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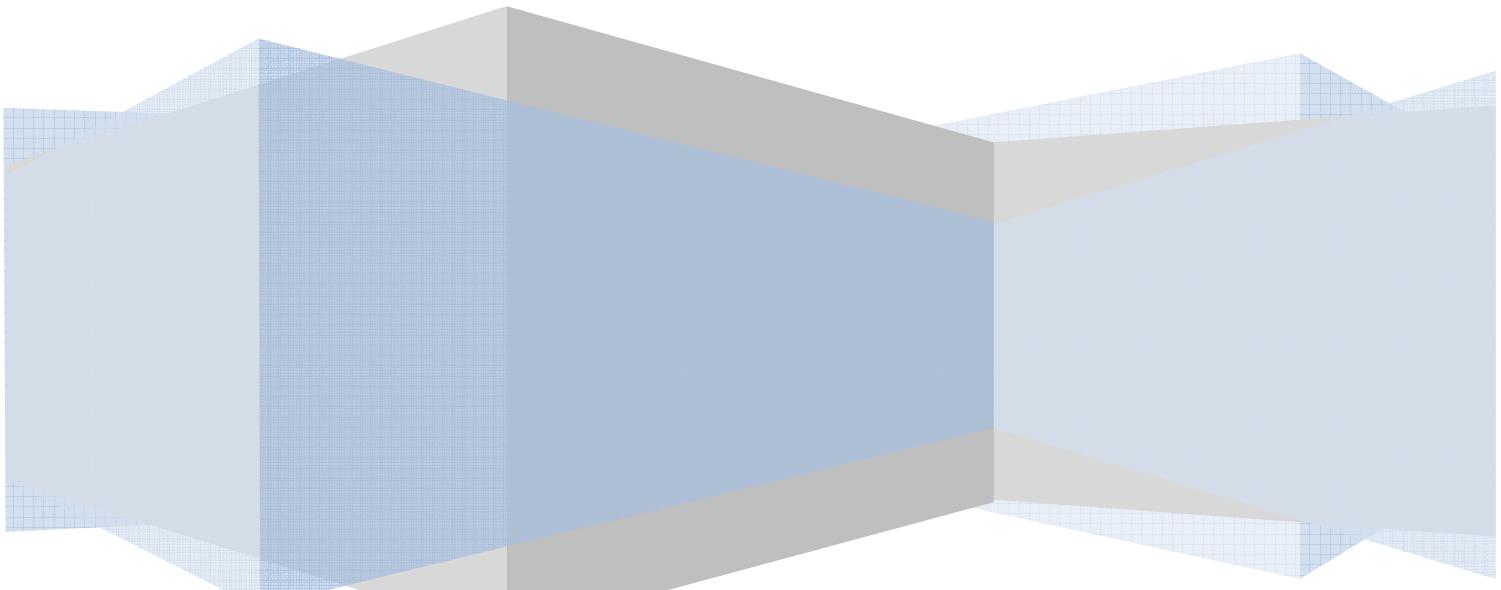
POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR QUEENSLAND URBAN UTILITIES - GIBSON ISLAND SEWAGE TREATMENT PLANT

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

1 SUMMARY OF GIBSON ISLAND STP – MAJOR PROTECTION DEVICES SETTINGS

This section of the report is an extract summary of major protection device settings obtained by Computer Aided Plotting for Time Overcurrent Reporting (CAPTOR) engineering software program used to carry out the Power System Analysis of Gibson Island STP as per details provided in Sections 2 and onward in this document.

This summary section has been provided for easy reference for each device setting (rather than looking for it in the entire document). At the end of this section guidance figures are also provided to assist in identifying location of each protection device (ie. where it belongs on the existing power distribution system).

Project Name: QUU Gibson Island STP-Protection Coordination Study
Date: 05 May 2012
Summary of protection device settings

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AND APPLICATION BY A REGISTERED ENGINEER ONLY.
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CAPTOR (Computer Aided Plotting for Time Overcurrent Reporting)
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Device Name:	1- MCGG (EF)	TCC Name:	tcc33.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	1695.1A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	0.2	(20A)	Test Points: @2.0X, 4.000s
2) [E] Extremely Invers	0.15		@5.0X, 0.500s
3) INST	15	(300A)	@10.0X, 0.121s

Device Name:	1- MCGG (O/C)	TCC Name:	RAS MCC - tcc30.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	1	(100A)	Test Points: @2.0X, 6.000s
2) [E] Extremely Invers	0.225		@5.0X, 0.750s
3) INST	13	(1300A)	@10.0X, 0.182s

Device Name:	2- MCGG (EF)	TCC Name:	tcc40.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	0.2	(20A)	Test Points: @2.0X, 17.333s
2) [E] Extremely Invers	0.65		@5.0X, 2.167s
3) INST	15	(300A)	@10.0X, 0.525s

Device Name:	2- MCGG (O/C)	TCC Name:	tcc25.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		

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Description:	50/51		
Type:	MCGG 22-82		Class Desc: MCGG 22
AIC Rating:	N/A		Fault Duty: 8420.6A
Current Rating:	100A / 5A		Curve Multiplier: 1
Time Multiplier:	1		Time Adder: 0
Setting: 1) Tap, Is	1	(100A)	Test Points: @2.0X, 10.667s
2) [E] Extremely Invers	0.4		@5.0X, 1.333s
3) INST	10	(1000A)	@10.0X, 0.323s

Device Name:	2-CDG11 (N)		TCC Name:	
Bus Name:	BUS 2		Bus Voltage:	11000.0V
Function Name:	Phase			
Manufacturer:	GEC			
Description:	50N/51N			
Type:	CDG 11, 1.3 sec, SI, In = 5A		Class Desc:	CDG61
AIC Rating:	N/A		Fault Duty:	8420.6A
Current Rating:	5A / 5A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) PS		2.00 A	(2A)	Test Points: @2.0X, 0.000s
2) TMS		0.15		@5.0X, 0.000s
3) INST				@10.0X, 0.000s

Device Name:	4- MCGG (EF)		TCC Name:	tcc46.tcc
Bus Name:	BUS 2		Bus Voltage:	11000.0V
Function Name:	Phase			
Manufacturer:	GEC			
Description:	50/51			
Type:	MCGG 22-82		Class Desc:	MCGG 22
AIC Rating:	N/A		Fault Duty:	1695.1A
Current Rating:	100A / 5A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) Tap, Is		0.2	(20A)	Test Points: @2.0X, 10.667s
2) [E] Extremely Invers		0.4		@5.0X, 1.333s
3) INST		15	(300A)	@10.0X, 0.323s

Device Name:	4- MCGG (O/C)		TCC Name:	tcc45.tcc
Bus Name:	BUS 2		Bus Voltage:	11000.0V
Function Name:	Phase			
Manufacturer:	GEC			
Description:	50/51			
Type:	MCGG 22-82		Class Desc:	MCGG 22
AIC Rating:	N/A		Fault Duty:	8420.6A
Current Rating:	100A / 5A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) Tap, Is		1	(100A)	Test Points: @2.0X, 5.333s
2) [E] Extremely Invers		0.2		@5.0X, 0.667s
3) INST		11	(1100A)	@10.0X, 0.162s

Device Name:	4-CDG11 (N)		TCC Name:	
Bus Name:	BUS 2		Bus Voltage:	11000.0V
Function Name:	Phase			
Manufacturer:	GEC			
Description:	50N/51N			
Type:	CDG 11, 1.3 sec, SI, In = 5A		Class Desc:	CDG61
AIC Rating:	N/A		Fault Duty:	8420.6A
Current Rating:	5A / 5A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) PS		2.00 A	(2A)	Test Points: @2.0X, 0.260s
2) TMS		0.15		@5.0X, 0.161s
3) INST				@10.0X, 0.130s

Device Name:	5- MCGG (EF)		TCC Name:	11kV MAIN SWBD EF tcc51.tcc
Bus Name:	BUS 2		Bus Voltage:	11000.0V
Function Name:	Phase			
Manufacturer:	GEC			
Description:	50/51			
Type:	MCGG 22-82		Class Desc:	MCGG 22
AIC Rating:	N/A		Fault Duty:	1695.1A
Current Rating:	100A / 5A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) Tap, Is		0.2	(20A)	Test Points: @2.0X, 17.333s

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2) [E] Extremely Invers	0.4		@5.0X, 2.167s
3) INST	15	(300A)	@10.0X, 0.525s

Device Name:	5- MCGG (O/C)	TCC Name:	11kV MAIN SWITCHBOARD tcc50.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	1	(100A)	Test Points: @2.0X, 10.667s
2) [E] Extremely Invers	0.4		@5.0X, 1.333s
3) INST	10	(1000A)	@10.0X, 0.323s

Device Name:	5-CDG11 (N)	TCC Name:	
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50N/51N		
Type:	CDG 11, 1.3 sec, SI, In = 5A	Class Desc:	CDG61
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	5A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) PS	2.00 A	(2A)	Test Points: @2.0X, 0.000s
2) TMS	0.15		@5.0X, 0.000s
			@10.0X, 0.000s

Device Name:	6- MCGG (EF)	TCC Name:	11kV MAIN SWBD EF tcc51.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	1695.1A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	0.2	(20A)	Test Points: @2.0X, 10.667s
2) [E] Extremely Invers	0.4		@5.0X, 1.333s
3) INST	15	(300A)	@10.0X, 0.323s

Device Name:	6- MCGG (O/C)	TCC Name:	11kV MAIN SWITCHBOARD tcc50.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	1	(100A)	Test Points: @2.0X, 5.333s
2) [E] Extremely Invers	0.2		@5.0X, 0.667s
3) INST	11	(1100A)	@10.0X, 0.162s

Device Name:	6-CDG11 (N)	TCC Name:	
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50N/51N		
Type:	CDG 11, 1.3 sec, SI, In = 5A	Class Desc:	CDG61
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	5A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) PS	2.00 A	(2A)	Test Points: @2.0X, 0.000s
2) TMS	0.15		@5.0X, 0.000s
			@10.0X, 0.000s

Device Name:	7- MCGG (EF)	TCC Name:	11kV MAIN SWBD EF tcc51.tcc
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Bus Name:	BUS 2		Bus Voltage:	11000.0V
Function Name:	Phase			
Manufacturer:	GEC			
Description:	50/51			
Type:	MCGG 22-82		Class Desc:	MCGG 22
AIC Rating:	N/A		Fault Duty:	1695.1A
Current Rating:	100A / 5A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) Tap, Is	0.2	(20A)	Test Points:	@2.0X, 17.333s
2) [E] Extremely Invers	0.4			@5.0X, 2.167s
3) INST	15	(300A)		@10.0X, 0.525s

Device Name:	7- MCGG (O/C)		TCC Name:	11kV MAIN SWITCHBOARD tcc50.tcc
Bus Name:	BUS 2		Bus Voltage:	11000.0V
Function Name:	Phase			
Manufacturer:	GEC			
Description:	50/51			
Type:	MCGG 22-82		Class Desc:	MCGG 22
AIC Rating:	N/A		Fault Duty:	8420.6A
Current Rating:	100A / 5A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) Tap, Is	1	(100A)	Test Points:	@2.0X, 10.667s
2) [E] Extremely Invers	0.4			@5.0X, 1.333s
3) INST	10	(1000A)		@10.0X, 0.323s

Device Name:	7-CDG11 (N)		TCC Name:	
Bus Name:	BUS 2		Bus Voltage:	11000.0V
Function Name:	Phase			
Manufacturer:	GEC			
Description:	50N/51N			
Type:	CDG 11, 1.3 sec, SI, In = 5A		Class Desc:	CDG61
AIC Rating:	N/A		Fault Duty:	8420.6A
Current Rating:	5A / 5A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) PS	2.00 A	(2A)	Test Points:	@2.0X, 0.000s
2) TMS	0.15			@5.0X, 0.000s
				@10.0X, 0.000s

Device Name:	8- MCGG (EF)		TCC Name:	tcc51.tcc
Bus Name:	BUS-0071		Bus Voltage:	11000.0V
Function Name:	Phase			
Manufacturer:	GEC			
Description:	50/51			
Type:	MCGG 22-82		Class Desc:	MCGG 22
AIC Rating:	N/A		Fault Duty:	1703.5A
Current Rating:	200A / 5A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) Tap, Is	0.6	(120A)	Test Points:	@2.0X, 5.333s
2) [E] Extremely Invers	0.2			@5.0X, 0.667s
3) INST	10	(1200A)		@10.0X, 0.162s

Device Name:	8- MCGG (O/C)		TCC Name:	tcc50.tcc
Bus Name:	BUS-0071		Bus Voltage:	11000.0V
Function Name:	Phase			
Manufacturer:	GEC			
Description:	50/51			
Type:	MCGG 22-82		Class Desc:	MCGG 22
AIC Rating:	N/A		Fault Duty:	8540.5A
Current Rating:	200A / 5A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) Tap, Is	1	(200A)	Test Points:	@2.0X, 5.333s
2) [E] Extremely Invers	0.2			@5.0X, 0.667s
3) INST	9	(1800A)		@10.0X, 0.162s

Device Name:	10- MCGG (EF)		TCC Name:	tcc49.tcc
Bus Name:	BUS 2		Bus Voltage:	11000.0V
Function Name:	Phase			
Manufacturer:	GEC			
Description:	50/51			
Type:	MCGG 22-82		Class Desc:	MCGG 22
AIC Rating:	N/A		Fault Duty:	1695.1A

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Current Rating: 100A / 5A	Curve Multiplier: 1
Time Multiplier: 1	Time Adder: 0
Setting: 1) Tap, Is 0.2 (20A)	Test Points: @2.0X, 10.667s
2) [E] Extremely Invers 0.4	@5.0X, 1.333s
3) INST 14 (280A)	@10.0X, 0.323s

