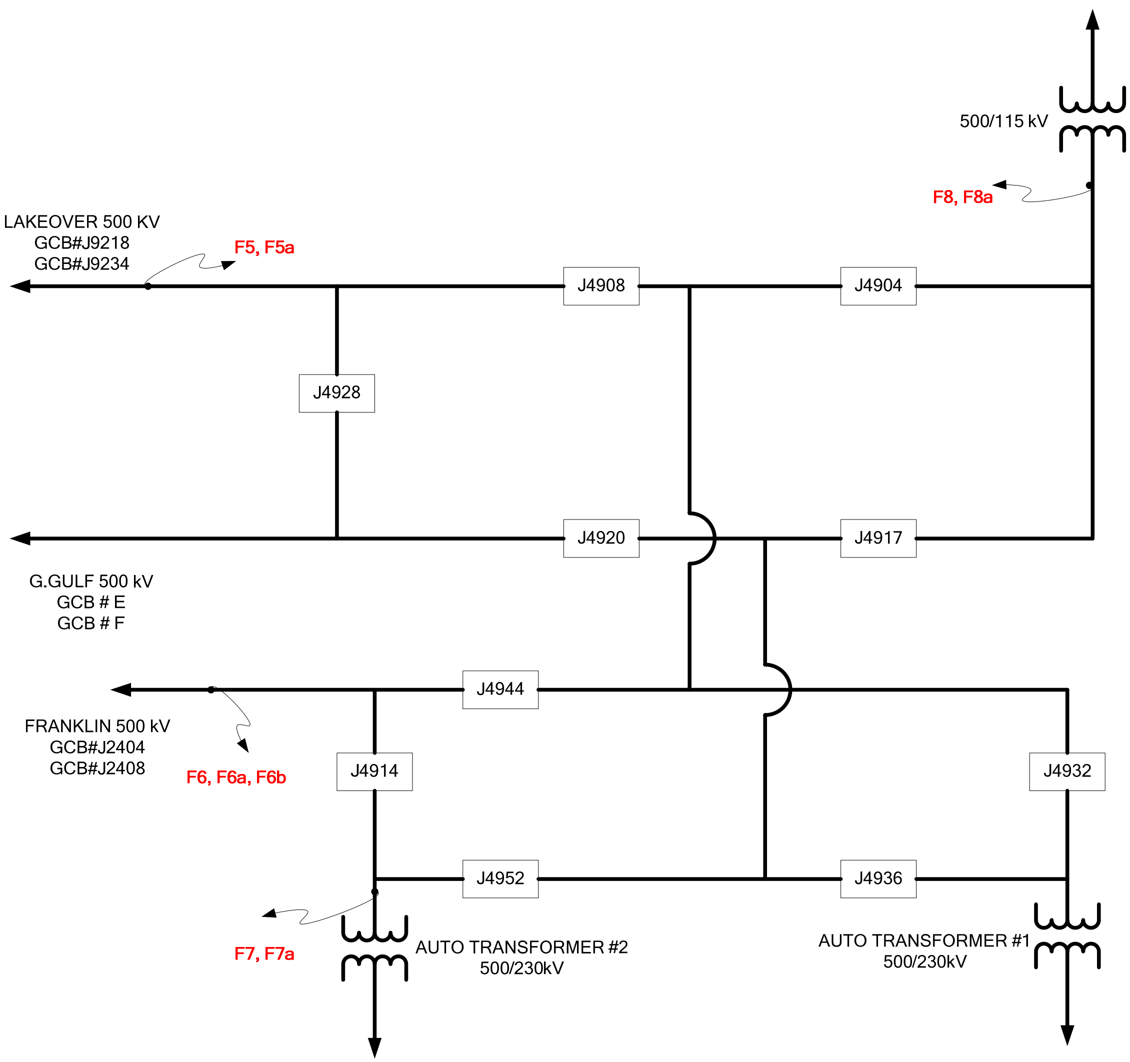
Bus configuration for B. Wilson 500 kV substation POST-PID-203



