

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 Resistivity (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 (concrete 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 Ω /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 10 Ω earths.

T2 (Feeder 812)

- a) Single horizontal circuit
- b) Shield wires 7.9m from centre, 28.5m above ground, 2.9 Ω /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 10 Ω earths.

T3 (Feeder 848)

- a) Single horizontal circuit
- b) Shield wires 5.9m from centre, 18.5m above ground, 0.189 Ω /km one shield and 1.47 Ω /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 10 Ω earths.

T4 (Feeder 849)

- a) Single horizontal circuit
- b) Shield wires 5.9m from centre, 18.5m above ground, 0.189 Ω /km one shield and 1.47 Ω /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 10 Ω 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 10 Ω earths.

3.5. Pipeline Data

- a) Outside diameter 323.9mm.
- b) Depth of cover of 1.0m.
- c) Trilaminar coating 1.3mm thick.
- d) The coating resistance is assumed to be 50k Ω /m².

- 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.

<i>Feeder</i>	<i>AC Interference</i>
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.

<i>Feeder</i>	<i>AC Interference</i>
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

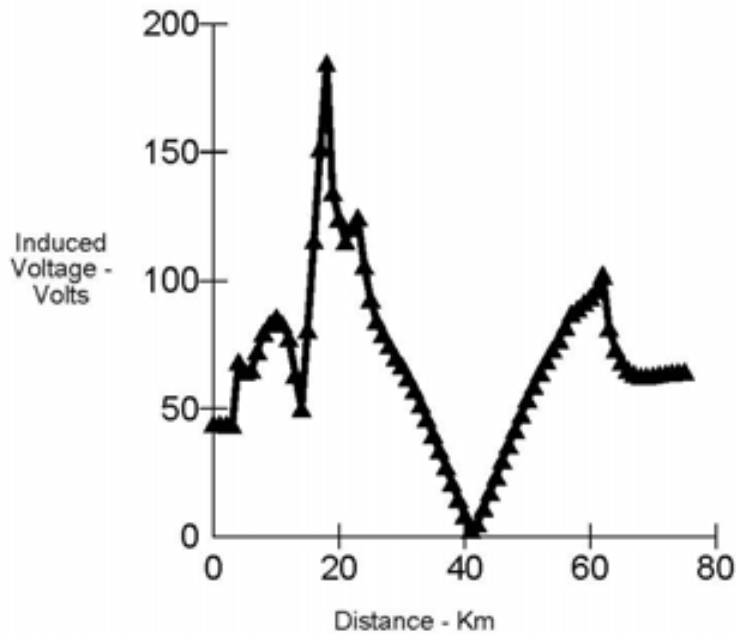
Comments

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No Mitigation

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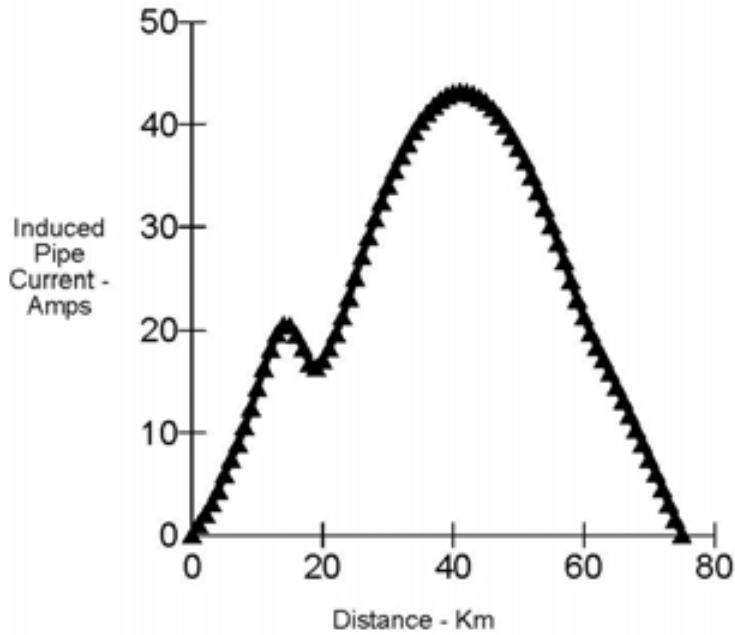
Steady State Voltage
Graph and Data



Pipe #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 Current
Graph and Data



Pipe #1		Pipe #1 (cont.)		Pipe #1 (cont.)	
Distance	Current	Distance	Current	Distance	Current
0.00	0.0	27.00	29.0	54.00	31.9
1.00	1.1	28.00	30.8	55.00	30.2
2.00	2.1	29.00	32.5	56.00	28.4
3.00	3.1	30.00	34.0	57.00	26.6
4.00	4.4	31.00	35.5	58.00	24.8
5.00	5.9	32.00	36.9	59.00	23.0
6.00	7.4	33.00	38.2	60.00	21.3
7.00	8.9	34.00	39.3	61.00	19.7
8.00	10.6	35.00	40.3	62.00	18.4
9.00	12.5	36.00	41.1	63.00	17.2
10.00	14.4	37.00	41.9	64.00	15.9
11.00	16.3	38.00	42.4	65.00	14.5
12.00	18.1	39.00	42.8	66.00	13.2
13.00	19.7	40.00	43.1	67.00	11.8
14.00	20.6	41.00	43.2	68.00	10.3
15.00	20.4	42.00	43.2	69.00	8.9
16.00	19.5	43.00	43.0	70.00	7.5
17.00	18.3	44.00	42.6	71.00	6.0
18.00	16.8	45.00	42.2	72.00	4.5
19.00	16.4	46.00	41.6	73.00	3.1
20.00	17.1	47.00	40.8	74.00	1.6
21.00	18.3	48.00	39.9	75.00	0.1
22.00	19.7	49.00	38.9		
23.00	21.4	50.00	37.7		
24.00	23.2	51.00	36.4		
25.00	25.2	52.00	35.0		
26.00	27.1	53.00	33.5		



Steady State Data
T-Line Information

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



Steady State Data
Section Information

Section	Length	Soil Mass	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	P1 - D	P1 - A	P2 - D	P2 - A	P3 - D	P3 - A
1	1000	4000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
2	1000	4000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
3	1000	4000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
4	1000	12000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
5	1000	12000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
6	1000	12000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
7	1000	84000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
8	1000	84000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
9	1000	43000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
10	1000	43000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
11	1000	18000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
12	1000	18000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
13	1000	18000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
14	1000	48000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
15	1000	48000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
16	1000	77000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
17	1000	77000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
18	1000	35000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
19	1000	16000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
20	1000	16000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
21	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
22	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
23	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
24	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
25	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
26	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
27	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
28	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
29	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
30	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
31	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
32	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
33	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
34	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
35	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
36	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
37	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
38	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
39	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
40	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
41	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
42	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
43	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
44	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
45	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
46	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
47	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
48	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
49	1000	13000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
50	1000	44000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
51	1000	44000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
52	1000	44000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0



Steady State Data
Branch Information

Branch	Length	Soil Res	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	P1 - D	P1 - A	P2 - D	P2 - A	P3 - D	P3 - A
53	1000	4400	-30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	1000	4400	-33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	1000	4400	-34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	1000	4400	-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	1000	4400	-23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	1000	4400	-51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	1000	4400	-46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	1000	4400	-45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	1000	4400	-42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	1000	4400	-26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	1000	4400	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	1000	4400	123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	1000	3100	184	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	1000	3100	275	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	1000	3100	412	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	1000	3100	771	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	1000	3100	95929	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	1000	3100	95929	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	1000	3100	95929	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	1000	3100	95929	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	1000	3100	95929	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	1000	3100	95929	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	1000	3100	95929	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