Device Name: 10- MCGG (O/C)	TCC Name: tcc48.tcc
Bus Name: BUS 2	Bus Voltage: 11000.0V
Function Name: Phase	
Manufacturer: GEC	
Description: 50/51	
Type: MCGG 22-82	Class Desc: MCGG 22
AIC Rating: N/A	Fault Duty: 8420.6A
Current Rating: 100A / 5A	Curve Multiplier: 1
Time Multiplier: 1	Time Adder: 0
Setting: 1) Tap, Is 0.6 (60A)	Test Points: @2.0X, 2.000s
2) [E] Extremely Invers 0.2	@5.0X, 0.250s
3) INST 9 (540A)	@10.0X, 0.061s

Device Name: ASB2-MS1-DPRO (O/C) 0	TCC Name:
Bus Name:	Bus Voltage: 415.0V
Function Name: Phase	
Manufacturer: NILSEN 16	
Description: 50/51	
Type: D-PRO	Class Desc: D-PRO
AIC Rating: N/A	Fault Duty: 200000.0A
Current Rating: 1600A / 1A	Curve Multiplier: 1
Time Multiplier: 1	Time Adder: 0
Setting: 1) O/C Pickup 0.5 (800A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI 0.8	@5.0X, 0.234s
3) 50P-2 INST 8 (12800A)	@10.0X, 0.072s

Device Name: ASB1-BUS TIE (OC)	TCC Name:
Bus Name: ASB1 - BUS2	Bus Voltage: 415.0V
Function Name: Phase	
Manufacturer: NILSEN 16	
Description: 50/51	
Type: D-PRO	Class Desc: D-PRO
AIC Rating: N/A	Fault Duty: 24222.4A
Current Rating: 1600A / 1A	Curve Multiplier: 1
Time Multiplier: 1	Time Adder: 0
Setting: 1) O/C Pickup 0.5 (800A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI 0.6	@5.0X, 0.234s
3) 50P-2 INST 2.4 (3840A)	@10.0X, 0.072s

Device Name: ASB1-BUS TIE (EF)	TCC Name:
Bus Name: ASB1 - BUS2	Bus Voltage: 415.0V
Function Name: Phase	
Manufacturer: NILSE16-EF	
Description: 50E/51E	
Type: D-PRO	Class Desc: D-PRO-E
AIC Rating: N/A	Fault Duty: 24222.4A
Current Rating: 1600A / 1A	Curve Multiplier: 1
Time Multiplier: 1	Time Adder: 0
Setting: 1) EF Pickup 0.05 (80A)	Test Points: @2.0X, 1.426s
2) Extremely Inv, EI 0.6	@5.0X, 0.193s
3) 50P-2 INST 2.0 (3200A)	@10.0X, 0.059s

Device Name: ASB1-MAIN SWITCH2(OC)	TCC Name:
Bus Name: ASB1 - BUS2	Bus Voltage: 415.0V
Function Name: Phase	
Manufacturer: NILSEN 16	
Description: 50/51	
Type: D-PRO	Class Desc: D-PRO
AIC Rating: N/A	Fault Duty: 24222.4A
Current Rating: 1600A / 1A	Curve Multiplier: 1
Time Multiplier: 1	Time Adder: 0
Setting: 1) O/C Pickup 0.4 (640A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI 0.6	@5.0X, 0.234s
3) 50P-2 INST 2.0 (3200A)	@10.0X, 0.072s

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Device Name:	ASB1-MAIN SWITCH2 (EF)	TCC Name:	
Bus Name:	ASB1 - BUS2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSE16-EF		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	24222.4A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.05	(80A)	Test Points: @2.0X, 1.426s
2) Extremely Inv, EI	0.6		@5.0X, 0.193s
3) 50P-2 INST	2.0	(3200A)	@10.0X, 0.059s

Device Name:	CB36	TCC Name:	
Bus Name:	ASB1 - BUS2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	250-400A		
Type:	TG-400B	Fault Duty:	24222.4A
AIC Rating:	56kA	Curve Multiplier:	1
Frame:	400 415V 400A	Time Adder:	0
Time Multiplier:	1		
Trip:	350A		
Setting: 1) LTD			
2) INST	5.0	(1750A)	

Device Name:	CB37	TCC Name:	
Bus Name:	ASB1 - BUS2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	125-225		
Type:	TG-225B	Fault Duty:	24222.4A
AIC Rating:	56kA	Curve Multiplier:	1
Frame:	225 415V 225A	Time Adder:	0
Time Multiplier:	1		
Trip:	125A		
Setting: 1) LTD			
2) INST	5.0	(625A)	

Device Name:	ASB1 LARGEST CB	TCC Name:	tcc31.tcc
Bus Name:	ASB1-BUS1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	250-400A		
Type:	TG-400B	Fault Duty:	26513.8A
AIC Rating:	56kA	Curve Multiplier:	1
Frame:	400 415V 400A	Time Adder:	0
Time Multiplier:	1		
Trip:	300A		
Setting: 1) LTD			
2) INST	5.0	(1500A)	

Device Name:	ASB1-MAIN SWITCH1 (EF)	TCC Name:	
Bus Name:	ASB1-BUS1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSE16-EF		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	26513.8A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.05	(80A)	Test Points: @2.0X, 1.426s
2) Extremely Inv, EI	0.6		@5.0X, 0.193s
3) 50P-2 INST	2.0	(3200A)	@10.0X, 0.059s

Device Name:	ASB1-MAIN SWITCH1(OC)	TCC Name:	
Bus Name:	ASB1-BUS1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN 16		

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Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	26513.8A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup	0.5	(800A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.6		@5.0X, 0.234s
3) 50P-2 INST	2.4	(3840A)	@10.0X, 0.072s

Device Name:	CB11	TCC Name:	tcc35.tcc
Bus Name:	ASB3 - BUS1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	TemBreak		
Type:	XS-NE		
AIC Rating:	50kA	Fault Duty:	21021.8A
Frame:	XS400NE 415V 400A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Sensor:	400A		
Plug:			
Setting: 1) LTPU	0.8	(320A)	
2) LTD	5.0		
3) STPU	2.0	(800A)	
4) STD	0.1		
5) INST	6.16	(2464A)	

Device Name:	CB12	TCC Name:	
Bus Name:	ASB3- BUS2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	TemBreak		
Type:	XS-NE		
AIC Rating:	50kA	Fault Duty:	19525.1A
Frame:	XS400NE 415V 400A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Sensor:	400A		
Plug:			
Setting: 1) LTPU	0.8	(320A)	
2) LTD	5.0		
3) STPU	2.0	(800A)	
4) STD	0.1		
5) INST	3.0	(1200A)	

Device Name:	BFP MCC MAIN SWITCH	TCC Name:	tcc47.tcc
Bus Name:	BFP MCC	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	TemBreak		
Type:	XS-NE		
AIC Rating:	50kA	Fault Duty:	10019.0A
Frame:	XS400NE 415V 400A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Sensor:	400A		
Plug:			
Setting: 1) LTPU	1.0	(400A)	
2) LTD	5.0		
3) STPU	2.0	(800A)	
4) STD	0.1		
5) INST	3.0	(1200A)	

Device Name:	Booster Pump CB	TCC Name:	tcc47.tcc
Bus Name:	BFP MCC	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	20-125A		
Type:	H 125-NJ, L 125-NJ		
AIC Rating:	125kA	Fault Duty:	10019.0A
Frame:	H 125-NJ 415V 125A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Trip:	32A		
Setting: 1) Ir, (0.63-1 x T)	0.63	(20.2A)	
2) Ii, (6-13)	6	(121A)	

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Device Name:	CB-24	TCC Name:	
Bus Name:	BUS-0114	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS2		
Description:	125-225		
Type:	TG-225B		
AIC Rating:	56kA	Fault Duty:	11800.6A
Frame:	TG-225B 415V 225A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Trip:	125A		
Setting: 1) LTD			
2) INST	5.0	(625A)	

Device Name:	2- MBSB DPRO (EF)	TCC Name:	tcc34.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25E		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	27545.6A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.05	(125A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	2.6	(6500A)	@10.0X, 0.072s

Device Name:	2- MBSB DPRO (O/C)	TCC Name:	tcc31.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	27545.6A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup	1.00	(2500A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	8.47	(21175A)	@10.0X, 0.072s

Device Name:	ASB1-DPRO (EF)	TCC Name:	tcc34.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSE16-EF		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	27545.6A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.063	(100.8A)	Test Points: @2.0X, 1.426s
2) Extremely Inv, EI	0.7		@5.0X, 0.193s
3) 50P-2 INST	2.6	(4160A)	@10.0X, 0.059s

Device Name:	ASB1-DPRO (O/C)	TCC Name:	tcc31.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN 16		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	27545.6A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup	1.00	(1600A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	10	(16000A)	@10.0X, 0.072s

Device Name:	ASB3-DPRO (EF) 1	TCC Name:	tcc36.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		

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Manufacturer:	NILSE16-EF		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	27545.6A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.05	(80A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	2.0	(3200A)	@10.0X, 0.072s

Device Name:	ASB3-DPRO (O/C)1	TCC Name:	tcc35.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN 16		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	27545.6A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup	0.625	(1000A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	10	(16000A)	@10.0X, 0.072s

Device Name:	BL1- CB	TCC Name:	tcc32.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERASAKI		
Description:	450-600A		
Type:	TG600B		
AIC Rating:	65kA	Fault Duty:	27545.6A
Frame:	TG600B 415V 600A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Trip:	450A		
Setting: 1) LTD			
2) INST	10.0	(4500A)	

Device Name:	BL4- CB	TCC Name:	tcc24.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	TemBreak		
Type:	XS-NE		
AIC Rating:	50kA	Fault Duty:	27545.6A
Frame:	XS800NE 415V 800A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Sensor:	800A		
Plug:			
Setting: 1) LTPU	1.0	(800A)	
2) LTD	5.0		
3) STPU	6.0	(4800A)	
4) STD	0.1		
5) INST	10	(8000A)	

Device Name:	PD-0140	TCC Name:	
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:			
Description:			
Type:			
AIC Rating:	0kA	Fault Duty:	27545.6A
Frame:		Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Sensor:			
Plug:			

Device Name:	5- MBSB DPRO (EF)	TCC Name:	
Bus Name:	BUS22	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25E		
Description:	50E/51E		

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Type:	D-PRO		Class Desc:	D-PRO-E
AIC Rating:	N/A		Fault Duty:	25092.2A
Current Rating:	2500A / 1A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) EF Pickup	0.05	(125A)	Test Points:	@2.0X, 1.729s
2) Extremely Inv, EI	0.8			@5.0X, 0.234s
3) 50P-2 INST	2.6	(6500A)		@10.0X, 0.072s

Device Name:	5-DPRO (O/C)		TCC Name:	
Bus Name:	BUS22		Bus Voltage:	415.0V
Function Name:	Phase			
Manufacturer:	NILSEN-25			
Description:	50/51			
Type:	D-PRO		Class Desc:	D-PRO
AIC Rating:	N/A		Fault Duty:	25092.2A
Current Rating:	2500A / 1A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) O/C Pickup	1.00	(2500A)	Test Points:	@2.0X, 0.000s
2) Extremely Inv, EI	0.8			@5.0X, 0.000s
3) 50P-2 INST	8.47	(21175A)		@10.0X, 0.000s

Device Name:	ASB1-DPRO (EF)0		TCC Name:	
Bus Name:	BUS22		Bus Voltage:	415.0V
Function Name:	Phase			
Manufacturer:	NILSE16-EF			
Description:	50E/51E			
Type:	D-PRO		Class Desc:	D-PRO-E
AIC Rating:	N/A		Fault Duty:	25092.2A
Current Rating:	1600A / 1A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) EF Pickup	0.063	(100.8A)	Test Points:	@2.0X, 1.426s
2) Extremely Inv, EI	0.7			@5.0X, 0.193s
3) 50P-2 INST	2.6	(4160A)		@10.0X, 0.059s

Device Name:	ASB1-DPRO (O/C)0		TCC Name:	
Bus Name:	BUS22		Bus Voltage:	415.0V
Function Name:	Phase			
Manufacturer:	NILSEN 16			
Description:	50/51			
Type:	D-PRO		Class Desc:	D-PRO
AIC Rating:	N/A		Fault Duty:	25092.2A
Current Rating:	1600A / 1A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) O/C Pickup	0.4	(640A)	Test Points:	@2.0X, 1.729s
2) Extremely Inv, EI	0.8			@5.0X, 0.234s
3) 50P-2 INST	10	(16000A)		@10.0X, 0.072s

Device Name:	ASB3-DPRO (EF)2		TCC Name:	
Bus Name:	BUS22		Bus Voltage:	415.0V
Function Name:	Phase			
Manufacturer:	NILSE16-EF			
Description:	50E/51E			
Type:	D-FRO		Class Desc:	D-PRO-E
AIC Rating:	N/A		Fault Duty:	25092.2A
Current Rating:	1600A / 1A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) EF Pickup	0.05	(80A)	Test Points:	@2.0X, 1.729s
2) Extremely Inv, EI	0.8			@5.0X, 0.234s
3) 50P-2 INST	2.0	(3200A)		@10.0X, 0.072s

