

Attachment D AC Interference Reports

- 170.007a CQGP AC Report KP320-393
- Review of CQGP AS interference Report Rev 0

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POWERLINE AC INTERFERENCE REPORT KP 320 TO 393

CENTRAL QUEENSLAND GAS PIPELINE

Prepared for

Enertrade

by

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1. EXECUTIVE SUMMARY

The proposed Central Queensland Gas Pipeline (CQGP) is approximately 435km long. The route is in high voltage powerline easements, in soils of high resistivity, commencing in the vicinity of the Stanwell Power Station and moving towards Gladstone for a distance of some 16km. The AC interference to the pipeline in this area can not be mitigated by earthing to comply with the safety requirements of AS4853:2000, nor to safe AC corrosion limits.

A reroute has been surveyed which alleviates the AC interference, however it introduces some environmental issues. This report has been prepared to allow an independent review of the AC interference calculations of the original route.

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2. INTRODUCTION

The proposed Central Queensland Gas Pipeline (CQGP) is approximately 435km long. The route is in high voltage powerline easements, in soils of high resistivity, commencing in the vicinity of the Stanwell Power Station and moving towards Gladstone for a distance of some 16km. Calculations carried out in August 2005 indicated that the AC interference to the pipeline could not be mitigated by earthing to comply with the safety requirements of AS4853:2000, nor to the safe AC corrosion limits. It was recommended that a reroute of the area be considered to take the pipeline out of the powerline easements. As a result a reroute has been surveyed which does alleviate AC interference. However while the subsequent reroute resolves the AC interference issues, it introduces some environmental issues.

Since the original calculations were carried out additional soil resistivity data has become available. This report has been prepared to formalise the calculations carried out in August 2005, updated with new soil resistivity data, so that they can be independently reviewed. The area covered by the calculations is the isolated pipeline section between KP320 and KP393.

Calculations were carried out using "AC Predictive and Mitigative Techniques" Version 1.5. This package was developed by John Dabkowski of Electro Sciences Inc and funded by the American Pipeline Research Committee. This is the standard software used by the pipeline industry in Australia for determining AC interference on pipelines. There has been some informal advice of possible technical limitations with the software. You will be kept advised on this matter as it may be necessary to re-evaluate the calculations if this advice proves to be substantive.

3. INPUT DATA

3.1. Criteria

Australia Standard 'AS4853:2000 Electrical hazards on metallic pipelines' presents a number of personnel safety criteria. The criteria that apply to the pipeline route, with the modeled power lines, are:

- a) Under power line operating conditions for personnel safety the maximum voltage is 32V.
- b) Under power line fault conditions for personnel safety, where there is public access to the pipeline, the maximum voltage is 300V for the 120mS fault clearance time. This is termed Category A conditions in AS4853:2000. This is also the criterion during construction and whenever the pipeline is excavated for repairs and maintenance. If this level can not be achieved then Category B conditions can be used and additional safety procedures implemented.
- c) Under power line fault conditions for personnel safety, where there is only authorized access to the pipeline, the maximum voltage is 1000V for up to 1 second. This is termed Category B conditions in AS4853:2000.

There is an additional consideration under power line operating conditions. AC corrosion of the pipeline can occur at coating defects, under high AC current densities, which is not mitigated by cathodic protection. Present research shows there is no simple relationship between pipeline AC voltage and AC corrosion, however there is unlikely to be corrosion at less than 5V rms.

3.2. Pipeline / Powerline Geometry

The pipeline / powerline relative geometry was taken from hard copy maps and is reflected in the software printouts appended to this report. There is a minimum clearance of 20m between the centreline of the pipeline and the centreline of all power transmission towers.

3.3. Soil Resistivity

Soil resistivity test locations and results are presented in the following table. They are used in the calculations at the appropriate locations as indicated in the software printouts appended to this report.

	CQGP SOIL RESISTIVITIES									
Nearest KP	Mean Resis	tivity (Ωcm)	Waypoint	Easting	Northing	Comments				
	5m	50m								
322.5	5,530	3,456	21	224507	7396790	In flat				
325.5	45,905	11,625	134	227049	7396163	Near pipeline crossing of powerlines				
327.5	27,115	83,577	137	229146	7395728	185m from nearest (concete pole) powerline				
329.8	10,117	42,417	138	231282	7395485	50m from nearest (concrete pole) powerline				
332.5	2,152	18,852	23	234370	7395474	In valley				
335	9,332	47,758	22	236527	7394435	On hill				
336.8	15,082	76,979	139	237839	7394681					
338	8,483	35,190	140	239571	7394679					
339	848	15,710	141	240930	7394673					
341	1,854	9,426	142	242298	7396665					
360	283	1,257	24	256022	7382183	In flat				
381	1,351	4,399	25	274612	7373527	Small hill				
393	503	3,079	26	286511	7368487	In flat				
401	430	2,828	27	292837	7367808	In flat				
420	754	4,713	28	308160	7363239	In flat				
422	15,082	15,710	147	310206	7362985	In valley where pipeline joins powerline				
423	6,284	34,562	146	310884	7362912	On hill				
425	2,199	6,284	145	312807	7362291	First hill from swamp				
427	66	408	60	315073	7361132	Swamp. Low resist to 500m before #145				
435	2,042	18,852	29	318959	7355978	On hill				

3.4. Powerline Data

T1 (Feeder 811)

- a) Single horizontal circuit
- b) Shield wires 7.9m from centre, 28.5m above ground, $2.9\Omega/km$.
- c) Phase wires 9.3m each side of central phase wire, 21m above ground.
- d) Operating current 1012A with phasing per software printouts.
- e) Fault current 15kA with 120mS clearance time.
- f) Towers at 400m spacings with 10Ω earths.

T2 (Feeder 812)

- a) Single horizontal circuit
- b) Shield wires 7.9m from centre, 28.5m above ground, $2.9\Omega/km$.
- c) Phase wires 9.3m each side of central phase wire, 21m above ground.
- d) Operating current 1012A with phasing per software printouts.
- e) Fault current 15kA with 120mS clearance time.
- f) Towers at 400m spacings with 10Ω earths.

T3 (Feeder 848)

- a) Single horizontal circuit
- b) Shield wires 5.9m from centre, 18.5m above ground, $0.189\Omega/km$ one shield and $1.47\Omega/km$ the other shield.
- c) Phase wires 7.1m each side of central phase wire, 12.5m above ground.
- d) Operating current 1961A with phasing per software printouts.
- e) Fault current 15.5kA with 120mS clearance time.
- f) Towers at 300m spacings with 10Ω earths.

T4 (Feeder 849)

- a) Single horizontal circuit
- b) Shield wires 5.9m from centre, 18.5m above ground, $0.189\Omega/km$ one shield and $1.47\Omega/km$ the other shield.
- c) Phase wires 7.1m each side of central phase wire, 12.5m above ground.
- d) Operating current 1961A with phasing per software printouts.
- e) Fault current 15.5kA with 120mS clearance time.
- f) Towers at 300m spacings with 10Ω earths.

T5 (Feeder 7167)

- a) Single vertical circuit
- b) No shield wires.
- c) Phase wires 11.5, 13.35 and 15.2 m above ground. Alternate horizontal location 2.5m from centre.
- d) Operating current 314A with phasing per software printouts.
- e) Fault current 7kA with 120mS clearance time. (132kV powerline)
- f) Towers at 400m spacings with 10Ω earths.

3.5. Pipeline Data

- a) Outside diameter 323.9mm.
- b) Depth of cover of 1.0m.
- c) Trilaminate coating 1.3mm thick.
- d) The coating resistance is assumed to be $50k\Omega/m^2$.

e) Isolation joints are installed at each end of the pipeline section; at KP320 and KP393.

4. OUTPUT DATA

4.1 Without Mitigation

The following maximum AC interference voltages were calculated using the software. The voltage given under fault conditions is for a fault at the tower that gave the maximum AC interference.

Feeder	AC Interference
Operating conditions	185V
Feeder 811 fault conditions at node 49	9195V
Feeder 812 fault conditions at node 24	1941V
Feeder 848 fault conditions at node 18	9106V
Feeder 849 fault conditions at node 18	10441V
Feeder 7167 fault conditions at node 17	8487V

The induced AC under powerline operating conditions is a maximum of 185V, substantially in excess of the 32V permitted under AS4853:2000, and substantially in excess of the 5V typically used as a criterion for AC corrosion. The AC interference under powerline fault conditions is substantially in excess of the 300V permitted under AS4853:2000 for operation under Category A conditions, and substantially in excess of the 1000V permitted under AS4853:2000 for operation under Category B conditions.

4.2 With Mitigation

To provide a guide to the effectiveness of earthing mitigation, mitigation was added in the form of continuous zinc ribbon installed for the full length of the pipeline section. The software calculated the following maximum AC interference.

Feeder	AC Interference
Operating conditions	41V
Feeder 811 fault conditions at node 49	213V
Feeder 812 fault conditions at node 24	242V
Feeder 848 fault conditions at node 18	1242V
Feeder 849 fault conditions at node 18	2628V
Feeder 7167 fault conditions at node 17	15520V

The induced voltage under powerline operation conditions is still significantly in excess of the personnel safety criterion and of the AC corrosion criterion. The AC interference under fault conditions at Feeders 848, 849 and 7167 is still in excess of the personnel safety criteria for both Category A and Category conditions. (The AC interference with mitigation at Feeder 7167 is increased by the mitigation due to earth potential rise factors. With detailed design this figure may be reduced to approximately 8000V, still substantially in excess of personnel safety requirements.)

4.3 Discussion

The software printouts for the non-compliant conditions are appended to the report, both in the unmitigated and mitigated condition.

The issue is the area between nodes 6 and 22. This is between where the pipeline crosses the powerlines near KP226, and where Feeders 848 and 849 are at least 500m from the pipeline near KP242. The ground in this area has very high electrical resistivity causing extremely high AC interference.

To operate the pipeline safely in accordance with the requirements of AS4853:2000, and to prevent AC corrosion of the pipeline, it should be relocated between KP 226 and 242 so that it is further away from the powerlines.