Steady State Data
Mitigation & Bond Info

Sec/Node	P1-Node	P1-AnodeDR	P1-ParWire	F2a1-Bond	P2-Node	P2-AnodeDR	P2-ParWire	P1a2-Bond	P3-Node	P3-AnodeDR	P3-ParWire	P1a3-Bond
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**Steady State Data
Mitigation & Bond Info**

Sec/Node	P1-Node	P1-Anode	P1-ParWire	P1-Bonded	P2-Node	P2-Anode	P2-ParWire	P2-Bonded	P3-Node	P3-Anode	P3-ParWire	P3-Bonded
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APPENDIX B FEEDER 848 FAULT CONDITIONS NO MITIGATION



**Faulted Tower Data
Comments**

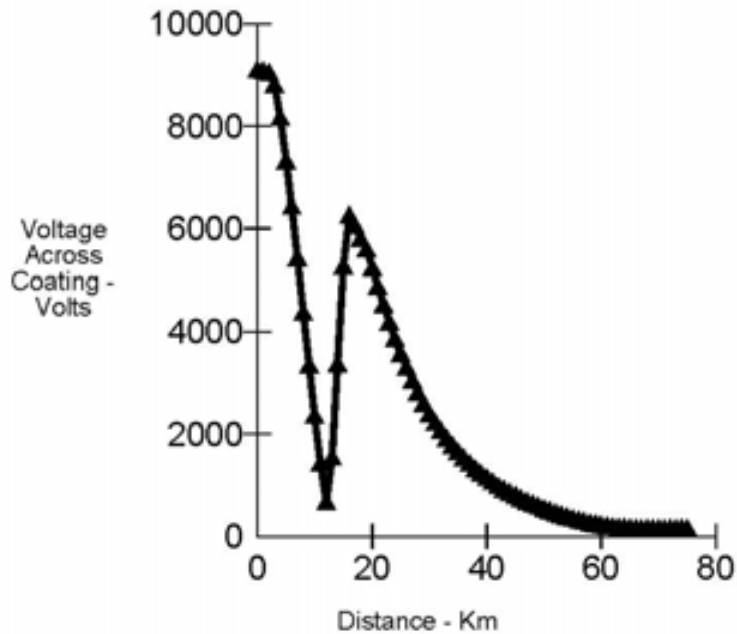
Comments

CQGP
KP 320 - 393
Fault Conditions T3 (Feeder 848) Node 18
No Mitigation

Brian Martin & Associates
9 February 2007



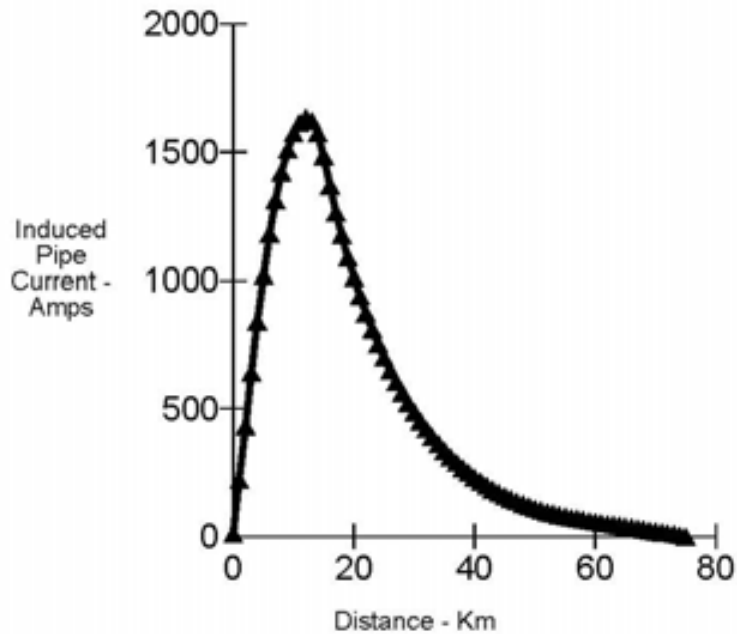
Fault Voltage Graph and Data



Pipe #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		



Fault Current Graph and Data



Pipe #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		



Faulted Tower Data
T-Line Information

T-Line

Shield Wire #1	-5.9	18.5	0.189	0.0008	
Shield Wire #2	5.9	18.5	1.47	0.0008	
Phase Wire	<u>D - m</u> -7.1	<u>H - m</u> 12.5	<u>IL - A</u> 15500	<u>IR - A</u> 0	<u>Total Current</u> 15500
Elec. Sys Parameters	<u>Avg Twr Sep. - m</u> 300	<u>Avg Twr Res - ohms</u> 10	<u>Faulted Twr Location</u> 18		
Arc Distance (m)	5.5				



Faulted Tower Data
Pipe Information

Pipe #1

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



Faulted Tower Data
Section Information

Section	Length	Soil Res	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	P1 - D	P1 - A	P2 - D	P2 - A	P3 - D	P3 - A
1	1000	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
2	1000	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
3	1000	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
4	1000	12000	-216	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
5	1000	12000	182	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
6	1000	12000	390	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
7	1000	84000	279	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
8	1000	84000	260	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
9	1000	43000	227	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
10	1000	43000	197	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
11	1000	19000	169	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
12	1000	19000	137	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
13	1000	19000	97	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
14	1000	48000	65	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
15	1000	48000	35	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
16	1000	77000	71	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
17	1000	77000	71	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
18	1000	35000	74	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
19	1000	16000	-54	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
20	1000	16000	-296	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
21	1000	9000	-401	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
22	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
23	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
24	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
25	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
26	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
27	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
28	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
29	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
30	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
31	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
32	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
33	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
34	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
35	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
36	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
37	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
38	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
39	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
40	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
41	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
42	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
43	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
44	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
45	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
46	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
47	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
48	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
49	1000	13000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
50	1000	44000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
51	1000	44000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
52	1000	44000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0



Steady State Data
Branch Information

Branch	Length	Soil Res	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	P1 - D	P1 - A	P2 - D	P2 - A	P3 - D	P3 - A	
53	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
54	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
55	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
56	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
57	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
58	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
59	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
60	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
61	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
62	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
63	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
64	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
65	1000	3100	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
66	1000	3100	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
67	1000	3100	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
68	1000	3100	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
69	1000	3100	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
70	1000	3100	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
71	1000	3100	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
72	1000	3100	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
73	1000	3100	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
74	1000	3100	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
75	1000	3100	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0



**Faulted Tower Data
Mitigation & Bond Info**

Sec/Node	P1-Node	P1-Anode	P1-PartWire	P241-Bond	P2-Node	P2-Anode	P2-PartWire	P142-Bond	P3-Node	P3-Anode	P3-PartWire	P143-Bond
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Steady State Data
Mitigation & Bond Info

Sec/Node	P1-Node	P1-ParWire	P1-Bonded	P2-Node	P2-ParWire	P2-Bonded	P3-Node	P3-ParWire	P3-Bonded
53									
54									
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APPENDIX C FEEDER 849 FAULT CONDITIONS NO MITIGATION