Device Name:	ASB3-DPRO (O/C)2		TCC Name:	
Bus Name:	BUS22		Bus Voltage:	415.0V
Function Name:	Phase			
Manufacturer:	NILSEN 16			
Description:	50/51			
Type:	D-FRO		Class Desc:	D-PRO
AIC Rating:	N/A		Fault Duty:	25092.2A
Current Rating:	1600A / 1A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) O/C Pickup	0.625	(1000A)	Test Points:	@2.0X, 1.729s
2) Extremely Inv, EI	0.8			@5.0X, 0.234s

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3) 50P-2 INST	4.2	(6720A)	@10.0X, 0.072s
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Device Name:	BL2- CB	TCC Name:	
Bus Name:	BUS22	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERASAKI		
Description:	450-600A		
Type:	TG600B		
AIC Rating:	65kA	Fault Duty:	25092.2A
Frame:	TG600B 415V 600A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Trip:	450A		
Setting: 1) LTD			
2) INST	10.0	(4500A)	

Device Name:	MBSB-BUSTIE1/2- DPRO (EF)	TCC Name:	
Bus Name:	BUS22	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25E		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	25092.2A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.05	(125A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	2.6	(6500A)	@10.0X, 0.072s

Device Name:	MBSB-BUSTIE1/2- DPRO (O/C)	TCC Name:	
Bus Name:	BUS22	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	25092.2A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup	1.00	(2500A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	8.47	(21175A)	@10.0X, 0.072s

Device Name:	7- MBSB DPRO (EF)	TCC Name:	
Bus Name:	BUS32	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25E		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	25091.1A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.05	(125A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	2.6	(6500A)	@10.0X, 0.072s

Device Name:	7-MBSB DPRO (O/C)	TCC Name:	
Bus Name:	BUS32	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	25091.1A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup	1.00	(2500A)	Test Points: @2.0X, 0.000s
2) Extremely Inv, EI	0.8		@5.0X, 0.000s
3) 50P-2 INST	8.47	(21175A)	@10.0X, 0.000s

Device Name:	BL3- CB	TCC Name:	tcc16.tcc
Bus Name:	BUS32	Bus Voltage:	415.0V
Function Name:	Phase		

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Manufacturer:	TERASAKI		
Description:	450-600A		
Type:	TG600B		
AIC Rating:	65kA	Fault Duty:	25091.1A
Frame:	TG600B 415V 600A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Trip:	450A		
Setting: 1) LTD			
2) INST	10.0	(4500A)	

Device Name:	MBSB-BUSTIE2/3- DPRO (EF)	TCC Name:	
Bus Name:	BUS32	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25E		
Description:	50E/51E	Class Desc:	D-PRO-E
Type:	D-PRO	Fault Duty:	25091.1A
AIC Rating:	N/A	Curve Multiplier:	1
Current Rating:	2500A / 1A	Time Adder:	0
Time Multiplier:	1	Test Points:	@2.0X, 1.729s @5.0X, 0.234s @10.0X, 0.072s
Setting: 1) EF Pickup	0.05	(125A)	
2) Extremely Inv, EI	0.8		
3) 50P-2 INST	2.6	(6500A)	

Device Name:	MBSB-BUSTIE2/3- DPRO (O/C)	TCC Name:	
Bus Name:	BUS32	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25		
Description:	50/51	Class Desc:	D-PRO
Type:	D-PRO	Fault Duty:	25091.1A
AIC Rating:	N/A	Curve Multiplier:	1
Current Rating:	2500A / 1A	Time Adder:	0
Time Multiplier:	1	Test Points:	@2.0X, 1.729s @5.0X, 0.234s @10.0X, 0.072s
Setting: 1) O/C Pickup	1.00	(2500A)	
2) Extremely Inv, EI	0.8		
3) 50P-2 INST	8.47	(21175A)	

Device Name:	SW-PUL-VSD-CB	TCC Name:	
Bus Name:	BUS48	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	TemBreak		
Type:	XS-NE	Fault Duty:	26140.2A
AIC Rating:	50kA	Curve Multiplier:	1
Frame:	XS630NE 415V 630A	Time Adder:	0
Time Multiplier:	1	Test Points:	
Sensor:	630A		
Plug:			
Setting: 1) LTPU	0.9	(567A)	
2) LTD	5.0		
3) STPU	8.0	(5040A)	
4) STD	0.1		
5) INST	10	(6300A)	

Device Name:	ASB2-GEN-DPRO (EF)	TCC Name:	
Bus Name:	BUS52	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSE16-EF		
Description:	50E/51E	Class Desc:	D-PRO-E
Type:	D-PRO	Fault Duty:	22870.0A
AIC Rating:	N/A	Curve Multiplier:	1
Current Rating:	1600A / 1A	Time Adder:	0
Time Multiplier:	1	Test Points:	@2.0X, 1.729s @5.0X, 0.234s @10.0X, 0.072s
Setting: 1) EF Pickup	0.05	(80A)	
2) Inv 4.3	0.1		
3) 50P-2 INST	12	(19200A)	

Device Name:	ASB2-GEN-DPRO (O/C)	TCC Name:	
Bus Name:	BUS52	Bus Voltage:	415.0V
Function Name:	Phase		

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QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

Manufacturer:	NILSEN 16		
Description:	50/51		
Type:	D-PRO		
AIC Rating:	N/A		
Current Rating:	1600A / 1A		
Time Multiplier:	1		
Setting: 1) O/C Pickup	0.5	(800A)	Class Desc: D-PRO
2) Inv 4.3	0.8		Fault Duty: 22870.0A
3) 50P-2 INST	12	(19200A)	Curve Multiplier: 1
			Time Adder: 0
			Test Points: @2.0X, 0.000s
			@5.0X, 0.000s
			@10.0X, 0.000s
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Device Name:	ASB2-MS1 - DPRO (EF)		TCC Name:
Bus Name:	BUS52		Bus Voltage: 415.0V
Function Name:	Phase		
Manufacturer:	NILSE16-EF		
Description:	50E/51E		
Type:	D-PRO		Class Desc: D-PRO-E
AIC Rating:	N/A		Fault Duty: 22870.0A
Current Rating:	1600A / 1A		Curve Multiplier: 1
Time Multiplier:	1		Time Adder: 0
Setting: 1) EF Pickup	0.05	(80A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	8	(12800A)	@10.0X, 0.072s
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Device Name:	ASB2-MS1-DPRO (O/C)		TCC Name:
Bus Name:	BUS52		Bus Voltage: 415.0V
Function Name:	Phase		
Manufacturer:	NILSEN 16		
Description:	50/51		
Type:	D-PRO		Class Desc: D-PRO
AIC Rating:	N/A		Fault Duty: 22870.0A
Current Rating:	1600A / 1A		Curve Multiplier: 1
Time Multiplier:	1		Time Adder: 0
Setting: 1) O/C Pickup	0.5	(800A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	8	(12800A)	@10.0X, 0.072s
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Device Name:	ASB2-MS2 - DPRO (EF)		TCC Name:
Bus Name:	BUS52		Bus Voltage: 415.0V
Function Name:	Phase		
Manufacturer:	NILSE16-EF		
Description:	50E/51E		
Type:	D-PRO		Class Desc: D-PRO-E
AIC Rating:	N/A		Fault Duty: 22870.0A
Current Rating:	1600A / 1A		Curve Multiplier: 1
Time Multiplier:	1		Time Adder: 0
Setting: 1) EF Pickup	0.05	(80A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	8	(12800A)	@10.0X, 0.072s
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Device Name:	ASB2-MS2-DPRO (O/C)		TCC Name:
Bus Name:	BUS52		Bus Voltage: 415.0V
Function Name:	Phase		
Manufacturer:	NILSEN 16		
Description:	50/51		
Type:	D-PRO		Class Desc: D-PRO
AIC Rating:	N/A		Fault Duty: 22870.0A
Current Rating:	1600A / 1A		Curve Multiplier: 1
Time Multiplier:	1		Time Adder: 0
Setting: 1) O/C Pickup	0.5	(800A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	8	(12800A)	@10.0X, 0.072s
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Device Name:	ESB1-FDR-CB		TCC Name: tcc41.tcc
Bus Name:	BUS52		Bus Voltage: 415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	250-400A		
Type:	TG-400B		
AIC Rating:	56kA		Fault Duty: 22870.0A
Frame:	400 415V 400A		Curve Multiplier: 1
Time Multiplier:	1		Time Adder: 0

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Trip: 350A
Setting: 1) LTD
2) INST 6 (2100A)

Device Name: ESB3-FDR-CB TCC Name:
Bus Name: BUS52 Bus Voltage: 415.0V
Function Name: Phase
Manufacturer: TERAS1
Description: 250-400A
Type: TG-400B
AIC Rating: 56kA Fault Duty: 22870.0A
Frame: 400 415V 400A Curve Multiplier: 1
Time Multiplier: 1 Time Adder: 0
Trip: 250A
Setting: 1) LTD
2) INST 6 (1500A)

Device Name: ESB4-FDR-CB TCC Name:
Bus Name: BUS52 Bus Voltage: 415.0V
Function Name: Phase
Manufacturer: TERAS1
Description: 250-400A
Type: TG-400B
AIC Rating: 56kA Fault Duty: 22870.0A
Frame: 400 415V 400A Curve Multiplier: 1
Time Multiplier: 1 Time Adder: 0
Trip: 250A
Setting: 1) LTD
2) INST 6 (1500A)

Device Name: ODSB-FDR-CB TCC Name:
Bus Name: BUS52 Bus Voltage: 415.0V
Function Name: Phase
Manufacturer: TERASAKI
Description: 125-225
Type: TG-225B
AIC Rating: 56kA Fault Duty: 22870.0A
Frame: TG-225B 415V 225A Curve Multiplier: 1
Time Multiplier: 1 Time Adder: 0
Trip: 150A
Setting: 1) LTD
2) INST 5.0 (750A)

Device Name: SW-PU2-VSD-CB TCC Name: RAW SW PUMP2 tcc43.tcc
Bus Name: BUS67 Bus Voltage: 415.0V
Function Name: Phase
Manufacturer: TERAS1
Description: TemBreak
Type: XS-NE
AIC Rating: 50kA Fault Duty: 22731.8A
Frame: XS630NE 415V 630A Curve Multiplier: 1
Time Multiplier: 1 Time Adder: 0
Sensor: 630A
Plug:
Setting: 1) LTPU 0.9 (567A)
2) LTD 5.0
3) STPU 8.0 (5040A)
4) STD 0.1
5) INST 10 (6300A)

Device Name: RAS PU1- MCCB TCC Name: tcc29.tcc
Bus Name: BUS7 Bus Voltage: 415.0V
Function Name: Phase
Manufacturer: TERASAKI
Description: 125-400A, 3-4 Poles, IEC
Type: TemBreak XS400
AIC Rating: 50kA ShortTime:25 Fault Duty: 14016.4A
Frame: XS400NS 415V 400A Curve Multiplier: 1
Time Multiplier: 1 Time Adder: 0

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Trip: 400A
Setting: 1) Thermal Curve
2) INST (5-10 x In) 7.1 (2840A)

Device Name: RAS PU2- MCCB TCC Name:
Bus Name: BUS7 Bus Voltage: 415.0V
Function Name: Phase
Manufacturer: TERASAKI
Description: 125-400A, 3-4 Poles, IEC
Type: TemBreak XS400
AIC Rating: 50kA ShortTime:25 Fault Duty: 14016.4A
Frame: XS400NS 415V 400A Curve Multiplier: 1
Time Multiplier: 1 Time Adder: 0
Trip: 400A
Setting: 1) Thermal Curve
2) INST (5-10 x In) 7.1 (2840A)

Device Name: RAS PU3- MCCB TCC Name:
Bus Name: BUS7 Bus Voltage: 415.0V
Function Name: Phase
Manufacturer: TERASAKI
Description: 125-400A, 3-4 Poles, IEC
Type: TemBreak XS400
AIC Rating: 50kA ShortTime:25 Fault Duty: 14016.4A
Frame: XS400NS 415V 400A Curve Multiplier: 1
Time Multiplier: 1 Time Adder: 0
Trip: 400A
Setting: 1) Thermal Curve
2) INST (5-10 x In) 7.1 (2840A)

Device Name: SW-PU3-VSD-CB TCC Name:
Bus Name: BUS75 Bus Voltage: 415.0V
Function Name: Phase
Manufacturer: TERAS1
Description: TemBreak
Type: XS-NE
AIC Rating: 50kA Fault Duty: 22731.8A
Frame: XS630NE 415V 630A Curve Multiplier: 1
Time Multiplier: 1 Time Adder: 0
Sensor: 630A
Plug:
Setting: 1) LTPU 0.9 (567A)
2) LTD 5.0
3) STPU 8.0 (5040A)
4) STD 0.1
5) INST 10 (6300A)

Device Name: CB-26 TCC Name:
Bus Name: ESB1 Bus Voltage: 415.0V
Function Name: Phase
Manufacturer: TERAS1
Description: 250-400A
Type: TG-400B
AIC Rating: 56kA Fault Duty: 14187.6A
Frame: 400 415V 400A Curve Multiplier: 1
Time Multiplier: 1 Time Adder: 0
Trip: 350A
Setting: 1) LTD 5.0 (1750A)
2) INST

Device Name: ESB1-LOADS TCC Name:
Bus Name: ESB1 Bus Voltage: 415.0V
Function Name: Phase
Manufacturer: TERAS1
Description: 125-225
Type: TG-225B
AIC Rating: 50kA Fault Duty: 14187.6A
Frame: 225 480V 225A Curve Multiplier: 1
Time Multiplier: 1 Time Adder: 0
Trip: 250A

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Setting: 1) LTD
2) INST 5.0 (1250A)