APPENDIX A OPERATING CONDITIONS NO MITIGATION



Steady State Data Comments

Comments

CQGP KP 320 - 393 Operating Conditions No Mitigtion

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Pip	e #1	Pipe #1	(cont.)	Pipe #1	(cont.)	
Distance	Volts	Distance	Volts	Distance	Volts	_
0.00	44.0	27.00	79.2	54.00	73.0	
1.00	44.0	28.00	74.6	55.00	77.0	
2.00	43.8	29.00	70.0	56.00	82.0	
3.00	43.5	30.00	67.1	57.00	87.2	
4.00	68.3	31.00	62.2	58.00	89.2	
5.00	64.6	32.00	57.2	59.00	91.4	
6.00	65.0	33.00	51.7	60.00	93.6	
7.00	72.4	34.00	46.0	61.00	96.2	
8,00	79.7	35.00	39.8	62.00	102.0	
9.00	83.3	36.00	33.6	63.00	81.4	
10.00	85.8	37.00	27.3	64.00	73.2	
11.00	83.1	38.00	21.0	65.00	68.3	
12.00	77.5	39.00	14.7	66.00	65.4	
13.00	63.2	40.00	8.4	67.00	63.6	
14.00	50.1	41.00	2.6	68.00	62.7	
15.00	80.8	42.00	5.0	69.00	62.7	
16.00	115.2	43.00	11.1	70.00	63.0	
17.00	151.5	44.00	17.3	71.00	63.4	
18.00	184.5	45.00	23.5	72.00	63.8	
19.00	134.1	46.00	29.7	73.00	64.2	
20.00	124.0	47.00	35.8	74.00	64.4	
21.00	115.0	48.00	41.8	75.00	64.5	
22.00	120.2	49.00	47.7			
23.00	124.2	50.00	53.7			
24.00	105.4	51.00	59.0			
25.00	92.8	52.00	64.2			
26.00	84.5	53.00	68.8			





Steady State Data T-Line Information

T-Line #1				
Shield Wire #1 Shield Wire #2	-7.9 7.9	28.5 28.5	2.9	0.0008
Phase Wire #1 Phase Wire #2 Phase Wire #3	<u>D - m</u> -9.3 0 9.3	H - m 21 21 21 21	<u>I - Amp</u> 1012 1012 1012	Phase - deg. 120 -120 0
T-Line #2				
Shield Wire #1 Shield Wire #2	-7.9 7.9	28.5 28.5	2.9 2.9	0.0008
Phase Wire #1 Phase Wire #2 Phase Wire #3	<u>D - m</u> -9.3 0 9.3	H - m 21 21 21 21	<u>I - Amp</u> 1012 1012 1012	Phase - deg. 120 -120 0
T-Line #3				
Shield Wire #1 Shield Wire #2	-5.9 5.9	18.5 18.5	0.189 1.47	0.0008 0.0008
Phase Wire #1 Phase Wire #2 Phase Wire #3	<u>D - m</u> -7.1 0 7.1	H - m 12.5 12.5 12.5	<u>I - Amp</u> 1961 1961 1961	Phase - deg. 120 -120 0
T-Line #4				
Shield Wire #1 Shield Wire #2	-5.9 5.9	18.5 18.5	0.189 1.47	0.0008
Phase Wire #1 Phase Wire #2 Phase Wire #3	$\frac{D - m}{-7.1}$ 0 7.1	<u>H - m</u> 12.5 12.5 12.5	<u>I - Amp</u> 1961 1961 1961	Phase - deg. 120 -120 0
T-Line #5				
Shield Wire #1 Shield Wire #2	9999 -9999	9999 9999	9999 9999	9999 9999
Phase Wire #1 Phase Wire #2 Phase Wire #3	<u>D - m</u> -2.5 2.5 -2.5	H - m 11.5 13.35 15.2	<u>I - Amp</u> 314 314 314	Phase - deg. 120 -120 0



Steady State Data Pipe Information

Pipe #1

0.324 1 50 0.0013 First section is terminated in insulator Last section is terminated in insulator

- 0	M
č	ATI6
	TERN
	Z

4.5

Steady State Data Section Information

- 66																																																				
0 · 66																																																				
<u>12 - A</u>																																																				
92 - D																																																				
P1 - A	•	•	•	•	0	0	0	•	•	•	•	•	•	0	•	•	•	•		1						•	•	•	0	0	•	•	0	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	0
9 - 14	•	•	•	•	•	•	0	•	•	•	•	•	•	•	•	•	•	•	0						•	•	•	•	•	0	•	•	•	•	•	•	•	•	•	•	•	•	•	0	•	•	•	0	•	•	•	0
R - 87	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		• •				0	0	0	0	ø	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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L4 - B	*****	****	-239	126	355	213	228	199	149	130	100	56	27	25	16	10	34	-69	-334	90.8-	00000					*****	*****	****	****	*****	*****	****	*****	4444.	*****	*****	*****	*****	*****	*****	*****	****	*****	*****	*****	*****	*****		66666-	****	****	****
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L3 - D	44444	00105	-216	102	390	279	260	227	197	169	137	57	65	35	77	77	74	-54	1960	104	00000						68666-	*****	*****	44444-		68666.	*****	-99999	68686.	44444	*****	68686-		68666-	*****	*****	48484-	66666-	68666-	*****	*****	68686-	66666-		*****	****
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5-011 He-8	40.00	40.00	120.00	120.00	1.20.00	840.00	04000	430.00	430.00	1.90.00	1.50.00	150 00	44000	48000	770.00	770.00	35000	14000	1.6000	60.08	00.00			20.00	80.06	0006	20.00	90.08	80.08	80.08	13 00	13 00	13 00	13 00	13 00	13 00	13 00	1300	13 00	13 00	1300	13 00	13 00	1300	1300	1300	1300	1300	13 00	44.00	44.00	44.00
Length	1000	1000	1000	1000	1000	1000	1000	1000	1000	2000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1040	1010			1000	0000	0001	1000	1000	2000	1000	1000	1000	1000	1010	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	2000	1010	1000	1000	0001
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E1 - A			0	•	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11			- 34	ę.	-23	-51	98-	145	-42	92-	8	123	104	275	41.2	171	48566	66566	66666	66666	66666	66666	66666
5011 Res	00.44	00.00	4400	4400	4400	44.00	44.00	44.00	4400	4400	4400	4400	3100	3100	3100	31.00	3100	3100	3100	3100	3100	3100	3100
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P1-NodeE P1-AnodeER P1-ParWire P2s1-Bond

Bec/Node

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11 February, 2007

35

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Steady State Data Mitigation & Bond Info

P3-Bonded

23-Parkire

P3-AnodeDR

P3-N04eR

P2-Bonded

P2-Parkire

P2-AnodeDR

P2-NoteR

P1-ParMire

P1-AnodeDR

P1-NodeR

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	- 100
	14

APPENDIX B FEEDER 848 FAULT CONDITIONS NO MITIGATION



Faulted Tower Data Comments

Comments

CQGP KP 320 - 393 Pault Conditions T3 (Feeder 848) Node 18 No Mitigtion

Brian Martin & Associates 9 February 2007



Pipe	e #1	Pipe #1	(cont.)	Pipe #1	(cont.)
Distance	Volts	Distance	Volts	Distance	Volts
0.00	9106.0	27.00	3056.6	54.00	400.8
1.00	9093.7	28.00	2822.8	55.00	367.6
2.00	9056.5	29.00	2605.6	56.00	336.7
3.00	8816.1	30.00	2407.5	57.00	308.2
4.00	8174.8	31.00	2232.2	58.00	282.0
5.00	7329.2	32.00	2073.8	59.00	258.4
6.00	6436.2	33.00	1927.0	60.00	237.4
7.00	5434.7	34.00	1790.8	61.00	219.1
8.00	4385.4	35.00	1664.5	62.00	203.6
9.00	3358.4	36.00	1547.5	63.00	191.0
10.00	2370.8	37.00	1439.0	64.00	181.4
11.00	1439.2	38.00	1338.4	65.00	174.3
12.00	681.7	39.00	1245.2	66.00	169.5
13.00	1564.3	40.00	1158.7	67.00	166.7
14.00	3383.1	41.00	1078.5	68.00	165.5
15.00	5276.2	42.00	1003.9	69.00	165.5
16.00	6262.9	43.00	934.6	70.00	166.2
17.00	6073.0	44.00	870.0	71.00	167.3
18.00	5811.8	45.00	809.8	72.00	168.4
19.00	5610.1	46.00	753.5	73.00	169.4
20.00	5240.0	47.00	700.7	74.00	170.1
21.00	4896.9	48.00	651.0	75.00	170.3
22.00	4541.6	49.00	603.5		
23.00	4196.9	50.00	557.9		
24.00	3878.3	51.00	514.8		
25.00	3583.1	52.00	474.3		
26.00	3309.7	53.00	436.3		

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Pip	e #1	Pipe #1	(cont.)	Pipe #1	(cont.)	
Distance	Current	Distance	Current	Distance	Current	
0.00	9.6	27.00	603.5	54.00	83.3	
1.00	220.1	28.00	561.1	55.00	78.0	
2.00	431.0	29.00	521.6	56.00	73.2	
3.00	640.8	30.00	484.8	57.00	68.7	
4.00	839.6	31.00	450.3	58.00	64.5	
5.00	1018.9	32.00	418.2	59.00	60.5	
6.00	1178.6	33.00	388.4	60.00	56.6	
7.00	1310.6	34.00	360.7	61.00	52.9	
8.00	1419.0	35.00	334.9	62.00	49.2	
9.00	1506.3	36.00	310.8	63.00	45.6	
10.00	1570.1	37.00	288.4	64.00	42.0	
11.00	1611.8	38.00	267.6	65.00	38.4	
12.00	1630.4	39.00	248.2	66.00	34.7	
13.00	1620.2	40.00	230.2	67.00	31.0	
14.00	1570.3	41.00	213.4	68.00	27.3	
15.00	1482.5	42.00	197.8	69.00	23.6	
16.00	1367.1	43.00	183.4	70.00	19.7	
17.00	1261.1	44.00	170.0	71.00	15.9	
18.00	1173.5	45.00	157.6	72.00	12.0	
19.00	1088.4	46.00	146.1	73.00	8.1	
20.00	1011.6	47.00	135.6	74.00	4.1	
21.00	939.0	48.00	126.0	75.00	0.2	
22.00	871.4	49.00	117.2			
23.00	809.0	50.00	109.1			
24.00	751.5	51.00	101.8			
25.00	698.3	52.00	95.1			
26,00	649.1	53.00	88.9			