**Faulted Tower Data
Comments**

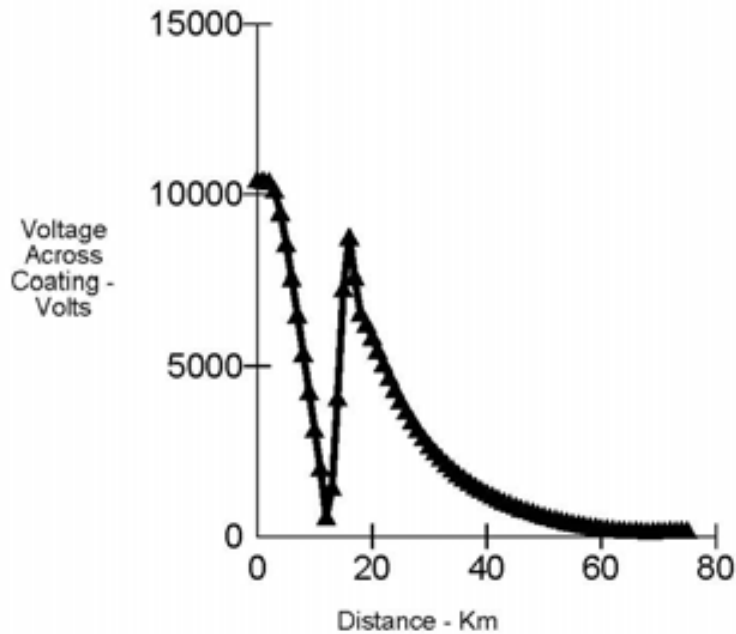
Comments

CQGP
KP 320 - 393
Fault Conditions T4 (Feeder 849) Node 18
No Mitigation

Brian Martin & Associates
9 February 2007



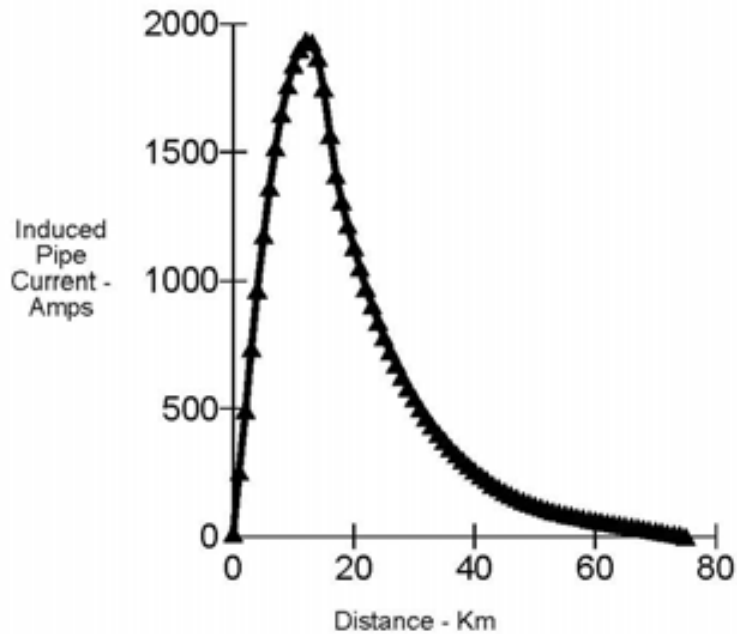
Fault Voltage Graph and Data



Pipe #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		



Fault Current
Graph and Data



Pipe #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		



Faulted Tower Data
T-Line Information

T-Line

Shield Wire #1	-5.9	18.5	0.189	0.0008	
Shield Wire #2	5.9	18.5	1.47	0.0008	
Phase Wire	<u>D - m</u> -7.1	<u>H - m</u> 12.5	<u>IL - A</u> 15500	<u>IR - A</u> 0	<u>Total Current</u> 15500
Elec. Sys Parameters	<u>Avg Twr Sep. - m</u> 300	<u>Avg Twr Res - ohms</u> 10	<u>Faulted Twr Location</u> 18		
Arc Distance (m)	5.5				



Faulted Tower Data
Pipe Information

Pipe #1

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



Faulted Tower Data
Section Information

Section	Length	Soil Res	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	P1 - D	P1 - A	P2 - D	P2 - A	P3 - D	P3 - A	
1	1000	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
2	1000	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
3	1000	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
4	1000	12000	-219	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
5	1000	12000	126	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
6	1000	12000	355	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
7	1000	84000	213	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
8	1000	84000	228	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
9	1000	43000	399	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
10	1000	43000	368	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
11	1000	19000	130	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
12	1000	19000	160	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
13	1000	19000	56	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
14	1000	48000	27	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
15	1000	48000	25	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
16	1000	77000	31	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
17	1000	77000	31	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
18	1000	35000	34	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
19	1000	16000	-65	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
20	1000	16000	-334	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
21	1000	9000	-429	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
22	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
23	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
24	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
25	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
26	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
27	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
28	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
29	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
30	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
31	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
32	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
33	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
34	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
35	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
36	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
37	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
38	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
39	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
40	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
41	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
42	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
43	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
44	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
45	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
46	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
47	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
48	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
49	1000	3300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
50	1000	4400	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
51	1000	4400	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
52	1000	4400	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0



Steady State Data
Branch Information

Branch	Length	Soil Res	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	P1 - D	P1 - A	P2 - D	P2 - A	P3 - D	P3 - A
53	1000	4400	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
54	1000	4400	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
55	1000	4400	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
56	1000	4400	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
57	1000	4400	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
58	1000	4400	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
59	1000	4400	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
60	1000	4400	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
61	1000	4400	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
62	1000	4400	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
63	1000	4400	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
64	1000	4400	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
65	1000	3100	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
66	1000	3100	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
67	1000	3100	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
68	1000	3100	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
69	1000	3100	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
70	1000	3100	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
71	1000	3100	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
72	1000	3100	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
73	1000	3100	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
74	1000	3100	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0
75	1000	3100	-95559	0	9559	0	9559	0	9559	0	9559	0	0	0	0	0	0	0



**Faulted Tower Data
Mitigation & Bond Info**

Sec./Node	P1-NodeR	P1-NodeDR	P1-ParWire	P241-Bond	P2-NodeR	P2-NodeDR	P2-ParWire	P242-Bond	P3-NodeR	P3-NodeDR	P3-ParWire	P243-Bond
1												
2												
3												
4												
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52												



Steady State Data
Mitigation & Bond Info

Sec/Node	P1-NodeR	F1-AnodeDR	P1-ParWire	P1-Bonded	P2-NodeR	F2-AnodeDR	F2-ParWire	P2-Bonded	F1-NodeR	F1-AnodeDR	F3-ParWire	P3-Bonded
53												
54												
55												
56												
57												
58												
59												
60												
61												
62												
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72												
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74												
75												
76												