Device Name:	ESB1-MAIN SWITCH	TCC Name:	tcc41.tcc
Bus Name:	ESB1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	250-400A		
Type:	TG-400B		
AIC Rating:	56kA	Fault Duty:	14187.6A
Frame:	400 415V 400A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Trip:	300A		
Setting: 1) LTD 2) INST	5.0	(1500A)	

Device Name:	ESB2-FDR-CB	TCC Name:	
Bus Name:	ESB1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	200-400A		
Type:	TO400BA		
AIC Rating:	30kA	Fault Duty:	14187.6A
Frame:	400 415V 400A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Trip:	225A		
Setting: 1) LTD 2) INST	6	(1350A)	

Device Name:	ESB2-MAIN SWITCH	TCC Name:	
Bus Name:	ESB2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERASAKI		
Description:	125-225		
Type:	TG-225B		
AIC Rating:	56kA	Fault Duty:	14129.1A
Frame:	TG-225B 415V 225A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Trip:	150A		
Setting: 1) LTD 2) INST	5.0	(750A)	

Device Name:	4-DPRO (EF)	TCC Name:	tcc46.tcc
Bus Name:	MPSB BUS1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25E		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	11708.4A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup 2) Extremely Inv, EI 3) 50P-2 INST	0.05 0.8 10	(125A) (2500A) (25000A)	Test Points: @2.0X, 1.729s @5.0X, 0.234s @10.0X, 0.072s

Device Name:	4-DPRO (O/C)	TCC Name:	tcc44.tcc
Bus Name:	MPSB BUS1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	27484.8A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup 2) Extremely Inv, EI 3) 50P-2 INST	1.00 0.8 10	(2500A) (2500A) (25000A)	Test Points: @2.0X, 1.729s @5.0X, 0.234s @10.0X, 0.072s

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Device Name:	ASB2-DPRO (EF)1	TCC Name:	
Bus Name:	MPSB BUS1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSE16-EF		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	27484.8A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.05	(80A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	4.0	(6400A)	@10.0X, 0.072s

Device Name:	ASB2-DPRO (O/C)1	TCC Name:	
Bus Name:	MPSB BUS1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN 16		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	27484.8A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup	0.625	(1000A)	Test Points: @2.0X, 0.000s
2) Extremely Inv, EI	0.8		@5.0X, 0.000s
3) 50P-2 INST	10	(16000A)	@10.0X, 0.000s

Device Name:	SW-PU1-DOL-CB	TCC Name:	tcc44.tcc
Bus Name:	MPSB BUS1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	TemBreak		
Type:	XS-NE		
AIC Rating:	50kA	Fault Duty:	27484.8A
Frame:	XS800NE 415V 800A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Sensor:	800A		
Plug:			
Setting: 1) LTPU	1.0	(800A)	
2) LTD	5.0		
3) STPU	10.0	(8000A)	
4) STD	0.1		
5) INST	12.0	(9600A)	

Device Name:	6-DPRO (EF)	TCC Name:	
Bus Name:	MPSB BUS2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25E		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	24064.9A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.05	(125A)	Test Points: @2.0X, 0.000s
2) Extremely Inv, EI	0.8		@5.0X, 0.000s
3) 50P-2 INST	10	(25000A)	@10.0X, 0.000s

Device Name:	6-DPRO (O/C)	TCC Name:	tcc43.tcc
Bus Name:	MPSB BUS2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	24064.9A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup	1.00	(2500A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	8	(20000A)	@10.0X, 0.072s

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Device Name:	ASB2-DPRO (EF)2	TCC Name:	ASB2 SUB BOARDS EF tcc42.tcc
Bus Name:	MPSB BUS2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSE16-EF		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	11310.8A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.05	(80A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	4.0	(6400A)	@10.0X, 0.072s
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Device Name:	ASB2-DPRO (O/C)2	TCC Name:	ASB2 SUBBOARDS tcc41.tcc
Bus Name:	MPSB BUS2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN 16		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	24064.9A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup	0.625	(1000A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	10	(16000A)	@10.0X, 0.072s
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Device Name:	MPSB-BUSTIE-DPRO (EF)	TCC Name:	
Bus Name:	MPSB BUS2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25E		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	24064.9A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.05	(125A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	4.0	(10000A)	@10.0X, 0.072s
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Device Name:	MPSB-BUSTIE-DPRO (O/C)	TCC Name:	
Bus Name:	MPSB BUS2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	24064.9A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup	1.00	(2500A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	10	(25000A)	@10.0X, 0.072s
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Device Name:	SW-PU2-DOL-CB	TCC Name:	tcc43.tcc
Bus Name:	MPSB BUS2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	TemBreak		
Type:	XS-NE		
AIC Rating:	50kA	Fault Duty:	24064.9A
Frame:	XS800NE 415V 800A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Sensor:	800A		
Plug:			
Setting: 1) LTPU	1.0	(800A)	
2) LTD	5.0		
3) STPU	10.0	(8000A)	
4) STD	0.1		
5) INST	12.0	(9600A)	

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

Device Name: SW-PU3-DOL-CB TCC Name:
Bus Name: MPSB BUS2 Bus Voltage: 415.0V
Function Name: Phase
Manufacturer: TERAS1
Description: TemBreak
Type: XS-NE
AIC Rating: 50kA Fault Duty: 24064.9A
Frame: XS800NE 415V 800A Curve Multiplier: 1
Time Multiplier: 1 Time Adder: 0
Sensor: 800A
Plug:
Setting: 1) LTPU 1.0 (800A)
2) LTD 5.0
3) STPU 10.0 (8000A)
4) STD 0.1
5) INST 12.0 (9600A)

Device Name: RAS MCC MAIN SWITCH TCC Name: RAS Pump CB.tcc
Bus Name: RASB1 Bus Voltage: 415.0V
Function Name: Phase
Manufacturer: Terasaki
Description: 700A
Type: TO-800BA
AIC Rating: 35kA Fault Duty: 14534.0A
Frame: TO-800A 440V 700A Curve Multiplier: 1
Time Multiplier: 1 Time Adder: 0
Trip:
Setting: 1) Ir 5 (3500A)
2) Inst

Device Name: RAS PUMPS MAIN MCCB TCC Name: tcc29.tcc
Bus Name: RASB1 Bus Voltage: 415.0V
Function Name: Phase
Manufacturer: TERASAKI
Description: 200-400A
Type: TO400BA
AIC Rating: 30kA Fault Duty: 14534.0A
Frame: TO400BA 415V 400A Curve Multiplier: 1
Time Multiplier: 1 Time Adder: 0
Trip: 350A
Setting: 1) LTD 6 (2100A)
2) INST

Given in the following two figures are the Power System Topology with Protection Devices Names listed in the above parameter setting tables.

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

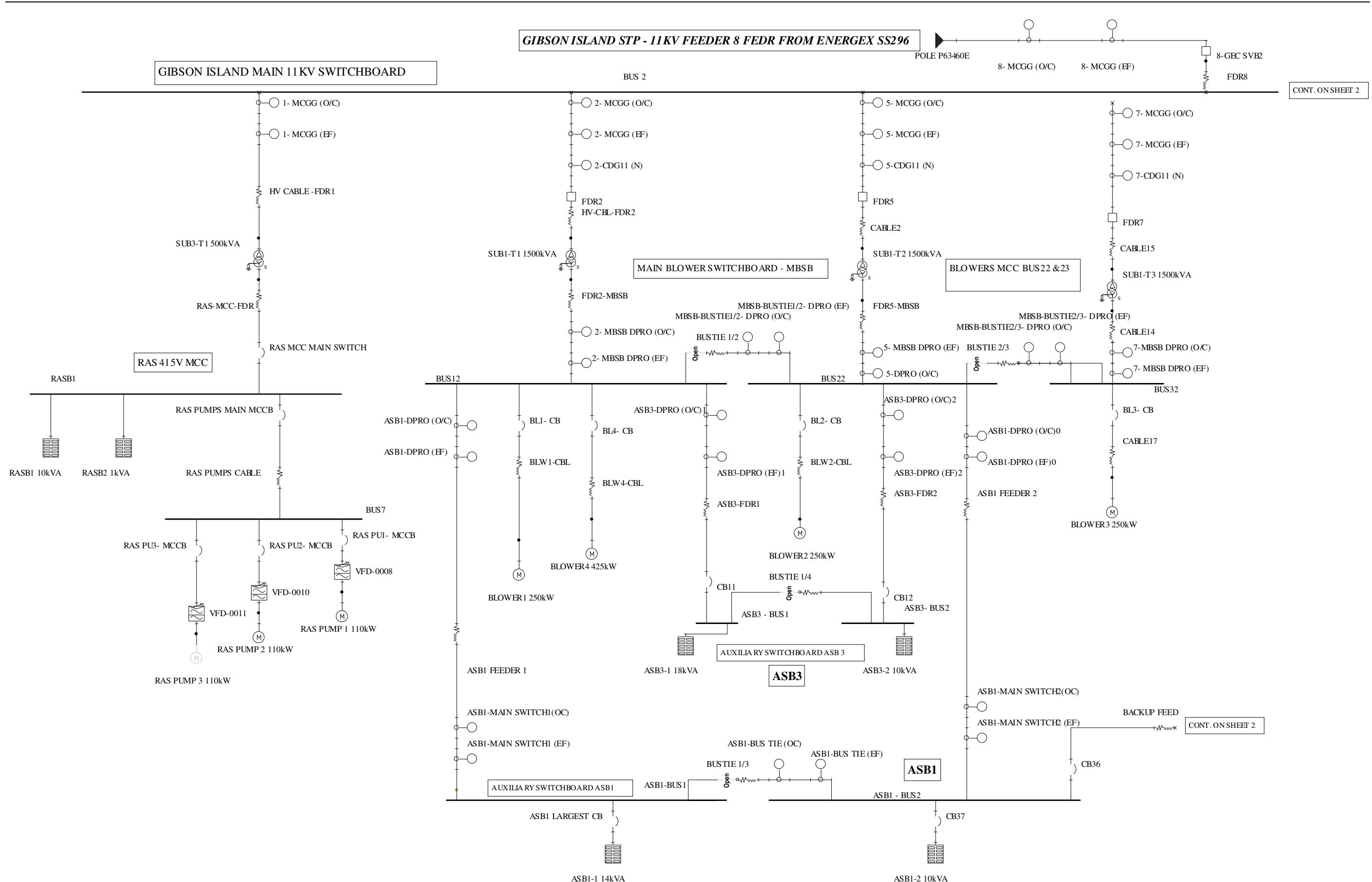


Figure 1 - Protection Devices Reference Guide (Sheet 1 of 2)

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

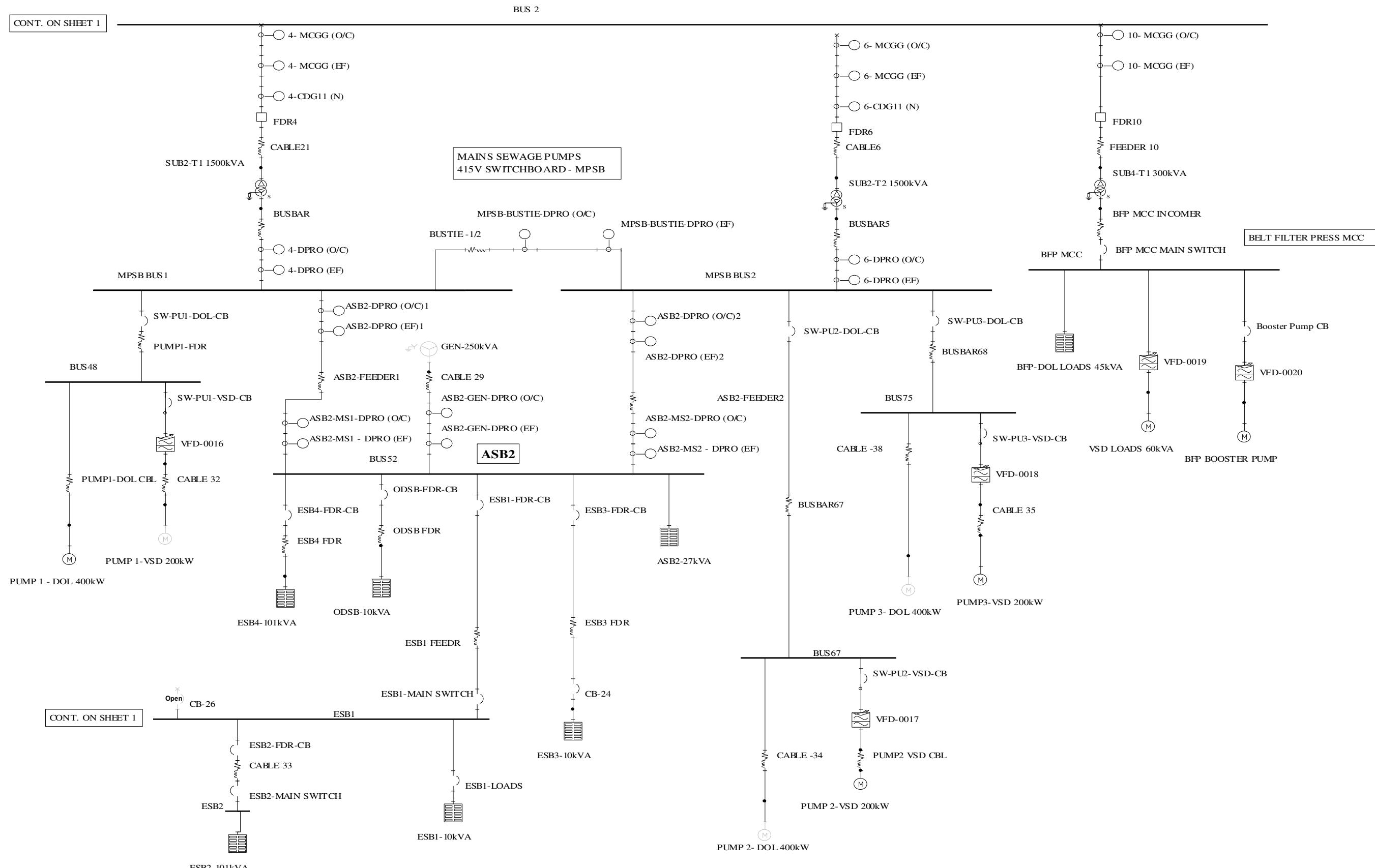


Figure 2 - Protection Devices Reference Guide (Sheet 2)

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAND URBAN UTILITIES - GIBSON ISLAND STP

2 INTRODUCTION

Queensland Urban Utilities (QUU) has commissioned Water Service Engineering (WSE) Pty. Ltd. to carry out a power system analysis and short circuit fault protection coordination study for Gibson Island Sewage Treatment Plant (GISTP).