PRC				Faulte	d Tower Data Information	
INTERNATIONAL						
T-Line						
Shield Wire #1 Shield Wire #2	-5.9 5.9	18.5		0.189	0.0008	
Phase Wire	<u>D - m</u> -7.1	<u>H - m</u> 12.5	11 - A 15500	<u>IR - A</u> 0	Total Current 15500	
Elec. Sys Parameters	Avg Twr :	Sep m 300	Avg Twr Res	- ohms Pau	lted Twr Location	
Arc Distance (m)	5.5					



Faulted Tower Data Pipe Information

Pipe #1

0.324 1 50 0.0013 First section is terminated in insulator Last section is terminated in insulator

4																																																														
- 64																																																														
0 - 64																																																														
92 - A																																																														
92 - D																																																														
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LS - A	e	•	•	•	0	•	•			e	•	0	•	4		•	•	•			e	•	4		•	•	•		2 1	e	•	•	0			•	•	•	•		•	e	•	•	•			•	•	•	•		1		0	•	•	۰	•	0	•	Þ
12	46.46	4555	4665	5555	5555	0000	0000	0000		4566	46.66	9999	0000		44.44	4666	6666	0000	24.00		6666	4665	0000		4666	4555	99.99	66.66	4444	29.99	4666	5555	0000	84.66	4444	4444	4646	9999	0000	1000	4444	4666	6666	9999	0000	10.00	4444	45 6.6	4666	9999	5555	0000	44.04	44.44	****	46.66	5555	6666	5555	0000	0000	
F4 - N	ę	ę	ę	•	0	•	4			9	•	•	4	1		0	•	4			0	•	-		•	•	4			9	ę	ę	-			9	ę	•	-			ę	•		4			9	ę	*	ę	-			9	•	ę	ę	ę	9	-	2
- 5	***	****	6444	5555	8588	0000	0000	0000		****	B.4.8.6	8688	0000			5.444	6666	0000	0000		6666	8686	0000		8488	8666	0000	0000		****	6444	5555	0000	0000		****	6.666	0000	0000		****	****	8666	0000	0000	the state		5.555	6.64.6	8666	5555	0000	0000		****	8444	5555	8668	4444	0000	0000	
T. 1 A	•	0	•	0	0	0	0			0	0	0	0			0	0	0			0	0	•		0	0	0			0	0	0	0			0	0	0	0		0	0	0	0	0			0	0	0	0	0			0	0	0	0	0	0		>
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Soil Res	4000	4000	4000	12000	12000	12000	04040	04040	00000	43000	43000	19000	19050	10000	DDDAT.	48000	48000	77000	ANAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA	22222	35000	16000	1 CAAA	0000T	3000	9000	9000	9000	0000	3000	3000	9000	9000	0000	0006	0006	1300	1300	1100		1300	1300	1300	1300	11400		0007	1300	1300	1300	1300	1100	1144	DOOT I	1300	1300	1300	1300	4400	4400	1100	~~
Length	0001	0001	0001	0001	2000	1000	1000	COOP.		0001	0001	1000	1000		ADD.	0001	1000	1000		A DOT	0001	1000	WAAA		0001	1000	1000	1000		0001	1000	1000	1000	1000	1000	COOT	0001	1000	1000		1000	0001	2000	1000	1000		0004	000T	0001	1000	1000	1000	1000	0007	000	0001	0001	0001	0001	1000	0000	#MAA
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Faulted Tower Data Section Information

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a	0	•	0	•	0	•	0	•	0	•	•	•	•	•	•	•	•	•	•	•	•	•	•
5 - N P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 · D	6666	8666	8666	2932	6666	2932	6666	2222	6666	2932	6666	2932	6666	5555	8666	5555	8666	5555	8666	6666	8666	6666	8686
K - N	e	•	0	•	0	•	0	•	0	•	0	•	•	•	•	•	•	e	•	•	•	0	•
1 · D	6666	8666	\$555	2222	\$555	2222	\$555	2222	8666	5535	\$555	2232	6666	\$555	5555	\$555	2222	\$555	2222	\$555	2222	\$555	2029
L3 - A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C · D	6666	6666	6566	6566	6666	6566	6666	6566	6666	6566	6666	6566	6666	6566	6366	6566	6366	6566	6566	6566	6566	6666	6066
L2 - A	•	•	0	0	0	•	0	•	0	•	•	0	•	•	•	•	•	0	•	0	•	•	•
L2 - D	5555	4444	6666	4444	6666	4444	6668	4444	6668	4444	6668	4444	9999	6666	9999	6666	444	6666	4444	6666	4444	6646	0000
K - 13	0	0	0	0	0	0	0	0	0	•	0	0	0	0	0	0	0	0	0	0	0	0	0
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11 208	4400	4400	4400	4400	4400	4400	4400	4400	4400	4400	4400	4400	3100	3100	3100	3100	3100	3100	0011	3100	0011	3100	3100
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I ranch	53	54	55	56	57	85	59	6.9	61	62	63	64	65	99	67	69	63	20	71	22	23	74	25



PRC	INTERNATIONAL

P1-Nodez P1-Anode28 P1-ParMire P1-Bonded

Sec/Node 53

Brian Martin & Associates

11 February, 2007

APPENDIX C FEEDER 849 FAULT CONDITIONS NO MITIGATION



Faulted Tower Data Comments

Comments

CQGP KP 320 - 393 Pault Conditions T4 (Feeder 849) Node 18 No Mitigtion

Brian Martin & Associates 9 February 2007



Pip	e #1	Pipe #	1 (cont.)	Pipe #1	(cont.)
Distance	Volts	Distance	Volts	Distance	Volts
0.00	10440.6	27.00	3406.5	54.00	446.9
1.00	10426.5	28.00	3146.1	55.00	409.8
2.00	10384.1	29.00	2904.3	56.00	375.4
3.00	10140.2	30.00	2683.8	57.00	343.6
4.00	9473.4	31.00	2488.6	58.00	314.5
5.00	8564.3	32.00	2312.0	59.00	288.1
6.00	7598.1	33.00	2148.3	60.00	264.7
7.00	6515.6	34.00	1996.5	61.00	244.3
8.00	5376.5	35.00	1855.7	62.00	227.0
9.00	4251.6	36.00	1725.2	63.00	213.0
10.00	3136.7	37.00	1604.3	64.00	202.2
11.00	2012.7	38.00	1492.2	65.00	194.3
12.00	576.0	39.00	1388.2	66.00	189.0
13.00	1457.2	40.00	1291.8	67.00	185.9
14.00	4066.7	41.00	1202.3	68.00	184.5
15.00	7268.8	42.00	1119.2	69.00	184.5
16.00	8766.4	43.00	1041.9	70.00	185.3
17.00	7605.1	44.00	970.0	71.00	186.5
18.00	6557.9	45.00	902.8	72.00	187.8
19.00	6248.7	46.00	840.0	73.00	188.9
20.00	5852.2	47.00	781.1	74.00	189.6
21.00	5458.7	48.00	725.7	75.00	189.8
22.00	5060.1	49.00	672.8		
23.00	4676.7	50.00	622.0		
24.00	4321.9	51.00	574.0		
25.00	3993.1	52.00	528.8		
26.00	3688.5	53.00	486.5		

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Pip	e #1	Pipe #1	(cont.)	Pipe #1	(cont.)	
Distance	Current	Distance	Current	Distance	Current	
0.00	11.0	27.00	672.8	54.00	92.8	
1.00	252.3	28.00	625.6	55.00	87.0	
2.00	494.2	29.00	581.5	56.00	81.6	
3.00	734.7	30.00	540.4	57.00	76.6	
4.00	964.0	31.00	502.0	58.00	71.9	
5.00	1172.8	32.00	466.3	59.00	67.4	
6.00	1360.2	33.00	433.0	60.00	63.1	
7.00	1517.1	34.00	402.1	61.00	58.9	
8.00	1648.5	35.00	373.3	62.00	54.9	
9.00	1757.7	36.00	346.5	63.00	50.8	
10.00	1841.3	37.00	321.6	64.00	46.8	
11.00	1900.6	38.00	298.3	65.00	42.8	
12.00	1933.4	39.00	276.7	66.00	38.7	
13.00	1926.2	40.00	256.6	67.00	34.6	
14.00	1868.5	41.00	237.9	68.00	30.5	
15.00	1748.5	42.00	220.5	69.00	26.3	
16.00	1564.6	43.00	204.4	70.00	22.0	
17.00	1407.6	44.00	189.5	71.00	17.7	
18.00	1306.6	45.00	175.7	72.00	13.4	
19.00	1213.4	46.00	162.9	73.00	9.0	
20.00	1127.6	47.00	151.2	74.00	4.6	
21.00	1046.7	48.00	140.5	75.00	0.2	
22.00	971.3	49.00	130.6			
23.00	901.9	50.00	121.7			
24.00	837.7	51.00	113.5			
25.00	778.5	52.00	106.0			
26.00	723.6	53.00	99.1			

PRC				Faulte	d Tower Data Information	
INTERNATIONAL						
T-Line						
Shield Wire #1 Shield Wire #2	-5.9 5.9	18.5		0.189	0.0008	
Phase Wire	<u>D - m</u> -7.1	<u>H - m</u> 12.5	11 - A 15500	<u>IR - A</u> 0	Total Current 15500	
Elec. Sys Parameters	Avg Twr :	Sep m 300	Avg Twr Res	- ohms Pau	lted Twr Location	
Arc Distance (m)	5.5					



Faulted Tower Data Pipe Information

Pipe #1

0.324 1 50 0.0013 First section is terminated in insulator Last section is terminated in insulator

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TOWe1 format		2 - A 23 -																																										
lted ion In		P2 - D P																																										
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U	INN	\$011 Res 4000	40.00	40.00	12000	12000	840.00	940.00	43000	430.00	19000	190.00	48000	480.00	220.00	35000	16000	160.00	0006	0006	0000	0006	90.00	0006	0006	0006	1300	1300	0011	11000	1300	1300	1300	1200	1300	1300	1300	0011	1300	1300	1300	1300	44 00	4400
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Faulted Tower Data Section Information

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Brian Martin & Associates 11 February, 2007