APPENDIX D FEEDER 7167 FAULT CONDITIONS NO MITIGATION



**Faulted Tower Data
Comments**

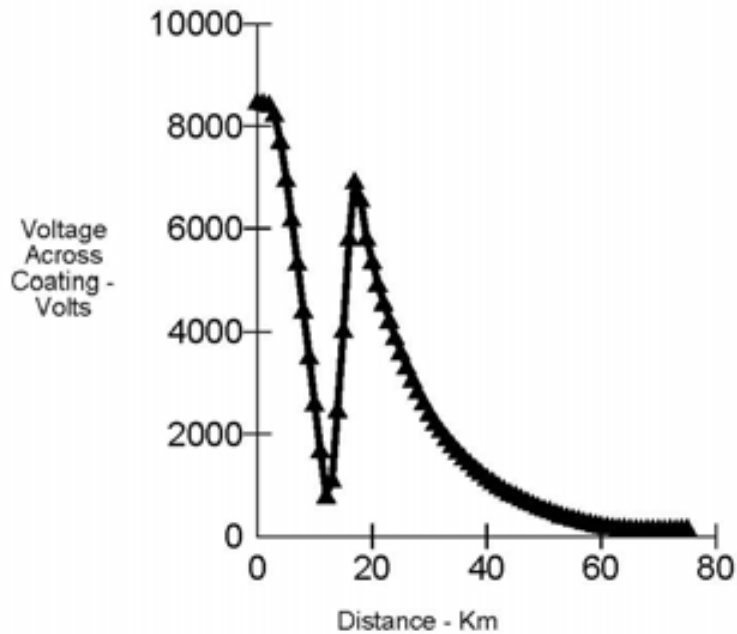
Comments

CQGP
KP 320 - 393
Fault Conditions T5 (Feeder 7167) Node 17
No Mitigation

Brian Martin & Associates
9 February 2007



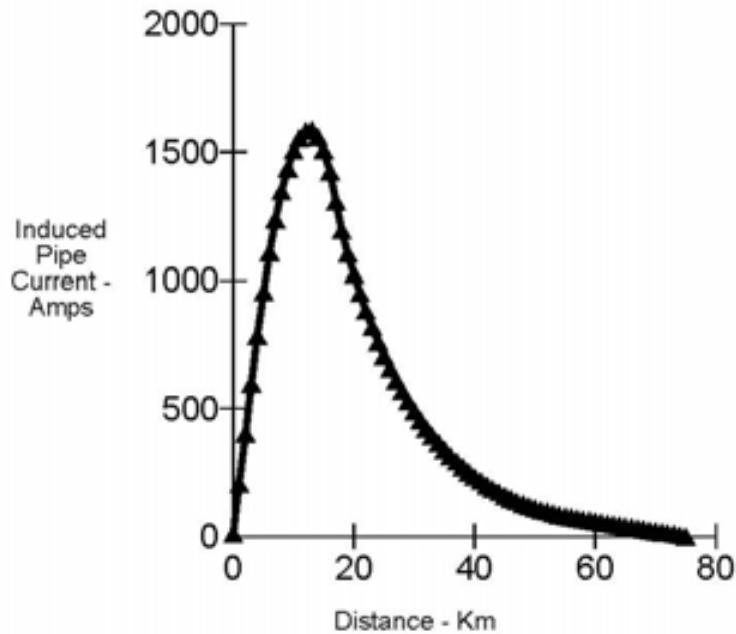
Fault Voltage Graph and Data



Pipe #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		



Fault Current Graph and Data



Pipe #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		



Faulted Tower Data
T-Line Information

T-Line

Shield Wire #1	9999	9999	9999	9999	
Shield Wire #2	-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	<u>Total Current</u> 7000
Elec. Sys Parameters	<u>Avg Twr Sep. - m</u> 400	<u>Avg Twr Res - ohms</u> 10	<u>Faulted Twr Location</u> 18		
Arc Distance (m)	3.5				



Faulted Tower Data
Pipe Information

Pipe #1

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



Faulted Tower Data
Section Information

Section	Length	Soil Res	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	P1 - D	P1 - A	P2 - D	P2 - A	P3 - D	P3 - A
1	3500	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
2	3500	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
3	3500	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
4	3500	12000	-267	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
5	3500	12000	84	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
6	3500	12000	368	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
7	3500	94000	185	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
8	3500	94000	201	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
9	3500	43000	170	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
10	3500	43000	136	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
11	3500	19000	101	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
12	3500	19000	75	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
13	3500	19000	21	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
14	3500	48000	20	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
15	3500	48000	20	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
16	3500	77000	20	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
17	3500	77000	20	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
18	3500	35000	-216	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
19	3500	16000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
20	3500	16000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
21	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
22	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
23	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
24	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
25	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
26	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
27	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
28	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
29	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
30	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
31	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
32	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
33	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
34	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
35	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
36	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
37	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
38	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
39	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
40	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
41	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
42	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
43	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
44	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
45	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
46	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
47	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
48	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
49	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
50	3500	4400	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
51	3500	4400	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
52	3500	4400	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0



Steady State Data
Branch Information

Branch	Length	Soil Res	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	P1 - D	P1 - A	P2 - D	P2 - A	P3 - D	P3 - A
53	1000	4400	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
54	1000	4400	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
55	1000	4400	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
56	1000	4400	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
57	1000	4400	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
58	1000	4400	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
59	1000	4400	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
60	1000	4400	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
61	1000	4400	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
62	1000	4400	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
63	1000	4400	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
64	1000	4400	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
65	1000	3100	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
66	1000	3100	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
67	1000	3100	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
68	1000	3100	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
69	1000	3100	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
70	1000	3100	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
71	1000	3100	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
72	1000	3100	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
73	1000	3100	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
74	1000	3100	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0
75	1000	3100	-955555	0	95555	0	95555	0	95555	0	95555	0	0	0	0	0	0	0



**Faulted Tower Data
Mitigation & Bond Info**

Sec/Node	P1-Node	P1-Anode	F1-ParWire	F2a1-Bond	F2-Node	F2-Anode	F2-ParWire	F2a2-Bond	F3-Node	F3-Anode	F3-ParWire	F3a1-Bond
1			X									
2			X									
3			X									
4			X									
5			X									
6			X									
7			X									
8			X									
9			X									
10			X									
11			X									
12			X									
13			X									
14			X									
15			X									
16			X									
17			X									
18			X									
19			X									
20			X									
21			X									
22			X									
23			X									
24			X									
25			X									
26			X									
27			X									
28			X									
29			X									
30			X									
31			X									
32			X									
33			X									
34			X									
35			X									
36			X									
37			X									
38			X									
39			X									
40			X									
41			X									
42			X									
43			X									
44			X									
45			X									
46			X									
47			X									
48			X									
49			X									
50			X									
51			X									
52			X									



Steady State Data
Mitigation & Bond Info

Sec/Node	P1-NodeR	P1-NodeDR	P1-ParWire	P1-Bonded	P2-NodeR	P2-NodeDR	P2-ParWire	P2-Bonded	P3-NodeR	P3-NodeDR	P3-ParWire	P3-Bonded
53												
54												
55												
56												
57												
58												
59												
60												
61												
62												
63												
64												
65												
66												
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76												