This power system analysis and protection coordination study has been carried out to provide details of the fault levels for 11kV Main Switchboard (MSB) and 415V Motor Control Centres (MCC) on the STP Site to provide protective devices settings to achieve the protection coordination for 11kV MSB and each of the 415V MCCs.

Engineering software called: "PTW - Power Tools" software program has been used for these studies that comprise of:

- DAPPER program is used for power system analysis and fault studies;
- CAPTER program is used to prepare Time Current Curves (TCC) using results of short circuit fault studies carried out by DAPPER.
- Arc Flash Evaluation study has been carried out to determine the Arc Flash Category of each switchboard based on the protection device settings provided.
- In order to verify the calculated results of DAPPER program a separate engineering software program called ETAP has also been used for fault level calculations and results matched with DAPPER results.

For the entire STP site a comprehensive system topology has been prepared with details of major equipment. All equipment and cabling details collected from site have been used as the input data to the software program and then using the input data, a load flow and voltage drop study was carried out for the entire site to determine maximum demand and voltage drop on each MCC. The results of Load Flow and Voltage Drop studies were used to carry out the short circuit fault currents on each MSB and MCC and then these results were used to carry out the protection coordination study. Follow on from protection coordination study, Arc Flash Evaluation study was carried out to determine the Arc Flash category of each MSB and MCC to specify the PPE requirements for safe maintenance of each switchboard.

The following pages indicate the overall power system topology with results of DAPPER studies for:

- System Input Data as collected from the site (Sheets 1 &2);
- System topology with load flow and voltage drop calculations (Sheets 1 &2);
- System topology with short circuit fault currents (Sheets 1 &2).

(Note: due to large scale of the system the overall power system topology has been broken into two sheets for each study to be able to fit in all details).

The following information was obtained from Energex in order to carry out accurate fault levels at the STP:

- 3 Phase (3P) Short Circuit Fault Levels at the 11kV Energex Pole No. P63460-E: 8,191 Amps;
- Single Phase to Ground (SLG) Short Circuit Fault Levels at the 11kV Energex Pole No. P63460-E: 1,694 Amps;

3 GIBSON ISLAND STP POWER DISTRIBUTION TOPOLOGY (INPUT DATA)

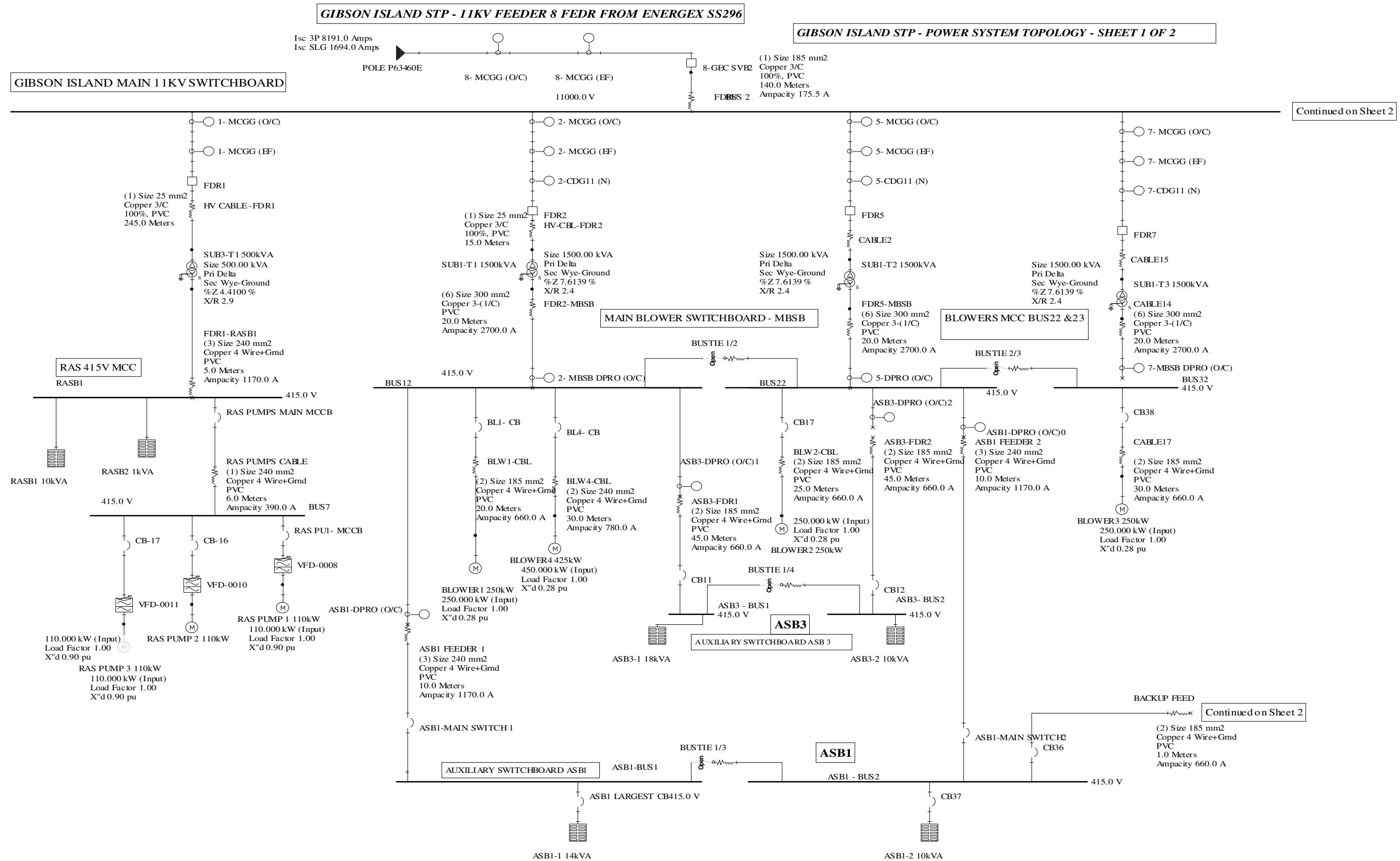


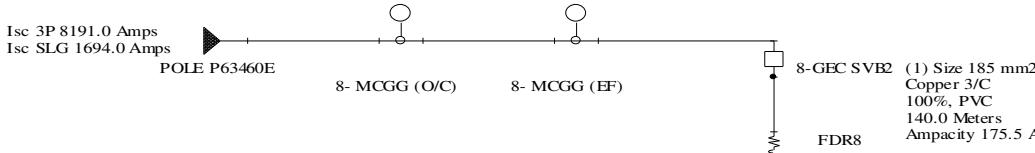
Figure 3 - Gibson Island STP - One Line Diagram with Input Data (Sheet 1 of 2)

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

GIBSON ISLAND STP - 11KV FEEDER 8 FEDR FROM ENERGEX SS296



GIBSON ISLAND STP - POWER SYSTEM TOPOLOGY SHEET 2 OF 2

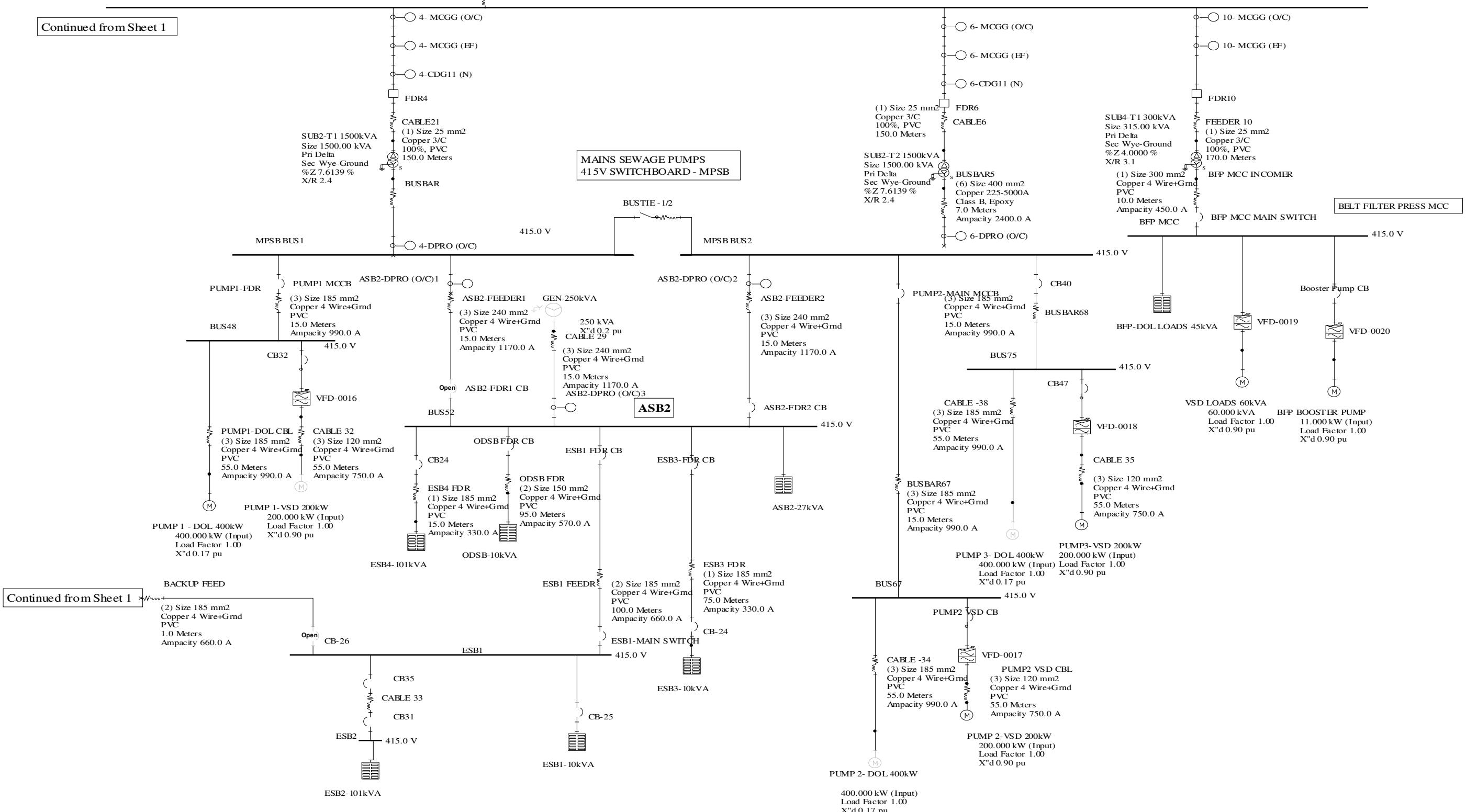


Figure 4 - Gibson Island STP - One Line Diagram with Input Data (Sheet 2 of 2)

Refer to Appendix 1 for full STP Input Data Report.