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		LS - D	3555	6666	4444	6666	6666	6666	6666	9999	3555	6666	0666	2222	6666	6666	4666	6666	6666	6666	5666	3535	5555	6666	6666
		14 - 3	¢	•	•	¢	•	•	ę	ę	ę	•	ę	•	•	•	ę	ę	\$	•	•	ę	•	•	•
		1 - 0	5555	8686	****	6686	6686	\$ \$ \$ \$	6686	6686	5.5.5	6686	8686	2222	6686	6686	2252	6666	4444	2.2.2	6686	4444	5565	6666	2999
		L3 - A	•	0	0	0	0	0	0	0	•	0	0	•	0	0	0	•	0	0	0	0	0	0	•
		17 - D	6556	6566	5555	6666	6556	5555	6556	9.999	5555	6556	6556	5555	6556	6556	5555	6556	6566	5555	6566	6666	6466	6556	6566
		L2 - A	°	0	0	0	0	0	0	0	0	0	•	0	0	0	0	0	0	•	0	0	0	0	•
		L2 - D	5555	6666	6656	66.68	6666	8888	6656	6666	29.99	6656	6666	22.05	6656	6666	8888	6656	6666	22.05	6656	6666	6666	6656	6666
		11 - V	°	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		L1 - D	55555-	66666-	66666-	65655-	65656-	66666-	65656-	66666-	66666-	65656-	65656-	66666-	65656-	66666-	66666-	65656-	66666-	66666-	65656-	65656-	66666-	65656-	66666-
Ü	NAL	Soil Res	4400	4400	4400	4400	4400	4400	4400	4400	4400	4400	4400	4400	3100	0016	0016	3100	0016	0016	3100	0016	0016	3100	3300
Ľ	TERNATI	Longth	10-00	10-00	10-00	10-00	10-00	10-00	10-00	10-00	10-00	1000	10-00	10-00	10-00	10-00	10-00	10-00	10-00	10-00	1000	10-00	10-00	1000	10-00
	6	Branch	53	3	ŝ	56	52	8	55	60	19	62	63	5	65	99	15	69	69	70	14	12	52	24	75
ver Data ^{Bond Info}		1 Centre 1 C																							
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Faulted To		P3 - 2017 P3 - 2017																							
		P1-15-																							
		P3 - MirodeDB																							
		241- 1004d																							
		D009e08 b7 - NaTeki 1e																							
PRC	INTERNATIONAL	P1- NodeR P1- NodER <t< th=""></t<>																							
		<u>c/ 64</u>																							

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Data nd Info		P9 - Bonded
State n & Bor		9日 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
eady		P) - Amode DR
St Mit		P3- HodeR
		2 - Bonded
		요.
		- AmodeBR
		P2 - WodeR
		P.1 - Bio todie d
		P1 PartW1.re
		P.L Am ode010
RC	TVNOLLVN	P.1- WodeR
d	INTER	840/3000 55 55 55 55 55 55 55 55 55 55 55 55

11 February, 2007

APPENDIX D FEEDER 7167 FAULT CONDITIONS NO MITIGATION



Faulted Tower Data Comments

Comments

CQGP KP 320 - 393 Pault Conditions T5 (Peeder 7167) Node 17 No Mitigtion

Brian Martin & Associates 9 February 2007



Pip	e #1	Pipe #	1 (cont.)	Pipe #1	(cont.)
Distance	Volts	Distance	Volts	Distance	Volts
0.00	8487.4	27.00	3087.9	54.00	405.1
1.00	8475.9	28.00	2851.9	55.00	371.6
2.00	8441.1	29.00	2632.9	56.00	340.4
3.00	8251.9	30.00	2433.1	57.00	311.5
4.00	7722.3	31.00	2256.1	58.00	285.1
5.00	6984.8	32.00	2096.1	59.00	261.2
6.00	6205.8	33.00	1947.7	60.00	240.0
7.00	5345.4	34.00	1810.0	61.00	221.5
8.00	4439.4	35.00	1682.4	62.00	205.8
9.00	3532.9	36.00	1564.1	63.00	193.1
10.00	2618.5	37.00	1454.5	64.00	183.3
11.00	1696.5	38.00	1352.8	65.00	176.2
12.00	811.9	39.00	1258.6	66.00	171.3
13.00	1125.4	40.00	1171.2	67.00	168.5
14.00	2489.0	41.00	1090.0	68.00	167.3
15.00	4056.2	42.00	1014.7	69.00	167.2
16.00	5828.7	43.00	944.6	70.00	167.9
17.00	6931.9	44.00	879.3	71.00	169.0
18.00	6583.3	45.00	818.5	72.00	170.2
19.00	5832.9	46.00	761.5	73.00	171.2
20.00	5367.6	47.00	708.1	74.00	171.9
21.00	4955.9	48.00	657.9	75.00	172.1
22.00	4583.2	49.00	610.0		
23.00	4237.6	50.00	564.0		
24.00	3916.9	51.00	520.4		
25.00	3619.3	52.00	479.5		
26.00	3343.4	53.00	441.1		



Pip	e #1	Pipe #:	1 (cont.)	Pipe #1	(cont.)
Distance	Current	Distance	Current	Distance	Current
0.00	8.9	27.00	610.0	54.00	84.1
1.00	205.1	28.00	567.1	55.00	78.9
2.00	401.7	29.00	527.2	56.00	74.0
3.00	597.2	30.00	490.0	57.00	69.4
4.00	784.1	31.00	455.1	58.00	65.2
5.00	954.3	32.00	422.7	59.00	61.1
6.00	1107.2	33.00	392.6	60.00	57.2
7.00	1235.6	34.00	364.5	61.00	53.4
8.00	1343.7	35.00	338.4	62.00	49.7
9.00	1434.1	36.00	314.1	63.00	46.1
10.00	1503.7	37.00	291.5	64.00	42.4
11.00	1553.2	38.00	270.5	65.00	38.8
12.00	1580.8	39.00	250.9	66.00	35.1
13.00	1583.4	40.00	232.6	67.00	31.4
14.00	1558.2	41.00	215.7	68.00	27.6
15.00	1504.4	42.00	199.9	69.00	23.8
16.00	1421.5	43.00	185.3	70.00	20.0
17.00	1305.5	44.00	171.8	71.00	16.1
18.00	1191.7	45.00	159.3	72.00	12.1
19.00	1103.2	46.00	147.7	73.00	8.2
20.00	1022.7	47.00	137.1	74.00	4.2
21.00	948.8	48.00	127.3	75.00	0.2
22.00	880.6	49.00	118.4		
23.00	817.6	50.00	110.3		
24.00	759.5	51.00	102.9		
25.00	705.8	52.00	96.1		
26.00	656.1	53.00	89.9		

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PRC				Faulte	d Tower Data Information	
INTERNATIONAL						
T-Line						_
Shield Wire #1 Shield Wire #2	9999 -9999	9999 9999		9999 9999	9999 9999	
Phase Wire	<u>D - m</u> -2.5	<u>H - m</u> 11.5	<u>IL - A</u> 7000	<u>IR - A</u> 0	Total Current 7000	
Elec. Sys Parameters	Avg Twr :	Sep m 400	Avg Twr Res	- ohms 10 Pau	lted Twr Location	
Arc Distance (m)	3.5					



Faulted Tower Data Pipe Information

Pipe #1

0.324 1 50 0.0013 First section is terminated in insulator Last section is terminated in insulator

P3 - A																																																	
P3 - D																																																	
92 - A																																																	
92 - D																																																	
P1 - A	°	0	8	8	8 6	5 6	5 6					0	0	8	0	8	0	0	•	0	8	8	0	0	8	8	8	8	8	0.4			0	0	8	8	0	8	8	8	0	0.0	8	8	8	8	0	0	-
p1 - D	•	0	0	0	• •						0	•	•	0	•	•	0	•	0	0	0	•	0	0	0	•	•	•	•	0 4			• •	0	0	0	•	0	0	•	0	0 0	0	0	0	0	0	•	
E5 - A	0	0	0	0	0 0					0	0	0	•	0	0	0	0	0	0	0	0	0	0	0	e	0	0	0	0	0 0	0 0			0	0	0	0	0	0	•	0	0	0	0	0	0	0	0	į
L5 - D	4645	4666	6655	8666	6666	20.00	10000	0000	0000	0000	0000	6666	66.66	6666	6666	6666	6655	6666	4645	4666	6666	6666	4666	6666	66.66	6666	6666	6666	6666	6666	2626	0000	6656	66.66	6655	8666	6666	4666	6666	6666	4646	6666	66.66	4646	6666	6655	6666	6666	
F4 - N	¢	¢	¢	¢	• •			• •				•	•	•	•	•	ę	•	ę	ę	¢	•	•	•	•	•	•	•	•		• <		•	•	•	¢	•	¢	ę	•	•	•	0	•	•	•	•	•	
- 1	6666	5666	6666	5555	6666	0000	2000	0000	0000	0000	8666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	2646	0000	6666	6666	6666	6666	6666	6666	5555	6666	5666	6666	5555	6666	6666	6666	6666	5666	
L3 - A	•	0	0	0	• •			> 0	• •	• •	0	0	0	0	•	•	0	0	0	0	0	•	0	•	0	•	•	0	0	0.4	0 4		• •	0	0	0	•	0	0	•	0	0 1	0	0	0	0	•	•	
a - 13	6665	6665	6665	6666	6666	6464	6000	0000	0000	0000	6066	6666	6665	6666	6665	6666	6665	6665	6665	6666	6665	6665	6665	6665	6665	6666	6666	6665	6666	6666	2222	6060	6665	6666	6665	6665	6665	6665	6665	6666	6665	6666	6666	6666	6666	6665	6665	6665	
L2 - A	•	0	0	0	• •	> <		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 4	0 0	0	0	0	0	0	0	0	0	0	0	0 0	0	0	0	0	0	0	
a - 2	6666	6666	6666	6668	6666	0000	0000	6666	0000	0000	0000	6666	6666	6666	6666	6666	6666	6666	6668	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	2222	6666	6666	6666	6666	6666	6666	6666	6668	6666	6668	6666		6666	6666	6666	6666	6666	
F1 - A	0	0	0	0	0 0	> <	0 0	> 0	• •	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 4	0 0	0	0	0	0	0	0	0	0	0	0	0 0	0	0	0	0	0	0	
1 - D	66666	66666	66666	-267	10.00	101		170	136	101	75	21	2	920	50	ŝ	-216	66666-	65656-	66666-	66666-	66666-	66666-	66666-	66666-	66666-	-99999	66666-	66666	66666-	-99999	60000-	66666-	66666-	66666-	66666-	66666-	-99999	66666-	66666-	-99999	66666-	66666-	66666-	66666-	66666-	66666-	-99999	
Soil Res	4000	4000	4000	12000	12000	ANNAL PROPERTY		\$1000	41000	19000	19000	19000	40000	48000	77000	77000	35000	16000	16000	0006	0006	0006	0006	0006	0006	0006	0006	0006	0006	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	4400	
Longth	0001	0001	0001	0001	0001	DOOT T	0000	0001	over	0001	1000	0001	1000	OOOT	0001	0001	0001	OOOT	OOOT	0001	OOOT	OOOT	OOOT	0001	1000	0001	00er	0001	0001	00001	0001	1000	1000	1000	1000	0001	OOOT	0001	0001	0001	00er	0001	0001	ooer	0001	OOOT	0001	0001	
Heat Lon	-	a	6	*			- 0		0	11	12	11	14	3.5	316	17	3.0	19	02	21	22	23	54	25	36	22	30	58	0 R	1		34	36	36	37	38	35		41	4	43	5	45	46	47	40	69	ŝ	