APPENDIX E

OPERATING CONDITIONS WITH MITIGATION



Steady State Data
Comments

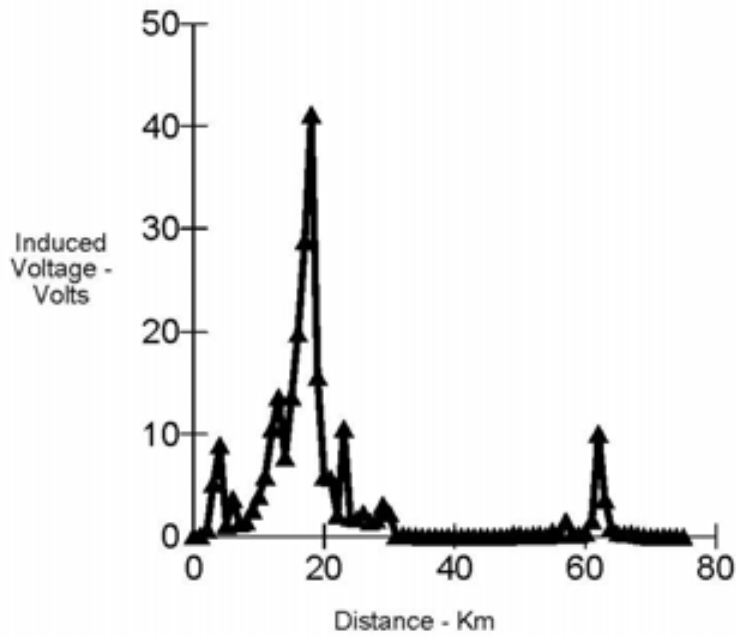
Comments

CQGP
KP 320 - 393
Operating Conditions
Full Zinc Ribbon Mitigation

Brian Martin & Associates
9 February 2007



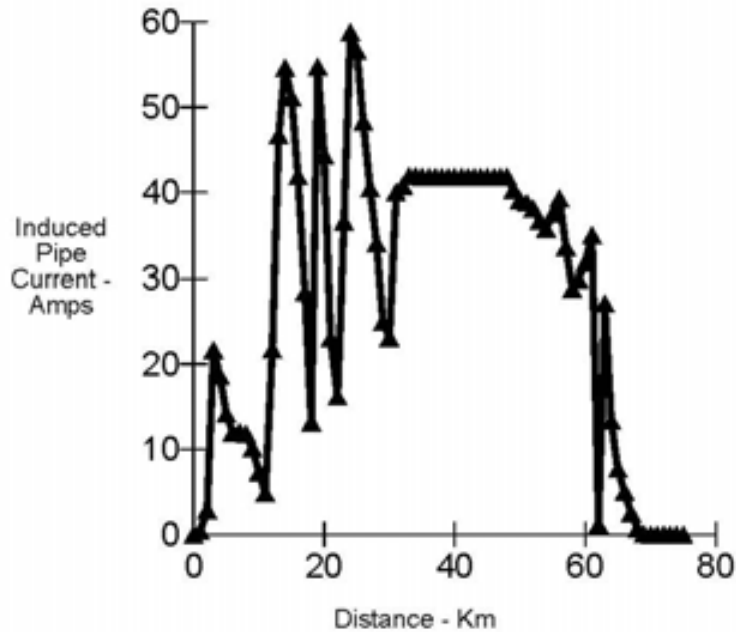
Steady State Voltage
Graph and Data



Pipe #1		Pipe #1 (cont.)		Pipe #1 (cont.)	
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		



Steady State Current
Graph and Data



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



Steady State Data
Pipe Information

Pipe #1

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



Steady State Data
Section Information

Section	Length	Soil Res	L1 - D	L1 - A	L2 - D	L2 - A	L3 - B	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	PL - B	PL - A	P2 - D	P2 - A	P3 - D	P3 - A
1	1000	4000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
2	1000	4000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
3	1000	4000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
4	1000	12000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
5	1000	12000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
6	1000	12000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
7	1000	84000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
8	1000	84000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
9	1000	43000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
10	1000	43000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
11	1000	19000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
12	1000	19000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
13	1000	19000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
14	1000	48000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
15	1000	48000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
16	1000	77000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
17	1000	77000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
18	1000	35000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
19	1000	16000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
20	1000	16000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
21	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
22	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
23	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
24	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
25	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
26	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
27	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
28	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
29	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
30	1000	9000	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
31	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
32	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
33	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
34	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
35	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
36	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
37	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
38	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
39	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
40	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
41	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
42	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
43	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
44	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
45	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
46	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
47	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
48	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
49	1000	1300	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
50	1000	4400	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
51	1000	4400	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0
52	1000	4400	99999	0	99999	0	99999	0	99999	0	99999	0	0	0	0	0	0	0



Steady State Data
Branch Information

Branch	Length	Soil	Base	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	F1 - D	F1 - A	F2 - D	F2 - A	F3 - D	F3 - A	
53	1000	4400	-30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	1000	4400	-33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	1000	4400	-34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	1000	4400	-34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	1000	4400	-23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	1000	4400	-51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	1000	4400	-46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	1000	4400	-45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	1000	4400	-42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	1000	4400	-26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	1000	4400	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	1000	4400	123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	1000	3100	184	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	1000	3100	275	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	1000	3100	412	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	1000	3100	771	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	1000	3100	9999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	1000	3100	9999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	1000	3100	9999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	1000	3100	9999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	1000	3100	9999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	1000	3100	9999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	1000	3100	9999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



Steady State Data
Mitigation & Bond Info

Sec/Node	P1-Node	P1-Anode	P1-ParWire	P241-Bond	P2-Node	P2-Anode	P2-ParWire	P1&2-Bond	P1-Node	P1-Anode	P1-ParWire	P1&3-Bond
1				X								
2				X								
3				X								
4				X								
5				X								
6				X								
7				X								
8				X								
9				X								
10				X								
11				X								
12				X								
13				X								
14				X								
15				X								
16				X								
17				X								
18				X								
19				X								
20				X								
21				X								
22				X								
23				X								
24				X								
25				X								
26				X								
27				X								
28				X								
29				X								
30				X								
31				X								
32				X								
33				X								
34				X								
35				X								
36				X								
37				X								
38				X								
39				X								
40				X								
41				X								
42				X								
43				X								
44				X								
45				X								
46				X								
47				X								
48				X								
49				X								
50				X								
51				X								
52				X								



Steady State Data
Mitigation & Bond Info

Sec/Node	P1-Node	P1-Anode	P1-ParWire	P1-Bonded	P2-Node	P2-Anode	P2-ParWire	P2-Bonded	P3-Node	P3-Anode	P3-ParWire	P3-Bonded
53			X									
54			X									
55			X									
56			X									
57			X									
58			X									
59			X									
60			X									
61			X									
62			X									
63			X									
64			X									
65			X									
66			X									
67			X									
68			X									
69			X									
70			X									
71			X									
72			X									
73			X									
74			X									
75			X									
76			X									

APPENDIX F FEEDER 848 FAULT CONDITIONS WITH MITIGATION



**Faulted Tower Data
Comments**

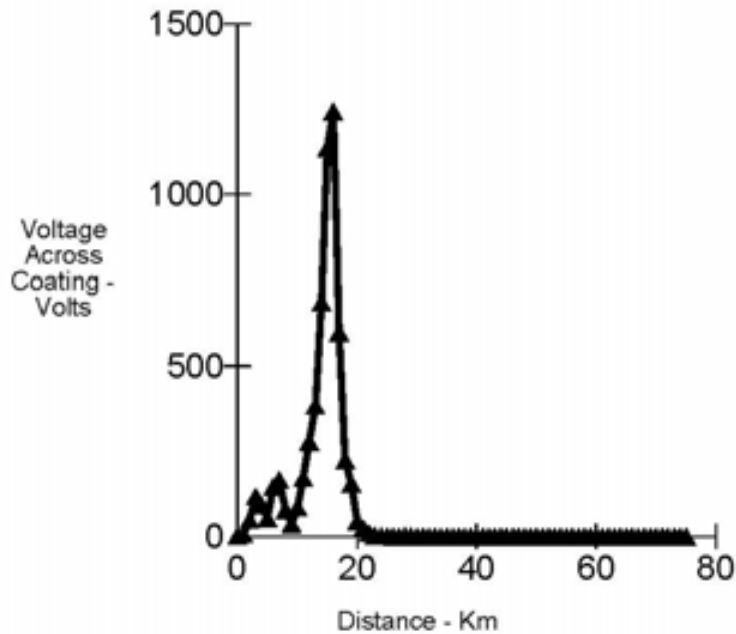
Comments

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

Brian Martin & Associates
9 February 2007



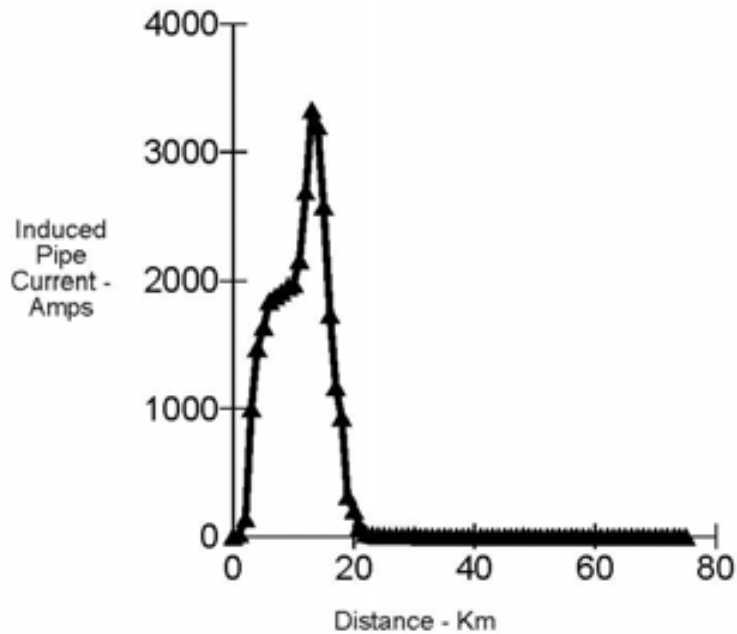
Fault Voltage Graph and Data



Pipe #1		Pipe #1 (cont.)		Pipe #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		