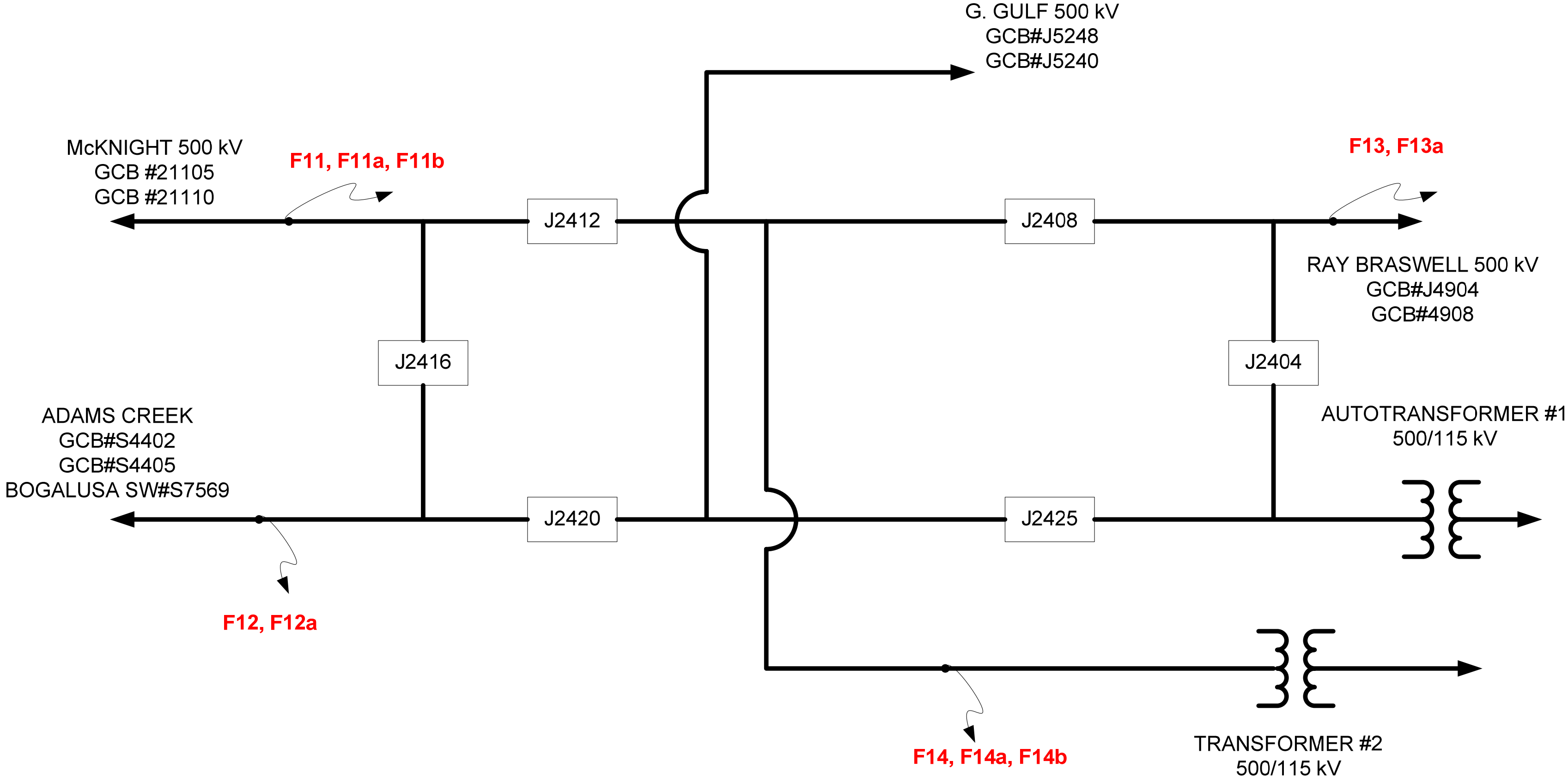
Bus configuration for Ray Braswell 500 kV substation PRE-PID-203



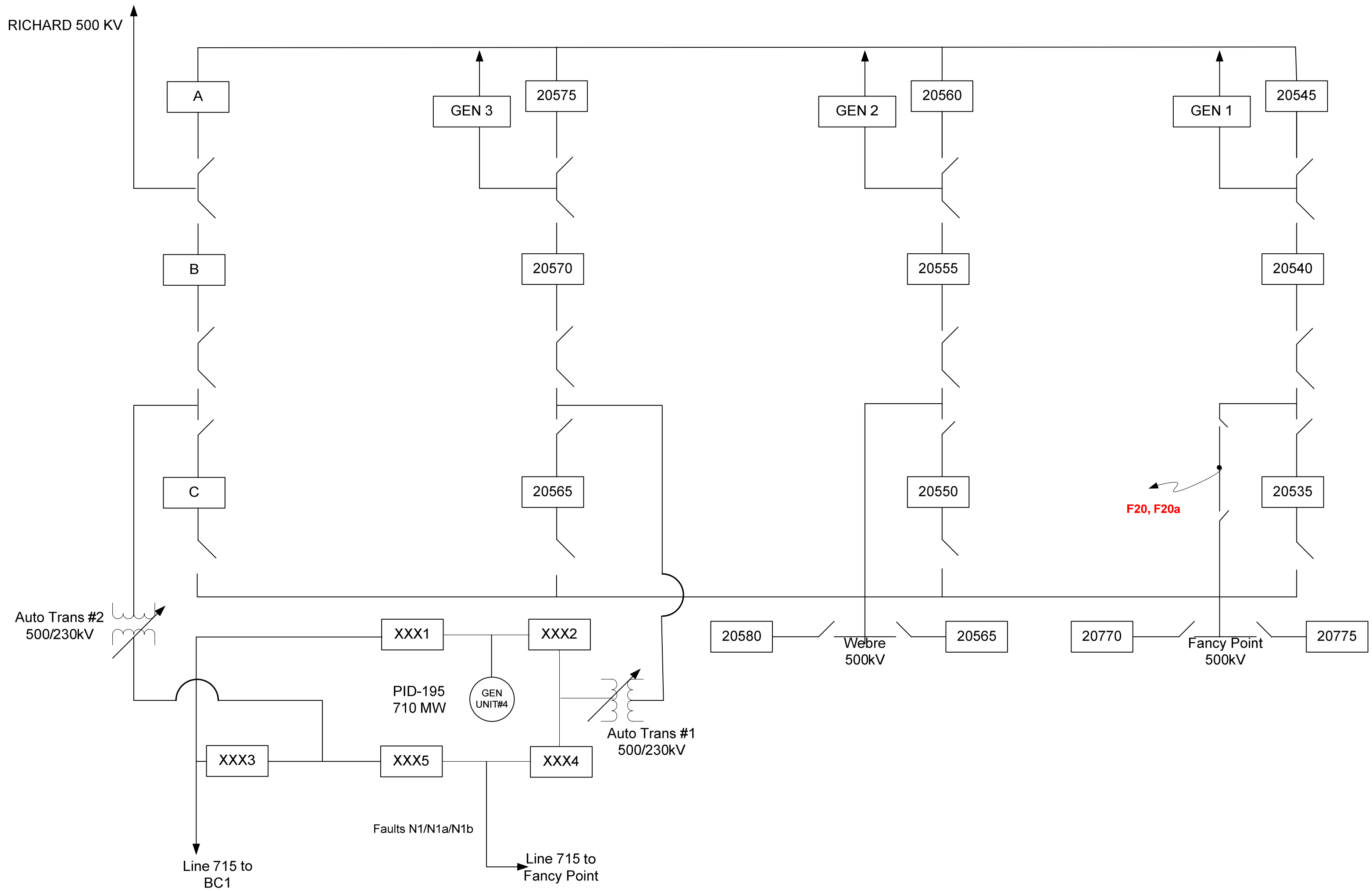