Faulted Tower Data Section Information

PRC

Steady State Data Stanch Information		1 - A P2 - D P2 - A P3 - D P3 - A		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1 · D	•	•	•	•	•	•	•	•	•	•	•	0	0	•	•	•	•	•	•	•	0	•	•
		S - A P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1 0 - 5	6666	6666	6666	8666	6666	6666	6666	6666	8666	6666	6666	6666	6666	6666	6666	6666	6666	6666	8666	6666	6666	6666	6666
		L4 - A L	0	0	0	•	•	0	0	0	•	•	0	•	0	•	0	0	0	•	•	•	0	0	0
		14 · D	5666	5555	5666	0000	5555	5666	5666	5555	8888	6666	5555	6666	6666	8666	6666	5666	5666	5666	6666	6666	5666	5666	5555
		L3 - A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		L3 - D	6456	6656	6656	6456	6456	6656	6656	6656	4456	6456	6656	6656	6656	4456	6466	6656	6656	6656	6456	6656	6656	6656	6656
		L2 - A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		10	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666
		L1 - A	0	0	0	0	0	0	0	0	•	0	0	0	0	0	0	0	0	0	o	0	0	0	0
		0 - 13	55555-	66668.	66666-	66868-	66866-	66656-	66666	66666-	86868-	66566-	66666.	66668-	66666-	86868-	66566-	66666"	66666	66666-	66868-	66556-	66666"	66666-	66666-
U	TVNO	Soil Res	44.00	44.00	44 00	44 00	44.00	44 00	44 00	44 00	44 00	44.00	44.00	44.00	3100	OOTE	3100	3100	3100	0016	0010	3100	3100	3100	0016
Ľ	TENNATI	Length	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
3		ranch	53	54	\$\$	3	52	50	65	60	19	62	63	64	65	55	63	69	69	20	1	72	73	74	22

Data Info		Pm04-15	
Tower a & Bond		23-24 FMTE6	
ulted		P1-AmodeDR	
Fa Mi		4 epost - (14	
		Place - bond	8 904
		64.7 L 4	1.0/2007 - P
		BGepo uv - 24	020
		P2-ModeR	
		P2a1- 1000	
		9 M M M M M M M M M M M M M M M M M M M	
		B1-Yrovena	
N C	NATIONAL	Pi-IG	
đ	INTER	740 / 100 /	

Data d Info		P) - Ronde d
State n & Bon		23-24:14.6
tigatio		PJ-AnodeER
St Mi		23 - ModeR
		10 B05+ 0
		P2-Farristo
		P.2 - An ode DR
		72 - Roda R
		町 単型 目20歳 - 門A
		9194.4%
		På - Maccie Da
PRC	TUNNUT	9.01 - 10-0
	EN I	846/3004 55 55 55 55 55 55 55 55 55 55 55 55 55

02/10/2037 - Fage 9



OPERATING CONDITIONS WITH MITIGATION

Steady State Data Comments

Comments

CQGP KP 320 - 393 Operating Conditions Full Zinc Ribbon Mitigtion

Brian Martin & Associates 9 February 2007



Distance	Volts	Distance	Volts	Distance	Volts
0.00	0.0	27.00	1.5	54.00	0.1
1.00	0.1	28.00	1.6	55.00	0.5
2.00	0.7	29.00	3.1	56.00	0.1
3.00	5.2	30.00	2.2	57.00	1.5
4.00	8.9	31.00	0.1	58.00	0.3
5.00	1.1	32.00	0.1	59.00	0.1
6.00	3.7	33.00	0.0	60.00	0.4
7.00	1.3	34.00	0.1	61.00	1.5
8.00	1.4	35.00	0.0	62.00	10.1
9.00	2.6	36.00	0.0	63.00	3.6
10.00	3.9	37.00	0.0	64.00	0.9
11.00	5.9	38.00	0.0	65.00	0.3
12.00	10.6	39.00	0.0	66.00	0.3
13.00	13.6	40.00	0.0	67.00	0.3
14.00	7.7	41.00	0.0	68.00	0.1
15.00	13.7	42.00	0.0	69.00	0.0
16.00	19.8	43.00	0.0	70.00	0.0
17.00	28.8	44.00	0.0	71.00	0.0
18.00	41.2	45.00	0.0	72.00	0.0
19.00	15.6	46.00	0.0	73.00	0.0
20.00	5.8	47.00	0.0	74.00	0.0
21.00	5.7	48.00	0.0	75.00	0.0
22.00	2.1	49.00	0.2		
23.00	10.6	50.00	0.2		
24.00	1.8	51.00	0.0		
25.00	1.7	52.00	0.2		
26.00	2.3	53.00	0.2		



Pip	e #1	Pipe #1	(cont.)	Pipe #1	(cont.)
Distance	Current	Distance	Current	Distance	Current
0.00	0.0	27.00	40.4	54.00	35.7
1.00	0.4	28.00	34.0	55.00	37.5
2.00	2.9	29.00	24.9	56.00	39.2
3.00	21.6	30.00	23.1	57.00	33.6
4.00	18.6	31.00	40.0	58.00	28.8
5.00	14.1	32.00	40.8	59.00	29.9
6.00	12.0	33.00	41.9	60.00	31.8
7.00	12.0	34.00	41.9	61.00	34.9
8.00	11.8	35.00	41.8	62.00	1.1
9.00	10.1	36.00	41.8	63.00	27.1
10.00	7.3	37.00	41.8	64.00	13.3
11.00	4.8	38.00	41.8	65.00	7.7
12.00	21.7	39.00	41.8	66.00	5.0
13.00	46.7	40.00	41.8	67.00	2.5
14.00	54.6	41.00	41.8	68.00	0.7
15.00	51.1	42.00	41.8	69.00	0.1
16.00	41.9	43.00	41.8	70.00	0.0
17.00	28.4	44.00	41.8	71.00	0.0
18.00	13.2	45.00	41.8	72.00	0.0
19.00	54.7	46.00	41.8	73.00	0.0
20.00	44.3	47.00	41.8	74.00	0.0
21.00	23.1	48.00	41.9	75.00	0.0
22.00	16.1	49.00	40.3		
23.00	36.6	50.00	39.1		
24.00	58.7	51.00	38.7		
25.00	56.6	52.00	38.1		
26.00	48.3	53.00	36.6		



Steady State Data T-Line Information

T-Line #1					
Shield Wire #1 Shield Wire #2	-7.9 7.9	28.5 28.5	2.9 2.9	0.0008	
Phase Wire #1 Phase Wire #2 Phase Wire #3	<u>D - m</u> -9.3 0 9.3	H - m 21 21 21 21	<u>I - Amp</u> 1012 1012 1012	Phase - deg. 120 -120 0	
T-Line #2					
Shield Wire #1 Shield Wire #2	-7.9 7.9	28.5 28.5	2.9 2.9	0.0008	
Phase Wire #1 Phase Wire #2 Phase Wire #3 T-Line #3	<u>D - m</u> -9.3 0 9.3	H - m 21 21 21 21	<u>I - Amp</u> 1012 1012 1012	Phase - deg. 120 -120 0	
Shield Wire #1 Shield Wire #2	-5.9 5.9	18.5 18.5	0.189	0.0008	
Phase Wire #1 Phase Wire #2 Phase Wire #3	<u>D - m</u> -7.1 0 7.1	H - m 12.5 12.5 12.5	I - Amp 1961 1961 1961	Phase - deg. 120 -120 0	
T-Line #4					
Shield Wire #1 Shield Wire #2	-5.9 5.9	18.5 18.5	0.189 1.47	0.0008	
Phase Wire #1 Phase Wire #2 Phase Wire #3	$\frac{D - m}{-7.1}$ 0 7.1	<u>H - m</u> 12.5 12.5 12.5	<u>I - Amp</u> 1961 1961 1961	Phase - deg. 120 -120 0	
T-Line #5					
Shield Wire #1 Shield Wire #2	9999 -9999	9999 9999	9999 9999	9999 9999	
Phase Wire #1 Phase Wire #2 Phase Wire #3	<u>D - m</u> -2.5 2.5 -2.5	H - m 11.5 13.35 15.2	<u>I - Amp</u> 314 314 314	Phase - deg. 120 -120 0	



Steady State Data Pipe Information

Pipe #1

0.324 1 50 0.0013 First section is terminated in insulator Last section is terminated in insulator

ate Data		<u>A</u> 23 - <u>D</u>	
teady St ction Info		 4 - 23 4 - 23 5 - 24 5 - 25 5 - 25	
S. St		Image: main state Image: main Image: main state <th< td=""><td></td></th<>	
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Brian Martin & Associates 11 February, 2007

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		P2 - HodaR
		P1-Bonded
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FEEDER 848 FAULT CONDITIONS WITH MITIGATION



APPENDIX F

Faulted Tower Data Comments

Comments

CQGP KP 320 - 393 Fault Conditions T3 (Feeder 848) Node 18 Full Zinc Ribbon Mitigtion