Fault Current Graph and Data



Pipe #1		Pipe #1 (cont.)		Pipe #1 (cont.)	
Distance	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		



Faulted Tower Data
T-Line Information

T-Line

Shield Wire #1	-5.9	18.5	0.189	0.0008	
Shield Wire #2	5.9	18.5	1.47	0.0008	
Phase Wire	<u>D - m</u> -7.1	<u>H - m</u> 12.5	<u>IL - A</u> 15500	<u>IR - A</u> 0	<u>Total Current</u> 15500
Elec. Sys Parameters	<u>Avg Twr Sep. - m</u> 300	<u>Avg Twr Res - ohms</u> 10	<u>Faulted Twr Location</u> 18		
Arc Distance (m)	5.5				



Faulted Tower Data
Pipe Information

Pipe #1

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



Faulted Tower Data
Section Information

Section	Length	Soil Res	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	P1 - D	P1 - A	P2 - D	P2 - A	P3 - D	P3 - A	
1	1000	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
2	1000	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
3	1000	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
4	1000	12000	-216	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
5	1000	12000	182	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
6	1000	12000	390	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
7	1000	84000	279	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
8	1000	84000	260	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
9	1000	43000	227	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
10	1000	43000	197	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
11	1000	19000	169	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
12	1000	19000	137	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
13	1000	19000	97	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
14	1000	48000	65	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
15	1000	48000	35	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
16	1000	77000	71	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
17	1000	77000	71	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
18	1000	35000	74	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
19	1000	16000	-54	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
20	1000	16000	-296	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
21	1000	9000	-401	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
22	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
23	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
24	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
25	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
26	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
27	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
28	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
29	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
30	1000	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
31	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
32	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
33	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
34	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
35	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
36	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
37	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
38	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
39	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
40	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
41	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
42	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
43	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
44	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
45	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
46	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
47	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
48	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
49	1000	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
50	1000	4400	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
51	1000	4400	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
52	1000	4400	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0



Steady State Data
Branch Information

Branch	Length	Boil	Res	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	P1 - D	P1 - A	P2 - D	P2 - A	P3 - D	P3 - A
53	1000	4400	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
54	1000	4400	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
55	1000	4400	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
56	1000	4400	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
57	1000	4400	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
58	1000	4400	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
59	1000	4400	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
60	1000	4400	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
61	1000	4400	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
62	1000	4400	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
63	1000	4400	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
64	1000	4400	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
65	1000	3100	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
66	1000	3100	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
67	1000	3100	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
68	1000	3100	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
69	1000	3100	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
70	1000	3100	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
71	1000	3100	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
72	1000	3100	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
73	1000	3100	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
74	1000	3100	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999
75	1000	3100	-55593	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999	0	9999



**Faulted Tower Data
Mitigation & Bond Info**

Sec/Node	P1-NodeR	P1-AnodeDR	P1-ParWire	P2+1-Bond	P2-NodeR	P2-AnodeDR	P2-ParWire	P1+2-Bond	P1-NodeR	P1-AnodeDR	P1-ParWire	P1+3-Bond
1			X									
2			X									
3			X									
4			X									
5			X									
6			X									
7			X									
8			X									
9			X									
10			X									
11			X									
12			X									
13			X									
14			X									
15			X									
16			X									
17			X									
18			X									
19			X									
20			X									
21			X									
22			X									
23			X									
24			X									
25			X									
26			X									
27			X									
28			X									
29			X									
30			X									
31			X									
32			X									
33			X									
34			X									
35			X									
36			X									
37			X									
38			X									
39			X									
40			X									
41			X									
42			X									
43			X									
44			X									
45			X									
46			X									
47			X									
48			X									
49			X									
50			X									
51			X									
52			X									



Steady State Data
Mitigation & Bond Info

Seq/Node	P1-Node	P1-NodeDR	P1-ParWire	P1-Bonded	P2-Node	P2-NodeDR	P2-ParWire	P2-Bonded	P3-Node	P3-NodeDR	P3-ParWire	P3-Bonded
53			X									
54			X									
55			X									
56			X									
57			X									
58			X									
59			X									
60			X									
61			X									
62			X									
63			X									
64			X									
65			X									
66			X									
67			X									
68			X									
69			X									
70			X									
71			X									
72			X									
73			X									
74			X									
75			X									
76			X									