Bus configuration for Ray Braswell 500 kV substation POST-PID-203



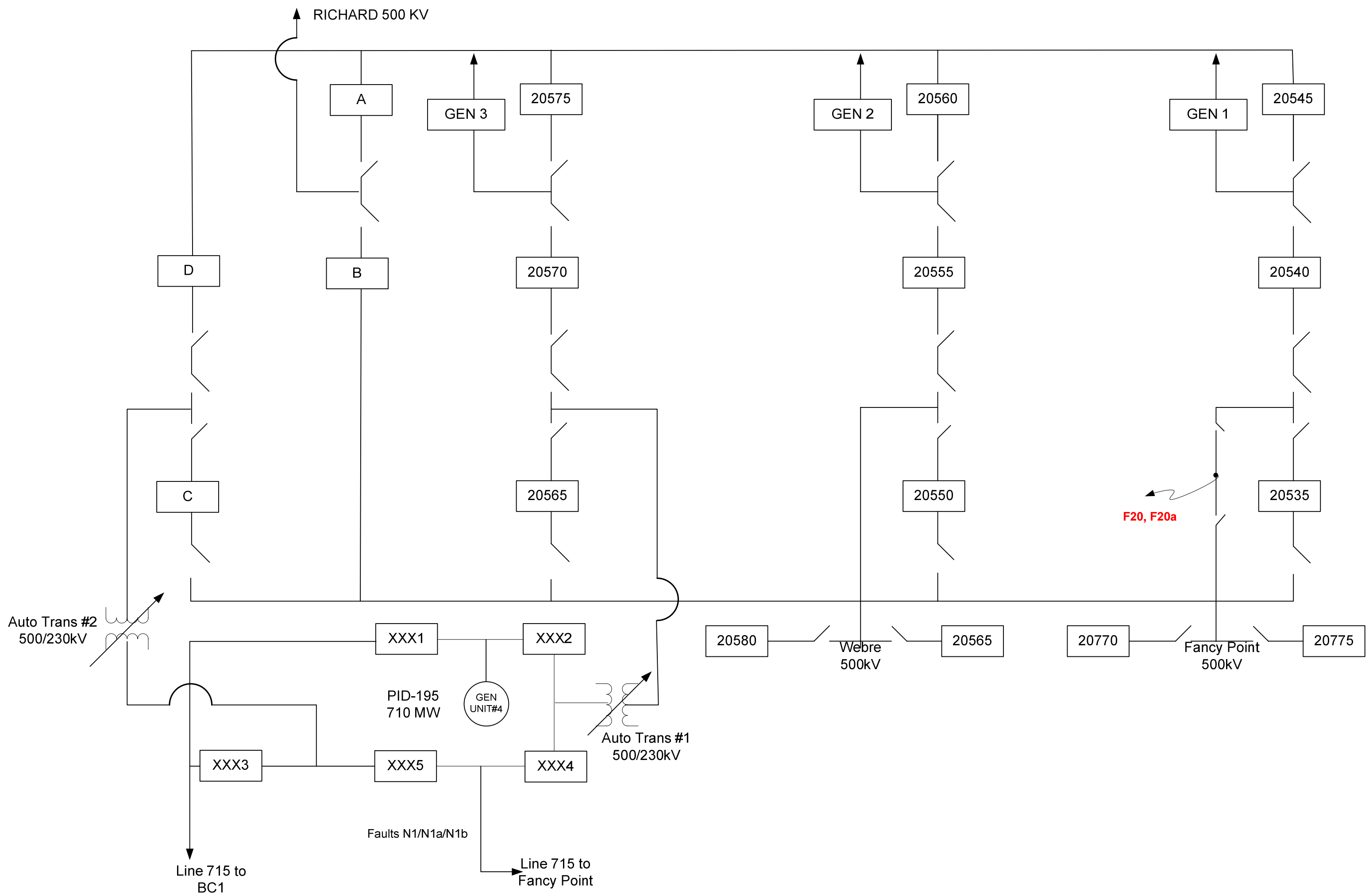
Bus configuration for Franklin 500 kV substation



B. CAJUN 2 500 KV
(Option-1)



B. CAJUN 2 500 KV
(Option-2)



RICHARD 500 KV