Brian Martin & Associates 9 February 2007



Pipe	ə #1	Pipe #	1 (cont.)	Pipe #1	1 (cont.)	
Distance	Volts	Distance	Volts	Distance	Volts	
0.00	1.7	27.00	0.1	54.00	0.0	
1.00	6.5	28.00	0.6	55.00	0.0	
2.00	48.4	29.00	0.7	56.00	0.0	
3.00	117.0	30.00	0.1	57.00	0.0	
4.00	91.4	31.00	0.1	58.00	0.0	
5.00	53.6	32.00	0.0	59.00	0.0	
6.00	145.8	33.00	0.0	60.00	0.0	
7.00	165.9	34.00	0.0	61.00	0.0	
8.00	77.2	35.00	0.0	62.00	0.0	
9.00	36.2	36.00	0.0	63.00	0.0	
10.00	84.8	37.00	0.0	64.00	0.0	
11.00	170.9	38.00	0.0	65.00	0.0	
12.00	277.0	39.00	0.0	66.00	0.0	
13.00	383.8	40.00	0.0	67.00	0.0	
14.00	685.1	41.00	0.0	68.00	0.0	
15.00	1136.0	42.00	0.0	69.00	0.0	
16.00	1242.3	43.00	0.0	70.00	0.0	
17.00	598.3	44.00	0.0	71.00	0.0	
18.00	223.9	45.00	0.0	72.00	0.0	
19.00	153.6	46.00	0.0	73.00	0.0	
20.00	43.8	47.00	0.0	74.00	0.0	
21.00	23.0	48.00	0.0	75.00	0.0	
22.00	9.3	49.00	0.0			
23.00	2.4	50.00	0.0			
24.00	0.9	51.00	0.0			
25.00	0.4	52.00	0.0			
26.00	0.2	53.00	0.0			



					(
Distance	e Current	Distance	Current	Distance	Current	
0.00	0.0	27.00	1.8	54.00	0.1	
1.00	18.4	28.00	2.7	55.00	0.1	
2.00	137.2	29.00	7.0	56.00	0.1	
3.00	999.3	30.00	8.8	57.00	0.1	
4.00	1472.5	31.00	0.2	58.00	0.1	
5.00	1640.6	32.00	0.1	59.00	0.1	
6.00	1841.6	33.00	0.1	60.00	0.0	
7.00	1874.4	34.00	0.1	61.00	0.0	
8.00	1910.0	35.00	0.1	62.00	0.1	
9.00	1951.7	36.00	0.1	63.00	0.3	
10.00	1976.0	37.00	0.1	64.00	0.4	
11.00	2147.5	38.00	0.1	65.00	0.0	
12.00	2688.5	39.00	0.1	66.00	0.0	
13.00	3324.8	40.00	0.1	67.00	0.0	
14.00	3197.2	41.00	0.0	68.00	0.0	
15.00	2572.1	42.00	0.0	69.00	0.0	
16.00	1731.9	43.00	0.0	70.00	0.0	
17.00	1169.1	44.00	0.0	71.00	0.0	
18.00	932.2	45.00	0.0	72.00	0.0	
19.00	312.1	46.00	0.0	73.00	0.0	
20.00	202.0	47.00	0.1	74.00	0.0	
21.00	76.7	48.00	1.1	75.00	0.0	
22.00	21.3	49.00	0.7			
23.00	11.3	50.00	0.1			
24.00	6.0	51.00	0.1			
25.00	3.3	52.00	0.1			
26.00	2.3	53.00	0.1			
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PRC				Faulte	d Tower Data Information	
INTERNATIONAL						
T-Line						
Shield Wire #1 Shield Wire #2	-5.9 5.9	18.5		0.189	0.0008	
Phase Wire	<u>D - m</u> -7.1	<u>H - m</u> 12.5	11 - A 15500	<u>IR - A</u> 0	Total Current 15500	
Elec. Sys Parameters	Avg Twr :	Sep m 300	Avg Twr Res	- ohms Pau	lted Twr Location	
Arc Distance (m)	5.5					



Faulted Tower Data Pipe Information

Pipe #1

0.324 1 50 0.0013 First section is terminated in insulator Last section is terminated in insulator

Q - 64																																																
N - 24																																																
82 · D																																																
P1 - A		0	0	0	• •			0	0	•	0	0	0	0	0	•			0	0 1	0	• •	0	• •	0	0	• •		0.4			•	•	0	0	0	0	0	•	0	0	• •	0	0.4	0.4	0.4		• •
0 - 1d		0	0	•	• •		0	•	•	•	0	0	0	0	0	0			0	0	0	0 1	0	•	0	0	• •		0 0		0	•	•	0	0	0	0	0	•	0	0	•	0	0 1				0
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L1 - D	0000	6666	6666	6666	6666	2400	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	5555	5655	5555	6666	6666	6666	6666	6666	6666	6666	6666	2422	0000	0000	6666	5555	5555	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	2460	0000	0000	6666
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12 - D	0000	6666	6666	6666	6666	0000	6666	6666	6666	6666	6666	6666	6666		6666	6668	6666	6666		5.5.5.B	6668	6666	5555	6666	6668	0.0.0.0	6666		0000	0000	6666	6666	6666	6666	6666	6666	6666	****	6666	****	6666	6666	6666	6666	2222	0000	0000	6666
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		13 -	0	0	0	0.	0.	0	0	0.	0	0	0	0.	0.	0.	0		0.	6	0	0.	0.	0.
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Steady State Data Branch Information

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		-Wolds 22-Aucode11 22-PartY1re 22-Bonded 23-Ms
PRC	TEINATIONAL	P1-ModeX P1-ModeX P1-ModeX P1-ModeX P1-ModeX P1-ModeX P1 P1 P1
	N	780 180 180 180 180 180 180 180 180 180 1

FEEDER 849 FAULT CONDITIONS WITH MITIGATION



APPENDIX G

Faulted Tower Data Comments

Comments

CQGP KP 320 - 393 Fault Conditions T4 (Feeder 849) Node 18 Full Zinc Ribbon Mitigtion

Brian Martin & Associates 9 February 2007



Distance Volts Distance Volts Distance Volts 0.00 1.8 27.00 0.1 54.00 0.0 1.00 6.7 28.00 0.6 55.00 0.0 2.00 49.4 29.00 0.7 56.00 0.0 3.00 132.0 30.00 0.1 57.00 0.0 4.00 109.7 31.00 0.1 58.00 0.0 5.00 58.9 32.00 0.0 59.00 0.0	Pip	e #1	Pipe #1	(cont.)	Pipe #1	(cont.)	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Distance	Volts	Distance	Volts	Distance	Volts	
1.00 6.7 28.00 0.6 55.00 0.0 2.00 49.4 29.00 0.7 56.00 0.0 3.00 132.0 30.00 0.1 57.00 0.0 4.00 109.7 31.00 0.1 58.00 0.0 5.00 58.9 32.00 0.0 59.00 0.0	0.00	1.8	27.00	0.1	54.00	0.0	
2.00 49.4 29.00 0.7 56.00 0.0 3.00 132.0 30.00 0.1 57.00 0.0 4.00 109.7 31.00 0.1 58.00 0.0 5.00 58.9 32.00 0.0 59.00 0.0	1.00	6.7	28.00	0.6	55.00	0.0	
3.00 132.0 30.00 0.1 57.00 0.0 4.00 109.7 31.00 0.1 58.00 0.0 5.00 58.9 32.00 0.0 59.00 0.0	2.00	49.4	29.00	0.7	56.00	0.0	
4.00 109.7 31.00 0.1 58.00 0.0 5.00 58.9 32.00 0.0 59.00 0.0	3.00	132.0	30.00	0.1	57.00	0.0	
5.00 58.9 32.00 0.0 59.00 0.0	4.00	109.7	31.00	0.1	58.00	0.0	
4 AA 100 22 00 0.0 60 00 0.0	5.00	58.9	32.00	0.0	59.00	0.0	
6.00 130.3 53.00 0.0 60.00 0.0	6.00	130.3	33.00	0.0	60.00	0.0	
7.00 138.5 34.00 0.0 61.00 0.0	7.00	138.5	34.00	0.0	61.00	0.0	
8.00 48.8 35.00 0.0 62.00 0.0	8.00	48.8	35.00	0.0	62.00	0.0	
9.00 49.4 36.00 0.0 63.00 0.0	9.00	49.4	36.00	0.0	63.00	0.0	
10.00 143.7 37.00 0.0 64.00 0.0	10.00	143.7	37.00	0.0	64.00	0.0	
11.00 323.9 38.00 0.0 65.00 0.0	11.00	323.9	38.00	0.0	65.00	0.0	
12.00 464.1 39.00 0.0 66.00 0.0	12.00	464.1	39.00	0.0	66.00	0.0	
13.00 657.6 40.00 0.0 67.00 0.0	13.00	657.6	40.00	0.0	67.00	0.0	
14.00 1018.3 41.00 0.0 68.00 0.0	14.00	1018.3	41.00	0.0	68.00	0.0	
15,00 2206,4 42.00 0.0 69.00 0.0	15.00	2206.4	42.00	0.0	69.00	0.0	
16.00 2627.8 43.00 0.0 70.00 0.0	16.00	2627.8	43.00	0.0	70.00	0.0	
17.00 1025.6 44.00 0.0 71.00 0.0	17.00	1025.6	44.00	0.0	71.00	0.0	
18,00 160.8 45.00 0.0 72.00 0.0	18.00	160.8	45.00	0.0	72.00	0.0	
19.00 149.3 46.00 0.0 73.00 0.0	19.00	149.3	46.00	0.0	73.00	0.0	
20.00 63.2 47.00 0.0 74.00 0.0	20.00	63.2	47.00	0.0	74.00	0.0	
21.00 27.5 48.00 0.0 75.00 0.0	21.00	27.5	48.00	0.0	75.00	0.0	
22.00 10.7 49.00 0.0	22.00	10.7	49.00	0.0			
23.00 2.6 50.00 0.0	23.00	2.6	50.00	0.0			
24.00 1.0 51.00 0.0	24.00	1.0	51.00	0.0			
25.00 0.4 52.00 0.0	25.00	0.4	52.00	0.0			
26.00 0.2 53.00 0.0	26.00	0.2	53.00	0.0			