APPENDIX G FEEDER 849 FAULT CONDITIONS WITH MITIGATION



**Faulted Tower Data
Comments**

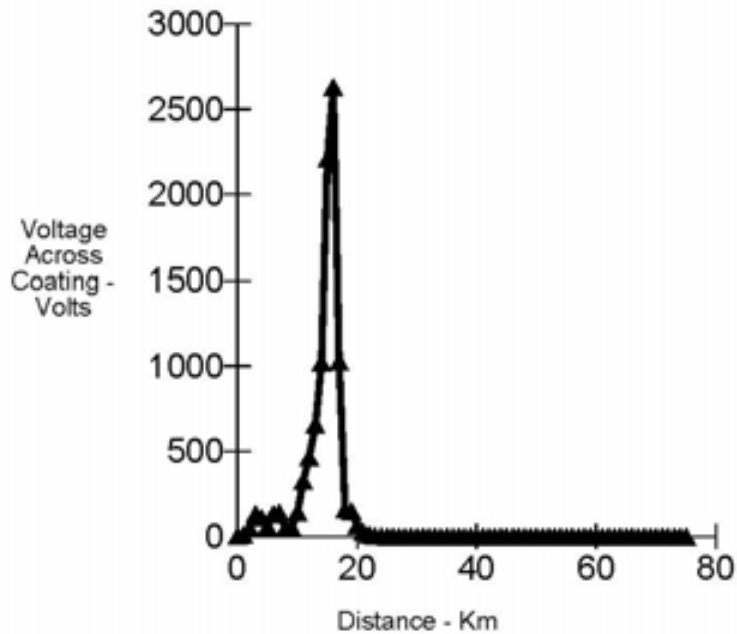
Comments

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

Brian Martin & Associates
9 February 2007



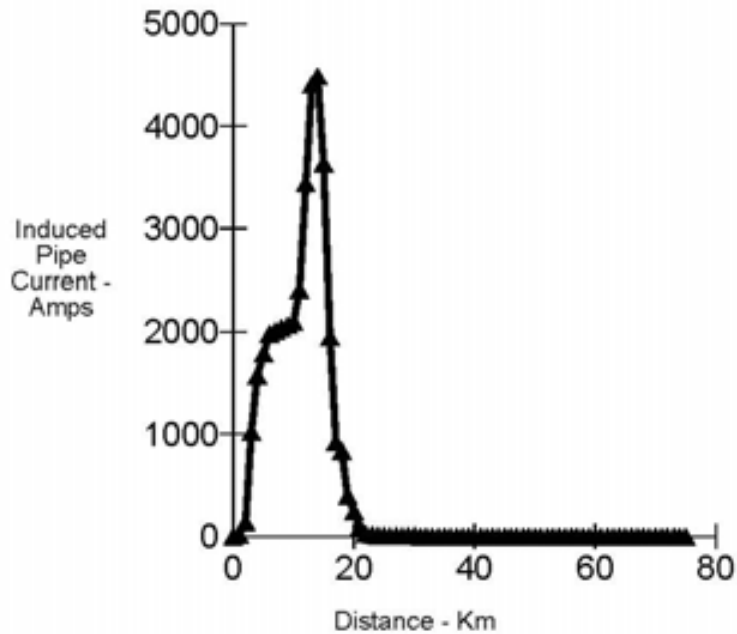
Fault Voltage Graph and Data



Pipe #1		Pipe #1 (cont.)		Pipe #1 (cont.)	
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
6.00	130.3	33.00	0.0	60.00	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
9.00	49.4	36.00	0.0	63.00	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
12.00	464.1	39.00	0.0	66.00	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
15.00	2206.4	42.00	0.0	69.00	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
18.00	160.8	45.00	0.0	72.00	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
21.00	27.5	48.00	0.0	75.00	0.0
22.00	10.7	49.00	0.0		
23.00	2.6	50.00	0.0		
24.00	1.0	51.00	0.0		
25.00	0.4	52.00	0.0		
26.00	0.2	53.00	0.0		



Fault Current Graph and Data



Pipe #1		Pipe #1 (cont.)		Pipe #1 (cont.)	
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		



**Faulted Tower Data
T-Line Information**

T-Line

Shield Wire #1	-5.9	18.5	0.189	0.0008	
Shield Wire #2	5.9	18.5	1.47	0.0008	
Phase Wire	<u>D - m</u> -7.1	<u>H - m</u> 12.5	<u>IL - A</u> 15500	<u>IR - A</u> 0	<u>Total Current</u> 15500
Elec. Sys Parameters	<u>Avg Twr Sep. - m</u> 300	<u>Avg Twr Res - ohms</u> 10	<u>Faulted Twr Location</u> 18		
Arc Distance (m)	5.5				



Faulted Tower Data
Pipe Information

Pipe #1

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



Faulted Tower Data
Section Information

Section	Length	Soil Res	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	P1 - D	P1 - A	P2 - D	P2 - A	P3 - D	P3 - A	
1	1000	4000	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
2	1000	4000	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
3	1000	4000	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
4	1000	12000	-239	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
5	1000	32000	126	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
6	1000	32000	355	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
7	1000	64000	213	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
8	1000	64000	228	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
9	1000	43000	159	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
10	1000	43000	148	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
11	1000	29000	130	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
12	1000	29000	160	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
13	1000	29000	56	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
14	1000	48000	27	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
15	1000	48000	25	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
16	1000	77000	31	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
17	1000	77000	31	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
18	1000	35000	34	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
19	1000	36000	-69	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
20	1000	36000	-134	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
21	1000	9000	-429	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
22	1000	9000	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
23	1000	9000	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
24	1000	9000	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
25	1000	9000	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
26	1000	9000	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
27	1000	9000	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
28	1000	9000	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
29	1000	9000	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
30	1000	9000	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
31	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
32	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
33	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
34	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
35	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
36	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
37	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
38	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
39	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
40	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
41	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
42	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
43	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
44	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
45	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
46	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
47	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
48	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
49	1000	1300	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
50	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
51	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0
52	1000	4400	-9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0	0



Steady State Data
Branch Information

Branch	Length	Soil Res	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	P1 - D	P1 - A	P2 - D	P2 - A	P3 - D	P3 - A	
53	1000	4400	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
54	1000	4400	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
55	1000	4400	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
56	1000	4400	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
57	1000	4400	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
58	1000	4400	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
59	1000	4400	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
60	1000	4400	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
61	1000	4400	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
62	1000	4400	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
63	1000	4400	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
64	1000	4400	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
65	1000	3100	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
66	1000	3100	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
67	1000	3100	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
68	1000	3100	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
69	1000	3100	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
70	1000	3100	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
71	1000	3100	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
72	1000	3100	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
73	1000	3100	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
74	1000	3100	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0
75	1000	3100	-95999	0	9599	0	9599	0	9599	0	9599	0	0	0	0	0	0	0	0



**Faulted Tower Data
Mitigation & Bond Info**

Sec/Node	P1-NodeR	P1-NodeDR	P1-ParWire	F2a1-Bond	F2-NodeR	P2-NodeDR	F2-ParWire	F2a2-Bond	P3-NodeR	P3-NodeDR	F3-ParWire	F3a3-Bond
1			X									
2			X									
3			X									
4			X									
5			X									
6			X									
7			X									
8			X									
9			X									
10			X									
11			X									
12			X									
13			X									
14			X									
15			X									
16			X									
17			X									
18			X									
19			X									
20			X									
21			X									
22			X									
23			X									
24			X									
25			X									
26			X									
27			X									
28			X									
29			X									
30			X									
31			X									
32			X									
33			X									
34			X									
35			X									
36			X									
37			X									
38			X									
39			X									
40			X									
41			X									
42			X									
43			X									
44			X									
45			X									
46			X									
47			X									
48			X									
49			X									
50			X									
51			X									
52			X									



Steady State Data
Mitigation & Bond Info

Bac/Node	F1-Node	F1-Anode	F1-ParMile	F1-Bonded	F2-Node	F2-Anode	F2-ParMile	F2-Bonded	F3-Node	F3-Anode	F3-ParMile	F3-Bonded
53			X									
54			X									
55			X									
56			X									
57			X									
58			X									
59			X									
60			X									
61			X									
62			X									
63			X									
64			X									
65			X									
66			X									
67			X									
68			X									
69			X									
70			X									
71			X									
72			X									
73			X									
74			X									
75			X									
76			X									

APPENDIX H FEEDER 7167 FAULT CONDITIONS WITH MITIGATION



**Faulted Tower Data
Comments**

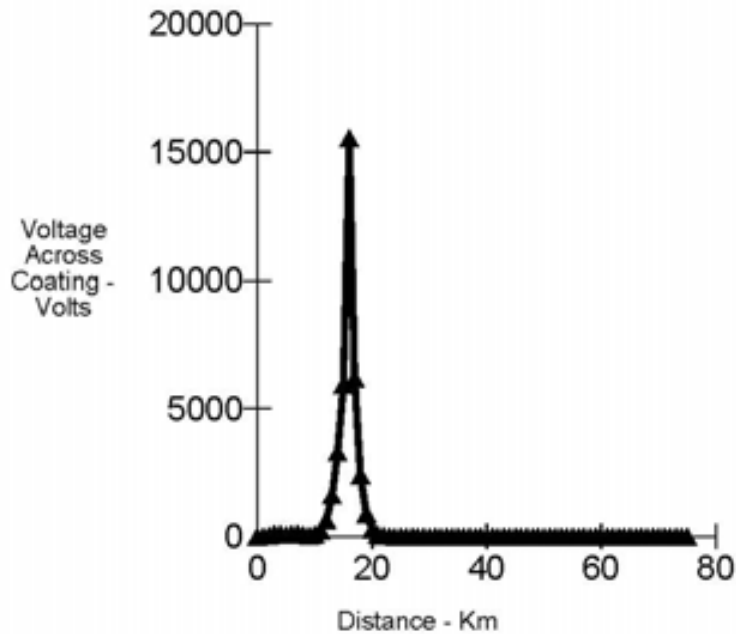
Comments

CQGP
KP 320 - 393
Fault Conditions T5 (Feeder 7167) Node 17
Full Zinc Ribbon Mitigation