4 GIBSON ISLAND STP POWER DISTRIBUTION TOPOLOGY (LOAD FLOW AND VOLTAGE DROP RESULTS)

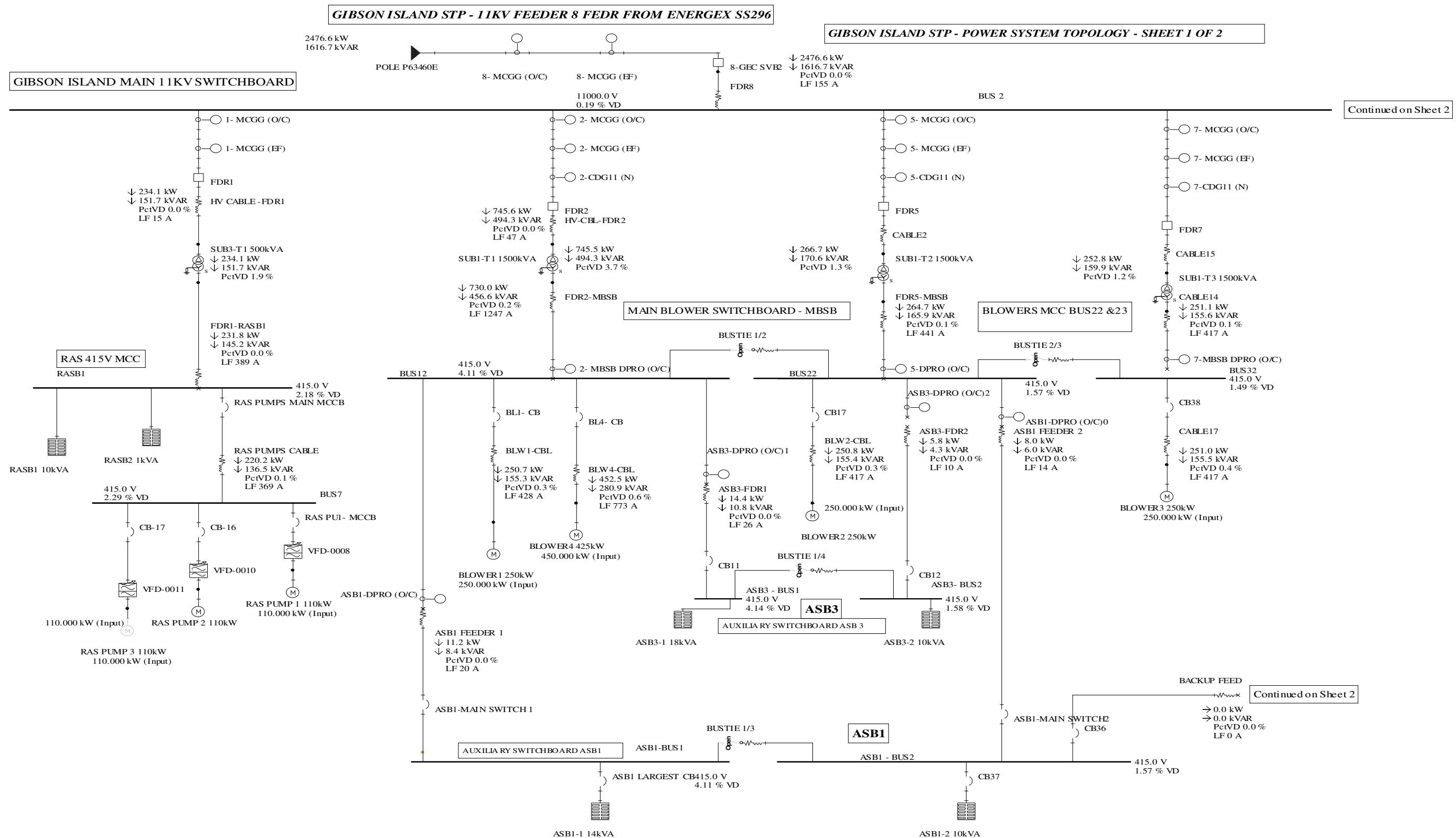
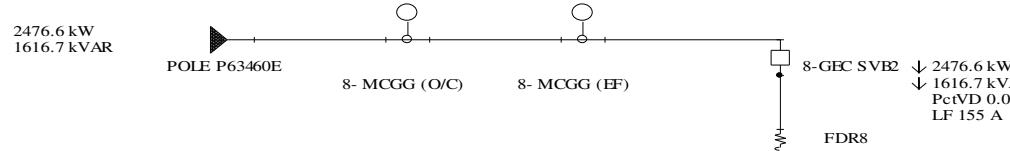


Figure 5 - Gibson Island STP - One Line Diagram with Load Flow and Voltage Drop Data (Sheet 1 of 2)

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:
QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

GIBSON ISLAND STP - 11KV FEEDER 8 FEDR FROM ENERGEX SS296



GIBSON ISLAND STP - POWER SYSTEM TOPOLOGY SHEET 2 OF 2

Continued from Sheet 1

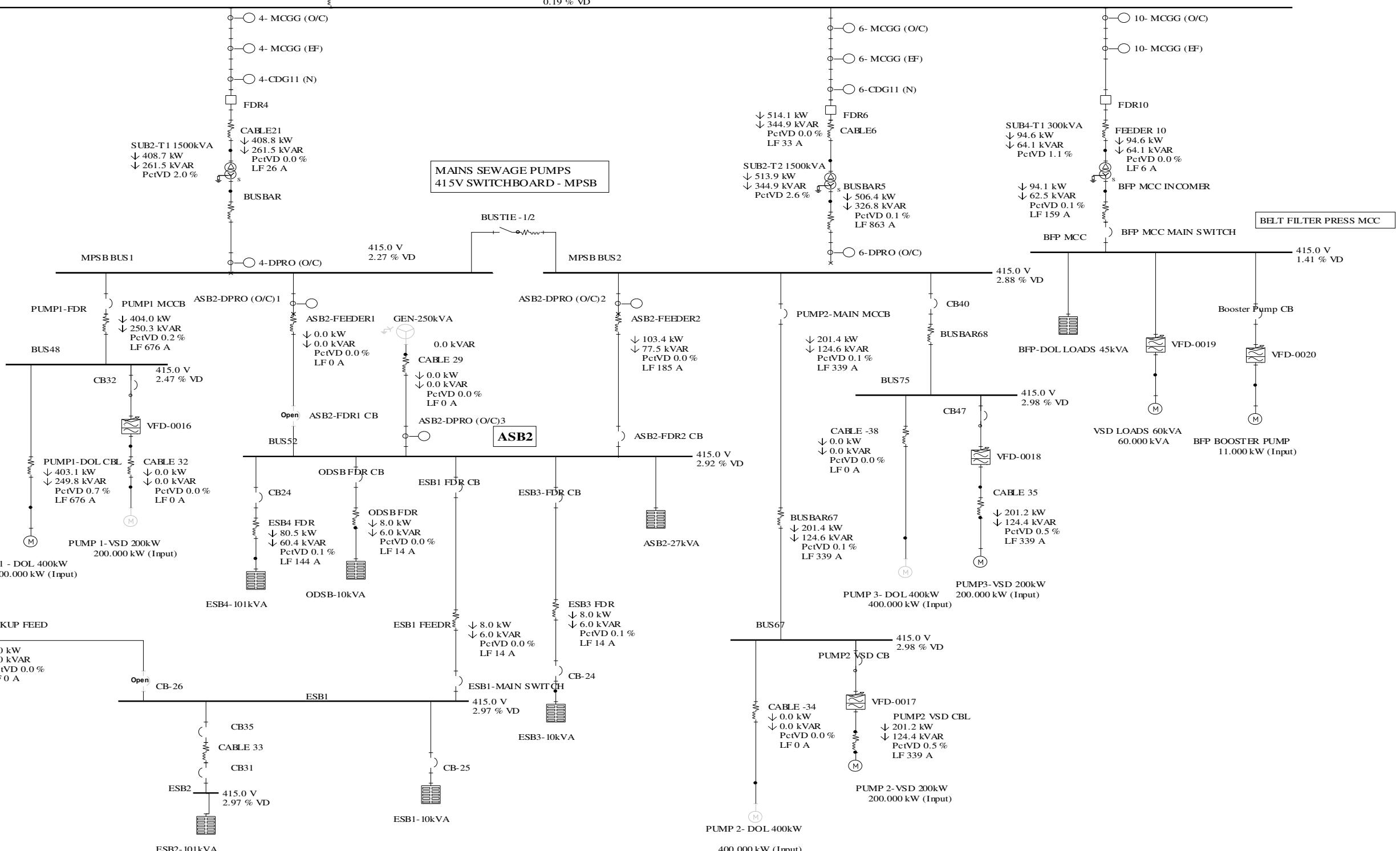


Figure 6 - Gibson Island STP - One Line Diagram with Load Flow and Voltage Drop Data (Sheet 2 of 2)

Refer to Appendix -2 for full Load Flow and Voltage Drop Report

5 GIBSON ISLAND STP POWER DISTRIBUTION TOPOLOGY (SHORT CIRCUIT FAULT LEVELS STUDY RESULTS)

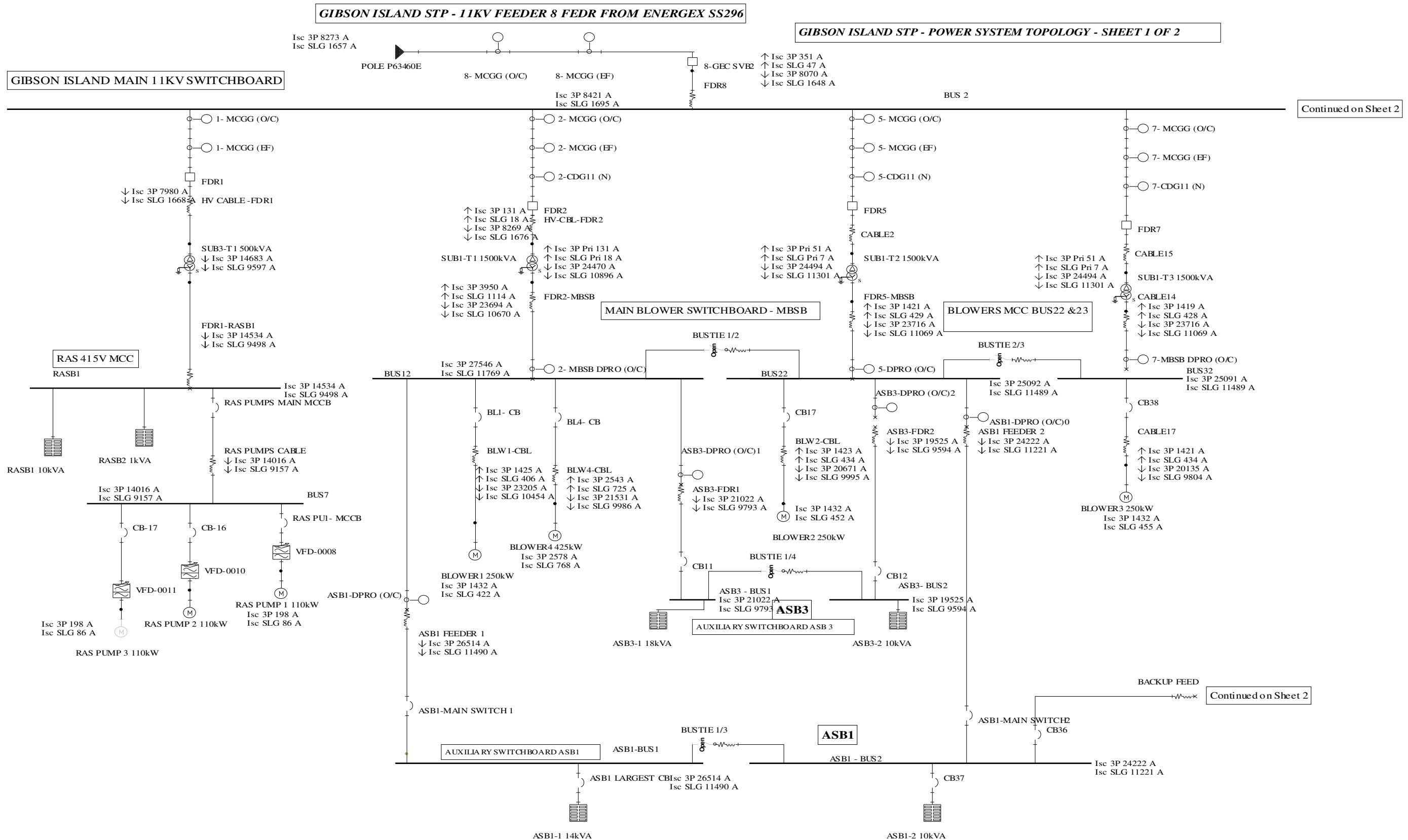


Figure 7- Gibson Island STP - One Line Diagram with Short Circuit Fault Levels (Sheet 1 of 2)

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

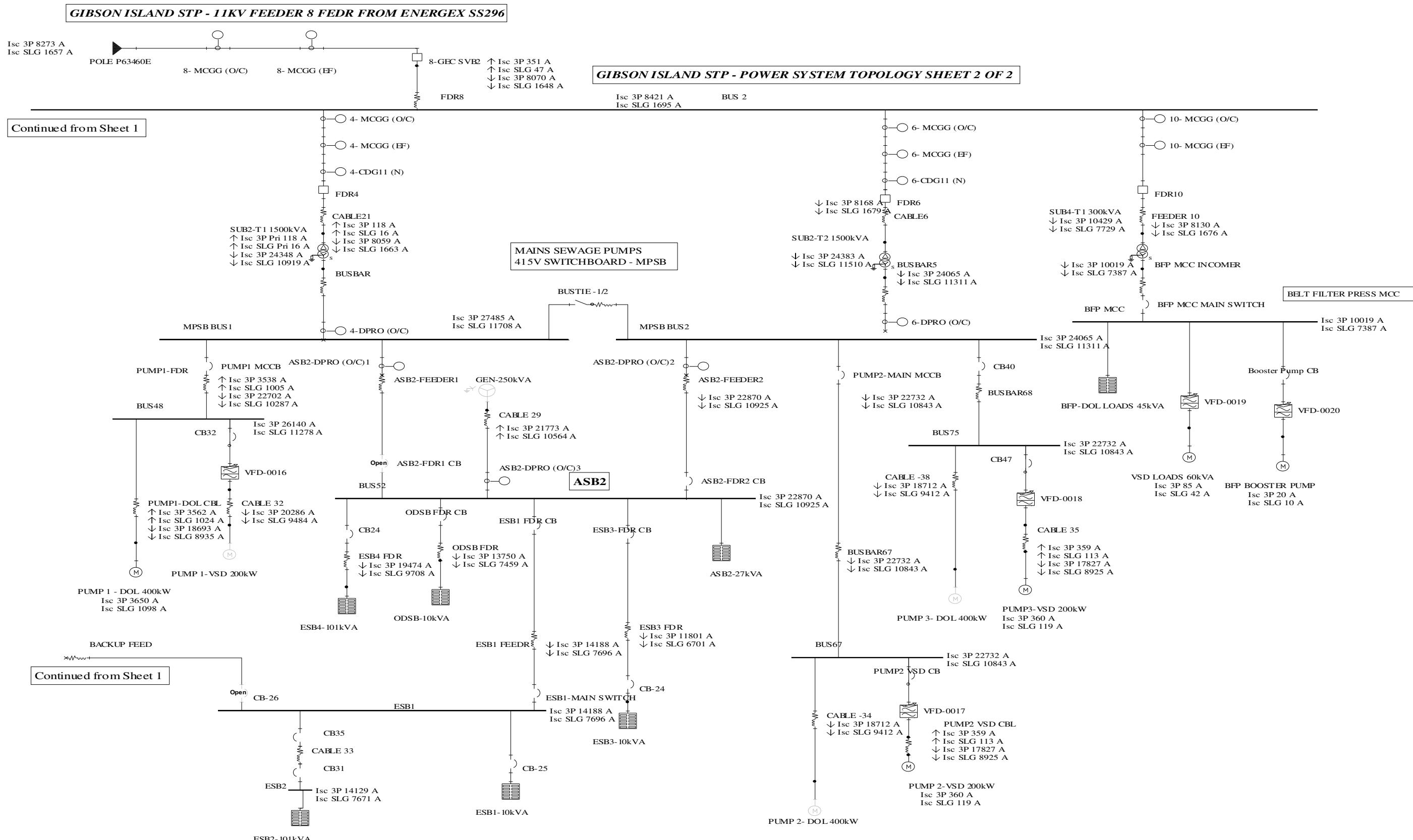


Figure 8-Gibson Island STP - One Line Diagram with Short Circuit Fault Levels (Sheet 2 of 2)

Refer to Appendix – 3 for full Short Circuit Fault Levels Report.