110	a 47	LTDe #T	(conc.)	LTbe #1	(conc.)	
Distance	Current	Distance	Current	Distance	Current	_
0.00	0.0	27.00	1.8	54.00	0.1	
1.00	18.7	28.00	2.7	55.00	0.1	
2.00	140.0	29.00	7.0	56.00	0.1	
3.00	1021.3	30.00	8.8	57.00	0.1	
4.00	1573.3	31.00	0.2	58.00	0.1	
5.00	1788.3	32.00	0.1	59.00	0.1	
6.00	1979.4	33.00	0.1	60.00	0.0	
7.00	2008.7	34.00	0.1	61.00	0.0	
8.00	2036.3	35.00	0.1	62.00	0.1	
9.00	2065.5	36.00	0.1	63.00	0.3	
10.00	2095.5	37.00	0.1	64.00	0.4	
11.00	2411.7	38.00	0.1	65.00	0.0	
12.00	3442.5	39.00	0.1	66.00	0.0	
13.00	4403.0	40.00	0.1	67.00	0.0	
14.00	4486.6	41.00	0.0	68.00	0.0	
15.00	3634.3	42.00	0.0	69.00	0.0	
16.00	1948.2	43.00	0.0	70.00	0.0	
17.00	922.4	44.00	0.0	71.00	0.0	
18.00	834.8	45.00	0.0	72.00	0.0	
19.00	396.2	46.00	0.0	73.00	0.0	
20.00	241.9	47.00	0.1	74.00	0.0	
21.00	89.2	48.00	1.1	75.00	0.0	
22.00	23.4	49.00	0.7			
23.00	11.8	50.00	0.1			
24.00	6.2	51.00	0.1			
25.00	3.4	52.00	0.1			
26.00	2.3	53.00	0.1			
		45.41				
		02/1	0/2007 - Page 3			

PRC		Faulted Tower Data T-Line Information									
INTERNATIONAL											
T-Line						_					
Shield Wire #1 Shield Wire #2	-5.9 5.9	18. 18.	5	0.189	0.0008						
Phase Wire	<u>D - m</u> -7.1	<u>H - m</u> 12.5	11 - A 15500	<u>IR - A</u> 0	Total Current 15500						
Elec. Sys Parameters	Avg Twr :	Sep m 300	Avg Twr Res	- ohms 10 Paul	ted Twr Location						
Arc Distance (m)	5.5										



Faulted Tower Data Pipe Information

Pipe #1

0.324 1 50 0.0013 First section is terminated in insulator Last section is terminated in insulator

Äg		5																																												
ver		P3 - D																																												
TOV		22 - A																																												
ted on I		P2 - D																																												
Faul		V - 14	0 4	0	0	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0	0 4	0 0	0	0	0	0	0	0 0	0	0	0	0 4	0 0	0	0	0	0	0 0	0	0	0	0 0	0 0	0	0
		0 - 1d	• •	• •		•	•	•	• •	• •	•	•	•	• •	0 4	• •	0	•	•	•	•	• •		• •	0	•	•	•	0 4		•	•	• •		0	0	•	•		• •	•	•	0 4		• •	0
		L5 - A	• •	0	0	0	0	0	0 0	0	0	0	0	0 1	0 <	0	0	0	0	0	0	0 1	0 0	0	0	0	0	0	0 0	0	0	0	0 1	0 0	0	0	0	0	0 0	0	0	0	0 4	0 0	0	0
		T\$ - D	4666	4666	6666	6666	6666	6666	6666	40.65	4666	4665	4666	6666	3333	0000	6666	6666	6666	6666	4666	4666	40.66	6666	6666	6565	6666	6666	6666	2000	4665	4666	4666	20.00	6566	6666	6666	6666	3998	4666	4665	4666	4666	44.66	6666	6666
		E4 - A	• •		•	0	0	•	• •		•	•	•	•	0.4		•	•	•	•	•				•	•	e	•	• •		•	•	• •			•	0	•	• •		•	•	• •			•
		L4 - D	6666	6666	6666	6666	6666	6666	6666	8000	6666	\$666	6666	6666	8444	8586	6666	6666	6666	6666	8466	6466	8586	6666	6666	6666	6666	6666	6666	8000	6666	5666	6666	2000	6666	6666	6666	6666	6666	8666	6666	6666	6466	0000	6666	6666
		13 - V	• •	• •	• •	0	•	•	• •	0	•	•	•	• •	0 4	0	•	•	0	•	• •	• •	0	• •	•	0	0	•	0 0	0	•	•	• •	0 0	0	0	•	•	0 0	0	•	•	0 4	0 0	0	0
		11 - 0	6666	6666	6666	6666	6666	6666	6666	6466	6466	6666	6466	6466	0000	0000	6666	6666	6666	6666	6466	6466	6466	6466	6666	6666	6666	6666	6666	0000	6466	6666	6666	0.000	6666	6666	6666	6666	6666	6466	6466	6466	6466	0000	6666	6666
		L2 - A	• •	0	0	0	0	0	0 0	0	0	0	0	0	0 0	0	0	0	0	0	0	0 4	0 0	0	0	0	0	0	0 0	0	0	0	0 1	0 0	0	0	0	0	0 0	0	0	0	0 4	0 0	0	0
		12 - 0	6666	6666	6666	6666	6666	6666	6666	0000	6666	6666	6666	6666	4444	0000	6666	6666	6555	6555	6666	6666	0000	6666	6666	6666	6666	6666	6666	0000	6666	6666	6666	2222	6666	6666	6666	6666	6668	0000	6666	6666	6666	0000	6666	6666
		L1 - A	• •	0	0	0	0	0	0 9	0	0	•	0	0	0 <	0	0	0	0	0	0	0 4	0 0	0	0	0	0	0	0 0	0	0	0	0 0	0 0	0	0	0	0	0 0	0	0	0	0 4	0 0	0	0
		11 - D	66666	66666	-239	126	355	213		140	130	100	26	27		18	36	-69	-334	-429	66666-	66666-	66666-	66666-	66666-	66666-	66666-	66666-	666666-	00000-	66666-	66666-	66666-	00000-	66666-	66666-	66666-	66666-	- 00000	66666-	66666-	65656-	66666-	00000-	66666-	65666-
0	NNL	Soil Res	4000	4000	12000	12000	12000	00078	00018	41000	19000	19000	19000	40000	44090	27600	35000	36000	16000	0000	0000	0000	0000	0006	0006	0-0-0-6	0406	0006	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1460	4400	4400
Ĩ	TERNATIO	Length	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	0001	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	0001	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
2	N	Section		• •	-	ŝ	9	-		1	1	12	3	1	33	1	10	19	8	12	22		5	12	52	88	62	90	16		1	35	*		12	40	41	42	6	: 5	3	47	;;	44	15	52

Faulted Tower Data

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CQGP - KP 320 to 393 Powerline AC Interference Report

ate Data mation		A 21 - D 21 - A																						
teady St ranch Infor		- X P2 - D P2 -		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
തല്പ		14 0 · 14	0	0	0	•	0	•	0	0	•	0	•	0	•	•	0	•	0	0	0	0	•	0
		TS - A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		L5 - D	6666	6666	46.66	4666	55.65	46.66	6666	99.99	4666	6666	44 66	6666	46.66	4666	66.66	4666	6666	4666	6666	4666	4666	6666
		2.2		•	•	•	¢	¢	•	•	•	¢	•	•	•	•	¢	•	•	•	•	•	•	•
		L4 - D	6666	5555	8666	8668	6666	8668	5555	8668	8668	6666	8668	6666	8646	8666	6666	8666	6666	8646	6666	6666	8666	5555
		L3 - A		•	•	•	0	0	0	•	•	•	•	0	0	0	•	•	0	•	•	•	0	•
		L3 - D	6666	6666	6666	5555	5555	5555	5666	5555	5666	6666	5555	6666	6666	5555	6666	6666	6666	6666	6666	6666	5666	6666
		12 - 8		•	0	0	0	0	0	0	0	0	0	0	0	0	ð	•	ð	0	8	0	0	0
		L2 - D	6666	6556	6666	4444	6666	6666	6666	8888	4044	6666	6666	6656	4444	6666	6666	6666	6666	6666	6668	6666	4044	6666
		L1 - A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		L1 - D	66666-	-99999	66666-	66666-	66666-	66666-	66666-	66666-	66666-	66666-	66656-	66666-	66666-	66666-	66666-	66656-	66666-	66666-	66666-	66666-	66666-	66666-
ũ	IONAL	Soil Res 4400	4400	44/00	4400	4400	4400	4400	4400	4400	4400	4400	4400	3100	OOTE	3100	OOTE	3100	33.00	OOTE	3100	OOTE	3100	3300
E	VTENNAT	Length	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
	-	0 ranch	3	55	56	52	85	ŝ	3	61	3	69	2	65	59	63	89	S	2	77	72	23	74	75

Steady State Data
ata nfo		Bond
nd I		
TOW6		수 전 월 1 국 전 수
ulted		0 - Anode DTR
Fa		P3-K24ek
		362-Bond
		2 - AttrodeDR
		241 - Bond
		1 - AnodeDR
S C	VATIONAL	b D D D D D D D D D D D D D D D D D D D
đ	INTERN	7 4 4 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7

l

Steady State Data Mitigation & Bond Info		03-NodeB P3-AnodeB9 P3-BarMire P3-Bonded
		P2-NodeD8 P2-AnodeD8 P2-PacKitee P2-Bonded
RC	ERNATIONAL	P1-Mode8 P1-
	INTE	840 / 180 de 55 55 55 55 55 55 55 55 55 55 55 55 55

APPENDIX H FEEDER 7167 FAULT CONDITIONS WITH MITIGATION



Faulted Tower Data Comments

Comments

CQGP KP 320 - 393 Pault Conditions T5 (Peeder 7167) Node 17 Full Zinc Ribbon Mitigtion