Brian Martin & Associates
9 February 2007



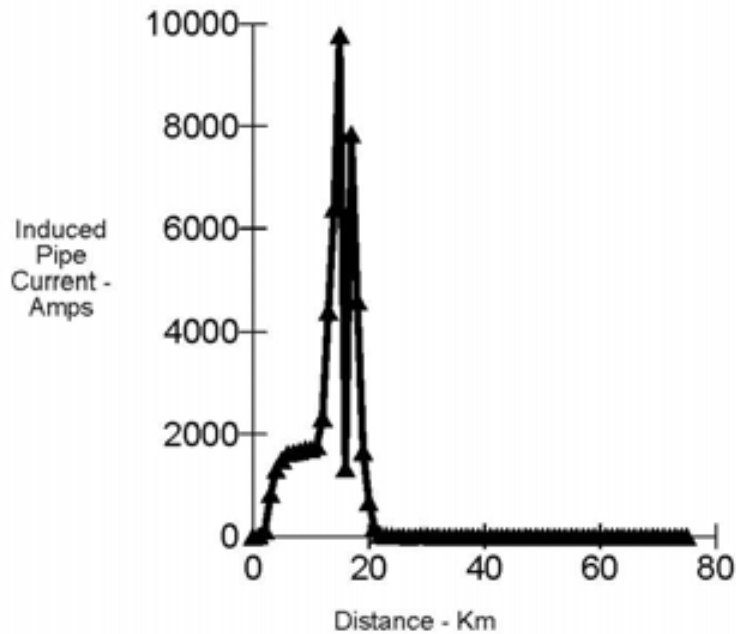
Fault Voltage Graph and Data



Pipe #1		Pipe #1 (cont.)		Pipe #1 (cont.)	
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
7.00	118.9	34.00	0.0	61.00	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
10.00	69.0	37.00	0.0	64.00	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
13.00	1599.1	40.00	0.0	67.00	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
16.00	15520.0	43.00	0.0	70.00	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
19.00	876.9	46.00	0.0	73.00	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
22.00	18.4	49.00	0.0		
23.00	4.5	50.00	0.0		
24.00	1.1	51.00	0.0		
25.00	0.4	52.00	0.0		
26.00	0.2	53.00	0.0		



Fault Current Graph and Data



Pipe #1		Pipe #1 (cont.)		Pipe #1 (cont.)	
Distance	Current	Distance	Current	Distance	Current
0.00	0.0	27.00	1.2	54.00	0.1
1.00	15.0	28.00	2.1	55.00	0.1
2.00	112.7	29.00	5.5	56.00	0.1
3.00	818.4	30.00	7.0	57.00	0.0
4.00	1298.0	31.00	0.2	58.00	0.0
5.00	1486.8	32.00	0.1	59.00	0.0
6.00	1614.7	33.00	0.1	60.00	0.0
7.00	1637.0	34.00	0.1	61.00	0.0
8.00	1664.3	35.00	0.1	62.00	0.1
9.00	1702.1	36.00	0.1	63.00	0.3
10.00	1713.2	37.00	0.1	64.00	0.3
11.00	1770.4	38.00	0.1	65.00	0.0
12.00	2309.0	39.00	0.0	66.00	0.0
13.00	4400.0	40.00	0.0	67.00	0.0
14.00	6396.1	41.00	0.0	68.00	0.0
15.00	9785.2	42.00	0.0	69.00	0.0
16.00	1327.3	43.00	0.0	70.00	0.0
17.00	7835.7	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		



Faulted Tower Data
T-Line Information

T-Line

Shield Wire #1	9999	9999	9999	9999	
Shield Wire #2	-9999	9999	9999	9999	9999
Phase Wire	<u>D - m</u>	<u>H - m</u>	<u>IL - A</u>	<u>IR - A</u>	<u>Total Current</u>
	-2.5	11.5	7000	0	7000
Elec. Sys Parameters	<u>Avg Twr Sep. - m</u>	<u>Avg Twr Res - ohms</u>	<u>Faulted Twr Location</u>		
	400	10	17		
Arc Distance (m)	5.5				



Faulted Tower Data
Pipe Information

Pipe #1

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



Faulted Tower Data
Section Information

Section	Length	Soil Res	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	P1 - D	P1 - A	P2 - D	P2 - A	P3 - D	P3 - A
1	3500	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
2	3500	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
3	3500	4000	99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
4	3500	12000	-267	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
5	3500	12000	84	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
6	3500	12000	368	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
7	3500	84000	185	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
8	3500	94000	201	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
9	3500	43000	170	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
10	3500	43000	136	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
11	3500	19000	101	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
12	3500	19000	75	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
13	3500	19000	21	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
14	3500	48000	20	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
15	3500	48000	20	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
16	3500	77000	20	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
17	3500	77000	20	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
18	3500	35000	-216	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
19	3500	16000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
20	3500	16000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
21	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
22	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
23	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
24	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
25	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
26	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
27	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
28	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
29	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
30	3500	9000	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
31	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
32	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
33	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
34	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
35	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
36	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
37	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
38	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
39	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
40	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
41	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
42	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
43	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
44	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
45	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
46	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
47	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
48	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
49	3500	1300	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
50	3500	4400	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
51	3500	4400	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0
52	3500	4400	-99999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0	0



Steady State Data
Branch Information

Branch	Length	Boil	Res	L1 - D	L1 - A	L2 - D	L2 - A	L3 - D	L3 - A	L4 - D	L4 - A	L5 - D	L5 - A	P1 - D	P1 - A	P2 - D	P2 - A	P3 - D	P3 - A
53	1000	4400	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
54	1000	4400	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
55	1000	4400	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
56	1000	4400	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
57	1000	4400	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
58	1000	4400	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
59	1000	4400	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
60	1000	4400	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
61	1000	4400	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
62	1000	4400	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
63	1000	4400	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
64	1000	4400	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
65	1000	3100	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
66	1000	3100	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
67	1000	3100	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
68	1000	3100	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
69	1000	3100	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
70	1000	3100	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
71	1000	3100	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
72	1000	3100	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
73	1000	3100	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
74	1000	3100	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0
75	1000	3100	-55999	0	9999	0	9999	0	9999	0	9999	0	9999	0	0	0	0	0	0



**Faulted Tower Data
Mitigation & Bond Info**

Sec/Node	P1-Node	P1-Anode	P1-ParWire	P2a3-Bond	P2-Node	P2-Anode	P2-ParWire	P1a2-Bond	P3-Node	P3-Anode	P3-ParWire	P1a3-Bond
1			X									
2			X									
3			X									
4			X									
5			X									
6			X									
7			X									
8			X									
9			X									
10			X									
11			X									
12			X									
13			X									
14			X									
15			X									
16			X									
17			X									
18			X									
19			X									
20			X									
21			X									
22			X									
23			X									
24			X									
25			X									
26			X									
27			X									
28			X									
29			X									
30			X									
31			X									
32			X									
33			X									
34			X									
35			X									
36			X									
37			X									
38			X									
39			X									
40			X									
41			X									
42			X									
43			X									
44			X									
45			X									
46			X									
47			X									
48			X									
49			X									
50			X									
51			X									
52			X									



Steady State Data
Mitigation & Bond Info

Sec/Node	P1-NodeR	P1-AnodeDR	P1-ParWire	F1-Bonded	P1-NodeR	P1-AnodeDR	P1-ParWire	F1-Bonded	P1-NodeR	P1-AnodeDR	P1-ParWire	F1-Bonded
53			X									
54			X									
55			X									
56			X									
57			X									
58			X									
59			X									
60			X									
61			X									
62			X									
63			X									
64			X									
65			X									
66			X									
67			X									
68			X									
69			X									
70			X									
71			X									
72			X									
73			X									
74			X									
75			X									
76			X									