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

6 GIBSON ISLAND STP - RAS PUMP STATION MCC POWER SYSTEM ANALYSIS

Power supply from the STP 11kV Main Switchboard to RAS Pump Station MCC is shown below and next page on one line diagrams with the input data and load flow/voltage drop calculations:

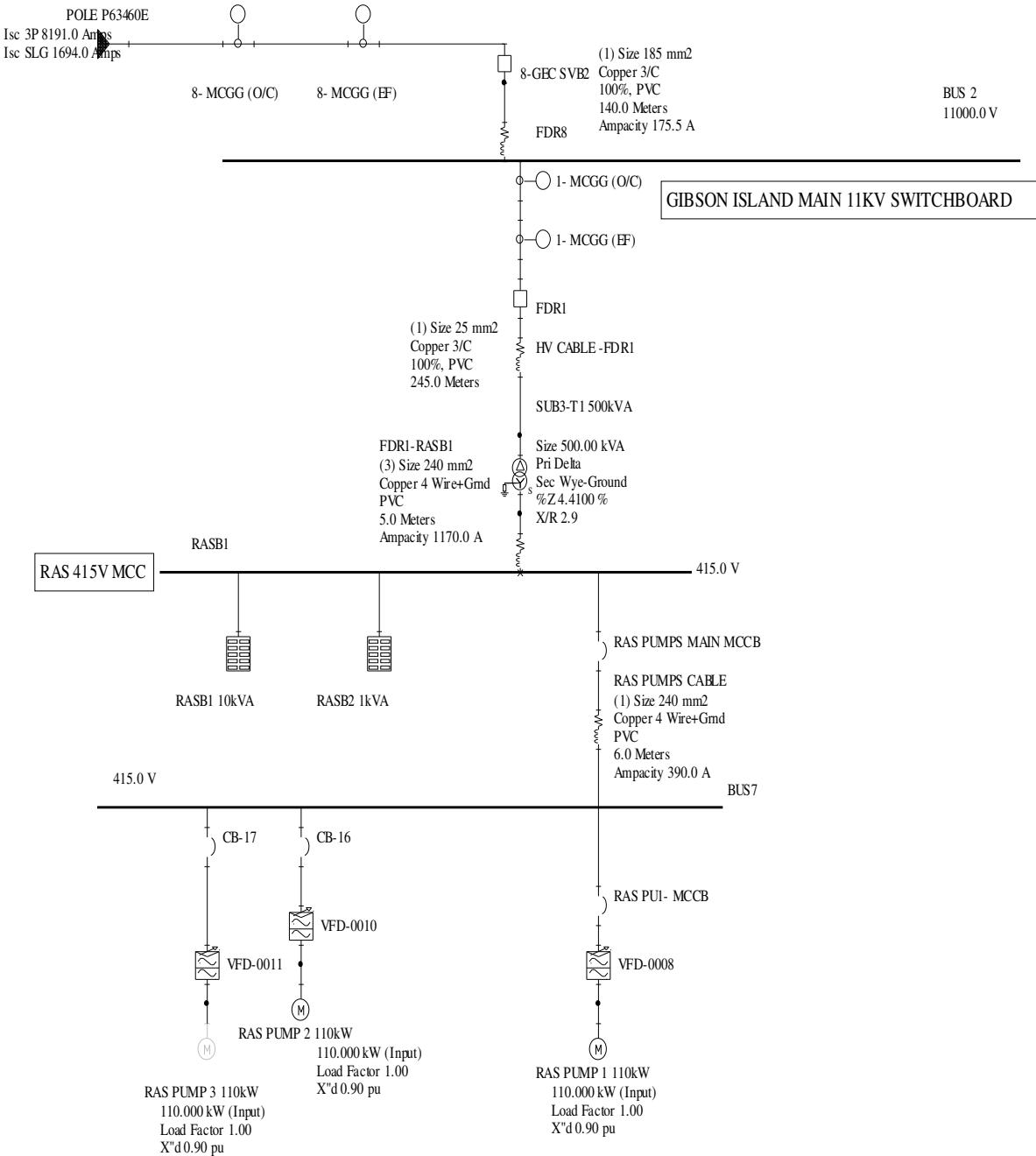


Figure 9 – RAS Pump Station MCC –One Line Diagram with Input Data

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

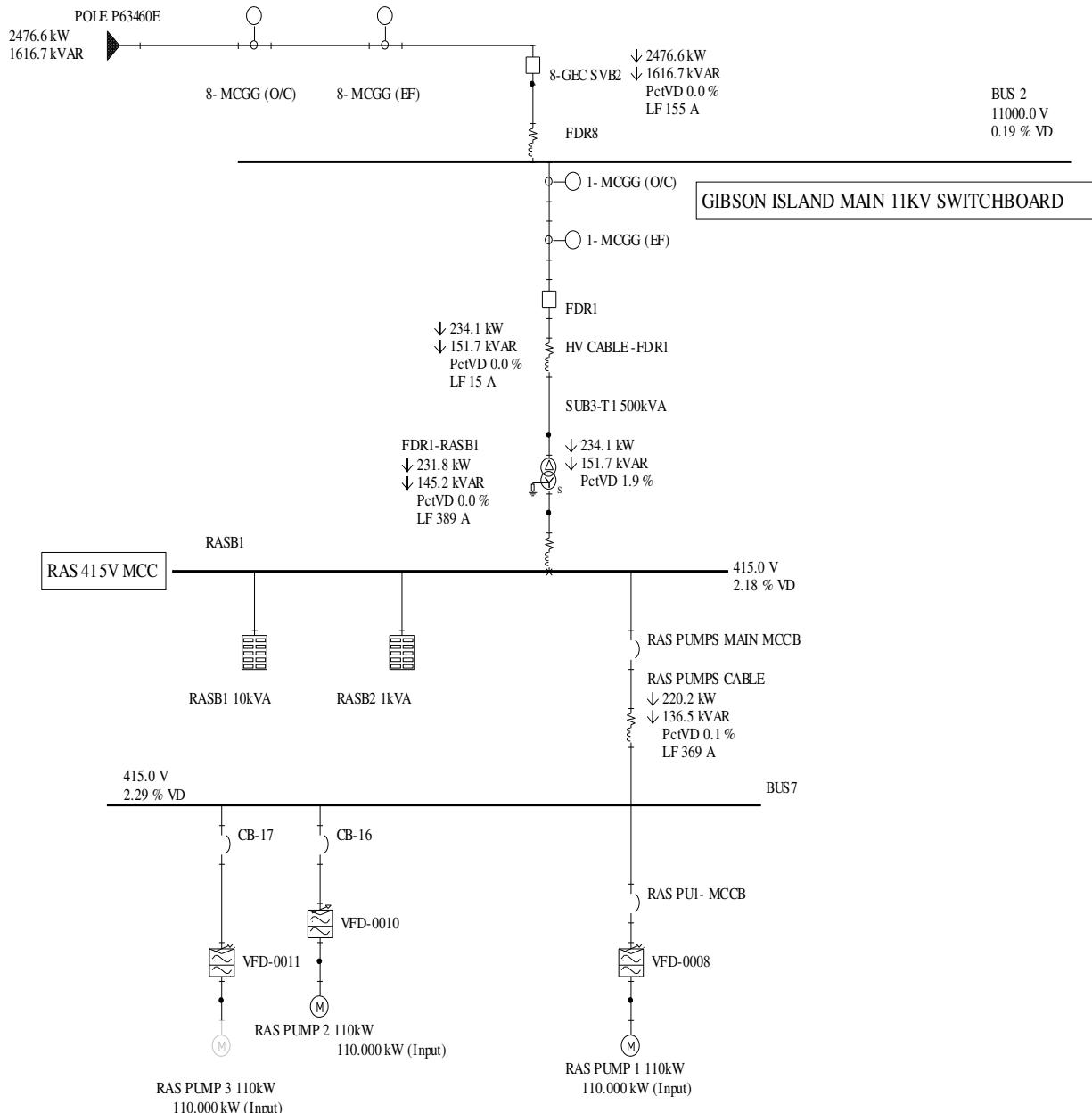


Figure 10 - RAS Pump Station MCC –One Line Diagram with Load Flow and Voltage Drop

6.1 RAS Pump Station MCC Power System Analysis

Given the above listed equipment input data to the Power Tools DAPPER Software Program, the following one-line diagram depicts fault levels on the RAS MCC Power System Topology:

WATER SERVICES ENGINEERING (WSE) PTY. LTD.

POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

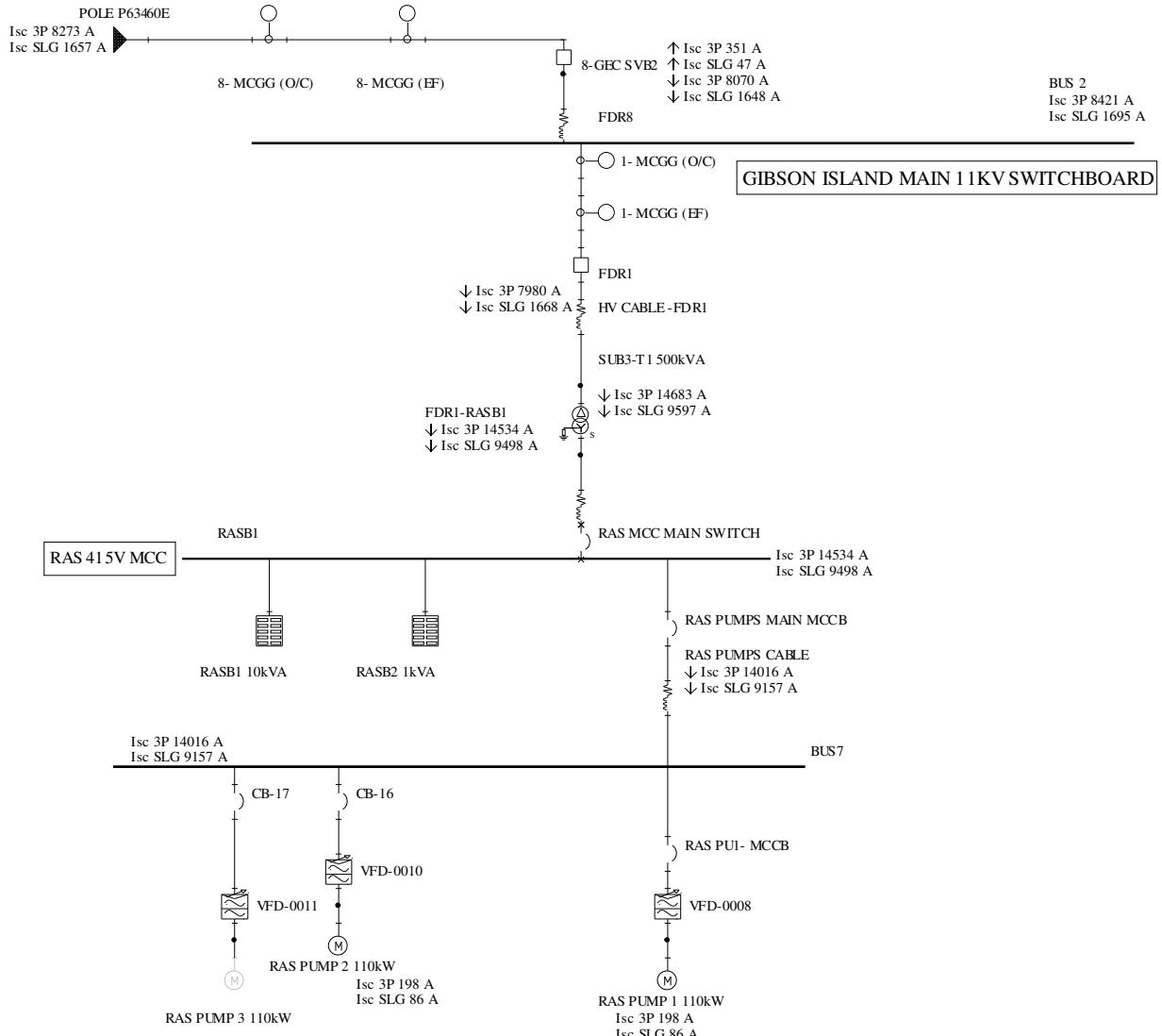


Figure 11 – RAS MCC – 3 Phase and Single Phase to Ground Short Circuit Fault Levels

Shown in the above one-line diagram are the 3 phase (3P) and single phase to ground (SLG) short circuit fault currents on the RAS MCC 415V Busbars which are **14.534kA** and **9.498kA** respectively.