Brian Martin & Associates 9 Pebruary 2007



Distance Volts Distance Volts Distance Volts 0.00 1.4 27.00 0.1 54.00 0.0 1.00 5.4 28.00 0.5 55.00 0.0 2.00 39.6 29.00 0.6 56.00 0.0 3.00 112.9 30.00 0.1 57.00 0.0 4.00 97.1 31.00 0.1 58.00 0.0 5.00 47.9 32.00 0.0 59.00 0.0 6.00 96.4 33.00 0.0 60.00 0.0	Pi	.pe #1	Pipe #	1 (cont.)	Pipe #1	(cont.)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Distance	Volts	Distance	Volts	Distance	Volts
	0.00	1.4	27.00	0.1	54.00	0.0
2.00 39.6 29.00 0.6 56.00 0.0 3.00 112.9 30.00 0.1 57.00 0.0 4.00 97.1 31.00 0.1 58.00 0.0 5.00 47.9 32.00 0.0 59.00 0.0 6.00 96.4 33.00 0.0 60.00 0.0	1.00	5.4	28.00	0.5	55.00	0.0
3.00 112.9 30.00 0.1 57.00 0.0 4.00 97.1 31.00 0.1 58.00 0.0 5.00 47.9 32.00 0.0 59.00 0.0 6.00 96.4 33.00 0.0 60.00 0.0	2.00	39.6	29.00	0.6	56.00	0.0
4.00 97.1 31.00 0.1 58.00 0.0 5.00 47.9 32.00 0.0 59.00 0.0 6.00 96.4 33.00 0.0 60.00 0.0	3.00	112.9	30.00	0.1	57.00	0.0
5.00 47.9 32.00 0.0 59.00 0.0 6.00 96.4 33.00 0.0 60.00 0.0	4.00	97.1	31.00	0.1	58.00	0.0
6.00 96.4 33.00 0.0 60.00 0.0	5.00	47.9	32.00	0.0	59.00	0.0
	6.00	96.4	33.00	0.0	60.00	0.0
7.00 118.9 34.00 0.0 61.00 0.0	7.00	118.9	34.00	0.0	61.00	0.0
8.00 59.9 35.00 0.0 62.00 0.0	8.00	59.9	35.00	0.0	62.00	0.0
9.00 24.6 36.00 0.0 63.00 0.0	9.00	24.6	36.00	0.0	63.00	0.0
10.00 69.0 37.00 0.0 64.00 0.0	10.00	69.0	37.00	0.0	64.00	0.0
11.00 213.7 38.00 0.0 65.00 0.0	11.00	213.7	38.00	0.0	65.00	0.0
12.00 630.8 39.00 0.0 66.00 0.0	12.00	630.8	39.00	0.0	66.00	0.0
13.00 1599.1 40.00 0.0 67.00 0.0	13.00	1599.1	40.00	0.0	67.00	0.0
14.00 3273.0 41.00 0.0 68.00 0.0	14.00	3273.0	41.00	0.0	68.00	0.0
15,00 5928,4 42.00 0.0 69.00 0.0	15.00	5928.4	42.00	0.0	69.00	0.0
16.00 15520.0 43.00 0.0 70.00 0.0	16.00	15520.0	43.00	0.0	70.00	0.0
17.00 6180.0 44.00 0.0 71.00 0.0	17.00	6180.0	44.00	0.0	71.00	0.0
18.00 2379.3 45.00 0.0 72.00 0.0	18.00	2379.3	45.00	0.0	72.00	0.0
19.00 876.9 46.00 0.0 73.00 0.0	19.00	876.9	46.00	0.0	73.00	0.0
20.00 281.5 47.00 0.0 74.00 0.0	20.00	281.5	47.00	0.0	74.00	0.0
21.00 73.5 48.00 0.0 75.00 0.0	21.00	73.5	48.00	0.0	75.00	0.0
22.00 18.4 49.00 0.0	22.00	18.4	49.00	0.0		
23.00 4.5 50.00 0.0	23.00	4.5	50.00	0.0		
24.00 1.1 51.00 0.0	24.00	1.1	51.00	0.0		
25.00 0.4 52.00 0.0	25.00	0.4	52.00	0.0		
26.00 0.2 53.00 0.0	26.00	0.2	53.00	0.0		



Pip	e #1	Pipe #1	(cont.)	Pipe #1	(cont.)	
Distance	Current	Distance	Current	Distance	Current	
0.00	0.0	29.00	2.1	54.00	0.1	
1.00	15.0	29.00	EE	55.00	0.1	
2.00	112.7	30.00	7.0	57.00	0.0	
3.00	1200 0	21.00	0.2	59.00	0.0	
4.00 E.00	1298.0	32.00	0.1	59.00	0.0	
5.00	1480.8	22.00	0.1	60.00	0.0	
5.00	1619.7	34.00	0.1	61.00	0.0	
7.00	1637.0	35.00	0.1	62.00	0.1	
0.00	1004.3	36.00	0.1	63.00	0.3	
30.00	1702.1	37.00	0.1	64.00	0.3	
10.00	1713.2	38.00	0.1	65.00	0.0	
12.00	2200.0	39.00	0.0	66.00	0.0	
12.00	2309.0	40.00	0.0	67.00	0.0	
14.00	6296 1	41.00	0.0	68.00	0.0	
15.00	0705 2	42.00	0.0	69.00	0.0	
16.00	1227 3	43.00	0.0	70.00	0.0	
17.00	7925 7	44.00	0.0	71.00	0.0	
18.00	4604 8	45.00	0.0	72.00	0.0	
19.00	1655 4	46.00	0.0	73.00	0.0	
20.00	668.6	47.00	0.1	74.00	0.0	
21.00	165.2	48.00	0.9	75.00	0.0	
22.00	38.3	49.00	0.6			
23.00	9.8	50.00	0.1			
24.00	4.6	51.00	0.1			
25.00	2.7	52.00	0.1			
26.00	1.6	53.00	0.1			

PRC				Faulte	d Tower Data Information	
INTERNATIONAL						
T-Line						_
Shield Wire #1 Shield Wire #2	9999 -9999	9999 9999		9999 9999	9999 9999	
Phase Wire	<u>D - m</u> -2.5	<u>H - m</u> 11.5	1L - A 7000	<u>IR - A</u> 0	Total Current 7000	
Elec. Sys Parameters	Avg Twr :	Sep m 400	Avg Twr Res	- ohms 10 Pau	lted Twr Location	
Arc Distance (m)	5.5					



Faulted Tower Data Pipe Information

Pipe #1

0.324 1 50 0.0013 First section is terminated in insulator Last section is terminated in insulator

P3 - A																																																	
P3 - D																																																	
8 - 24																																																	
P2 - D																																																	
P1 - A	0	8	8	ð	8 4		5 6					5 4		5 0	5 0		5 6	5 6		5 0					8	0	•	0	0	0	0					0	0	0	0	0	0	0	8	8	8	8	0 0	8	
p1 - D	•	0	0	0	• •																			• •	0	•	•	0	0	0	•	• •			0	•	0	0	0	•	¢	0	0	•	0	0	• •	0	
E5 - A	0	0	0	0	0 0																				0	•	0	0	0	0	0	0	0 0			•	0	0	0	e	0	0	0	0	0	0	0 0	0	
L5 - D	4646	4666	6656	6666	6666	20.00	10000	0000	0000	0000	10000	4646	46.46	2000	20000	0000	10000	0000	0000	10000	20.00	0000	0000	6666	6655	6666	6656	6656	6666	6666	6666	6666	2525	0000	6655	6666	6655	6666	6656	6666	6656	6656	6666	4646	4655	6656	6666	4646	
K - M	¢	ę	¢	0	• •			• •	• •							• •	• •		• •	• •		• •	• •	• •	0	•	•	•	¢	ę	•	•	0 1			•	•	•	ę	¢	¢	ę	ę	•	ę	•	• •		
- 1	6666	5666	6666	6666	6666	0000	0000	0000	0000	0000	0000	22.22	2000	2000	22.25	0000	2000	0000	0000	2000	0000	0000	0000	6666	5666	6666	6666	6666	6666	6666	6666	6666	5666	0000	6666	6666	6666	6666	6666	6666	6666	6666	5555	6666	6666	6666	6666	6666	
E3 - A	°	0	0	0	• •																		0		0	•	•	0	0	0	0	•	0 4	• •		•	0	0	0	•	0	0	0	0	0	0	• •	0	
a - 13	6665	6665	6665	6665	6666	6464	6000	0000	0000	0000	2000	2624	6464	2222	6666	6000	6400	0000	0000	2400	6464	6000	0000	6666	6665	6666	\$ \$ \$ \$	6665	6665	6665	6666	6666	6666	6060	6665	6665	6665	6665	6665	6666	6665	6665	6666	6666	6665	6665	6666	6666	
22 - A	•	0	0	0	• •	> <		> <	• •	> <								0 0			> <		• •	0	0	0	0	0	0	0	0	0	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 0	0	
a - 2	6666	6666	6666	6666	6666	0000	0000	6660	0000	0000	0000		2222			0000	10000	0000	0000	1000	0000	0000	0000	6666	6668	6666	6666	6666	6666	6666	6666	6666	6666	0000	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	6666	
L1 - A	0	0	0	0	0 0	> <	0 0	> <	• •	> <					0 0	> <		0 0	0	0	> <	0 0	0	0	0	0	0	0	0	0	0	0 1	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 0	0	
1 - D	66666	66666	66666	-267	10.00	101		100	196	101	104						280	00000	00000			00000	00000	66666-	66666-	66666-	-99999	66666-	66666-	-99999	66666-	66666-	-99999	00000	66666	66666-	65656-	66666-	66666-	66666-	-99999	66666-	66666-	66666-	-99999	66666-	66666-	66666-	
Soil Res	4000	4000	4000	12000	12000	AND AL			0000 W	00000	2000 F	00047	DODAT		00000	200046	200012	20002	A0000	00044	0000	0000	0000	0006	0006	0006	0006	0006	0006	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	4400	
Longth	0001	0001	0001	0001	0001	DOOT T	0000	0000	0000	0000	0000	0001	0001	OOAT.	0001		0000	DOAT	0000	0000	DOAT.	OCC -	0000	1000	0001	1000	0001	0001	0001	0001	ooer	0001	0001	0001	1000	1000	ODOT	ODOT	0001	1000	OOOT	0001	ooet	ooer	0001	0001	0001	0001	
HOLE OD	-	a	0	*			- 0				1:	1;	1;	1		1				1	100		1	15	36	12	30	29	OR	16	32	8	:		37	30	35		41	43	43	44	45	46	47		6.9	20	

Faulted Tower Data Section Information

PRC

Data		D P3 - A																						
r State Informati		P2 - A P3 -																						
Steady Branch		P1 - A P2 - I	0	0	0	•	•	0	0	0	0	0	0	0	•	•	0	•	0	0	0	0	0	0
		0 - 14	•	•	0	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
		- 51 66	66	66	55	8.8	88	86	66	55	66	66	66	55	88	88	86	55	55	66	66	66	8.8	66
		- 7 T	0 99	66 0	66 0	66 0	99	46 0	0 99	0 99	0 99	0 99	0 99	66 0	66 0	99	0 35	0 99	0 99	0 55	66 0	66 0	0 39	66 0
		14 - D 14	6666	6666	6666	4466	4466	4666	6666	6666	6666	6666	6666	4666	4466	4666	4666	6666	6666	6666	6666	6666	4466	4466
		<u>13 - A</u>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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