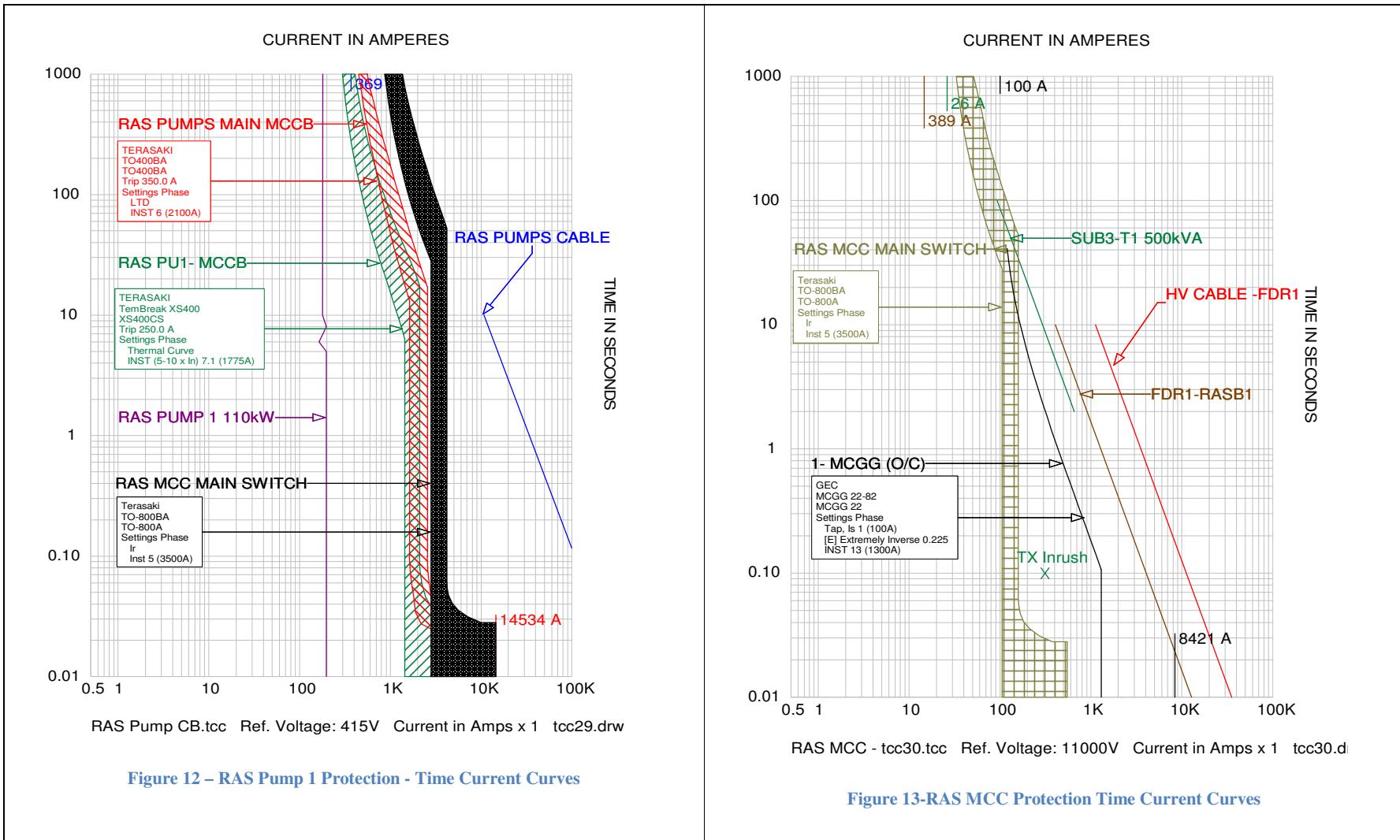
Shown in the following diagrams are the Time Current Curves (TCC) for the major protection devices at the Pump Station MCC that provide protection to the: Largest drive in the MCC and MCC Busbars. These Protection Devices settings are provided in the following pages in order to achieve the protection co-ordination shown on the TCC diagrams.

CAPTOR (Computer Aided Plotting for Time Over current Reporting) Software has been used for this Protection Coordination Study with the following output report.

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP



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QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

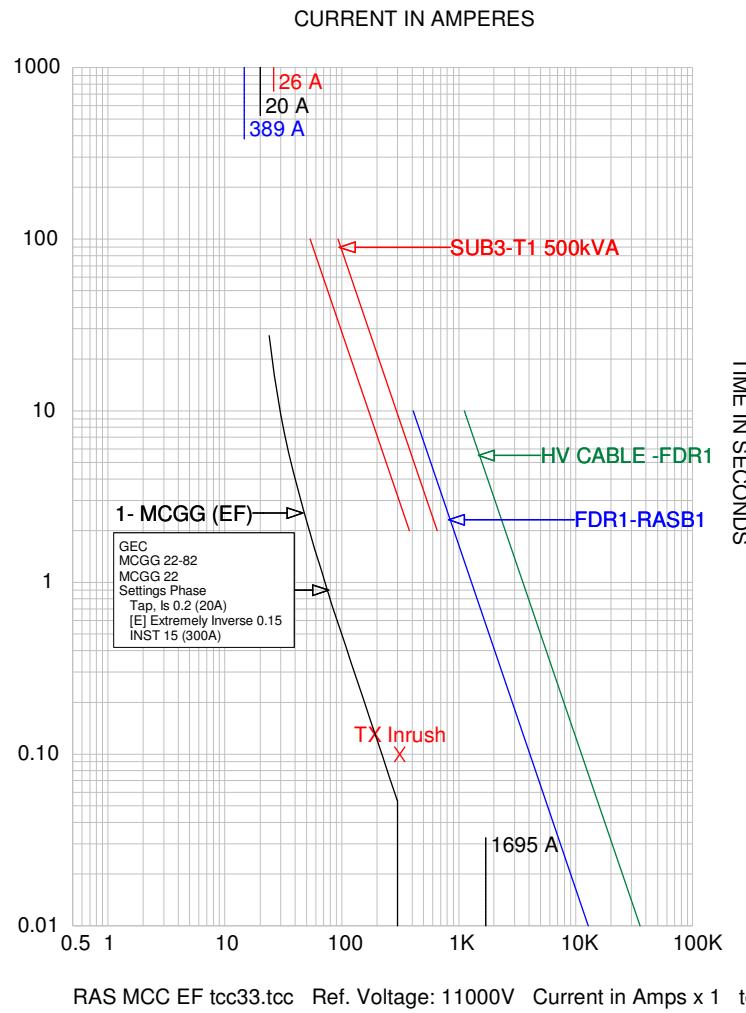


Figure 14 - RAS MCC Earth Fault Protection Time Current Curves

6.1.1 RAS Pump Station MCC Power System Analysis – Device Setting Parameters

The following CAPTOR Report provides protection device settings shown on the Time Current Curves in Figures 12,13&14 above:

TCC Name: RAS Pump CB.tcc
 Reference Voltage: 415 V
 Current Scale: X 10⁰
 Fault Duty Option: Study Result - Bus Fault Current

 CAPTOR (Computer Aided Plotting for Time Overcurrent Reporting)
 COPYRIGHT SKM SYSTEMS ANALYSIS, INC. 1983-2007

Device Name:	RAS PUMPS MAIN MCCB	TCC Name:	RAS Pump CB.tcc
Bus Name:	RASB1	Bus Voltage:	415.0V
Function Name:	Phase	Fault Duty:	14534.0A
Manufacturer:	TERASAKI	Curve Multiplier:	1
Description:	200-400A	Time Adder:	0
Type:	TO400BA		
AIC Rating:	30kA		
Frame:	TO400BA 415V 400A		
Time Multiplier:	1		
Trip:	350A		
Setting: 1)	LTD		
	INST		

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

Device Name:	RAS PUMPS CABLE	TCC Name:	RAS Pump CB.tcc
Bus Name:	RASB1	Bus Voltage:	415.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	240	Qty/Ph:	1
Material:	Copper	Cont. Temp:	90 deg C.
		Damage Temp:	250 deg C.
Device Name:	RAS PU1- MCCB	TCC Name:	RAS Pump CB.tcc
Bus Name:	BUS7	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERASAKI		
Description:	200-400A		
Type:	XS400NJ		
AIC Rating:	50kA	Fault Duty:	14016.4A
Frame:	XS400NJ 415V 400A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Trip:	250A		
Setting: 1)	LTD		
Setting: 2)	INST		
	7.1		
Device Name:	RAS PUMP 1 110kW	TCC Name:	RAS Pump CB.tcc
Bus Name:	BUS-0101	Bus Voltage:	415.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Motor Starting Curve	Time Adder:	0
Rated Size:	110kW (1 of 1 Plotted)	Inrush:	1.1 (198.0A)
Power Factor:	0.85	FLA+Load Adder:	180.0A + 0.0A
Efficiency:	0.93	Starting Time:	10.00s
		Full Voltage (Square Transient)	
Device Name:	RAS MCC MAIN SWITCH	TCC Name:	RAS Pump CB.tcc
Bus Name:	RASB1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	Terasaki		
Description:	700A		
Type:	TO-800BA		
AIC Rating:	35kA	Fault Duty:	14534.0A
Frame:	TO-800A 440V 700A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Trip:			
Setting: 1)	Ir		
Setting: 2)	Inst		
	800A		
Device Name:	HV CABLE -FDR1	TCC Name:	RAS MCC - tcc30.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	25	Qty/Ph:	1
Material:	Copper	Cont. Temp:	90 deg C.
		Damage Temp:	250 deg C.
Device Name:	FDR1	TCC Name:	RAS MCC - tcc30.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	400A		
Type:	SBV2		
AIC Rating:	20kA	Fault Duty:	8420.6A
Frame:	SBV2 11000V 400A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Sensor:			
Plug:			
Device Name:	SUB3-T1 500kVA	TCC Name:	RAS MCC - tcc30.tcc
Bus Name:	BUS-0007	Bus Voltage:	11000.0V / 415V
Time Multiplier:	1	Curve Multiplier:	1
Description:	2-Winding Transformer Damage Curve	Time Adder:	0
Nominal Size:	500.0kVA	Rated Volts:	11000 LL/415 LL
Impedance (%Z):	4.4100	Pri Connection:	Delta
Inrush Factor:	12.0x	Sec Connection:	Wye-Ground

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

Device Name:	FDR1-RASB1	TCC Name:	RAS MCC - tcc30.tcc
Bus Name:	BUS-0008	Bus Voltage:	415.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	240	Qty/Ph:	3
Material:	Copper	Cont. Temp:	90 deg C.
Damage Temp:	250 deg C.		

Device Name:	1- MCGG (O/C)	TCC Name:	RAS MCC - tcc30.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	1	(100A)	Test Points: @2.0X, 6.000s
2) [E] Extremely Invers	0.225		@5.0X, 0.750s
3) INST	13	(1300A)	@10.0X, 0.182s

Device Name:	1- MCGG (EF)	TCC Name:	RAS MCC EF tcc33.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	1695.1A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	0.2	(20A)	Test Points: @2.0X, 4.000s
2) [E] Extremely Invers	0.15		@5.0X, 0.500s
3) INST	15	(675A)	@10.0X, 0.121s

6.2 RAS Pump Station Arc Flash Evaluation

Electrical arc burns account for a large percentage of electrical injuries. An arc flash study combines short circuit calculations, empirical equations and protective device operating times to estimate incident energy and protective clothing requirements at typical working distances.

Causes of Electrical Arc Flash Events:

- Contact with live parts typically from dropping tools or loose parts.
- Insulation failure
- Over-voltages
- Dust
- Corrosion
- Condensation

Why Perform Arc Flash Studies?

- Prevent worker injury or death
- Avoid litigation expense
- Minimize equipment damage
- Minimize system down time
- Comply with codes and safety regulations (OSHA, NFPA, NEC).
- Insurance requirements

Arc Flash Studies estimate incident energy exposure from potential arc sources. The PTW Arc Flash Study follows the IEEE 1584 2002 methods for determining the arc-flash hazard distance and the incident energy that workers may be exposed to when working on or near electrical equipment.

WATER SERVICES ENGINEERING (WSE) PTY. LTD.

POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

The following Arc Flash Evaluation Study has been carried out to provide PPE Requirements for the Gibson Island STP RAS MCC 415V power supplies and switchboard.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Bus Name	Protective Device	Bus kV	Bus Bolted	Prot Dev Arcing	Trip/ Arcing	Breaker Delay	Ground	Equip Type	Gap (mm)	Arc Flash Boundary	Working Distance (mm)	Incident Energy (cal/cm2)	PPE Level	Label #	Cable Length		
2																From Trip Device		
3																		
4																		
23	RASB1 (RAS MCC BUS BARS)	RAS MCC MAIN SWITCH	0.415	14.54	8.07	14.54	8.07	0.03	0.000	Yes	PNL	25	356	457	0.79	Category 0	# 0019	

Figure 1548 - Arc Flash Calculation & PPE Description Table

The highest PPE Level on this switchboard is Category 0 at the Switchboard Busbars. The following label is recommended to be shown on the switchboard front door for PPE Requirements (shown below are descriptions of terminologies shown the label):

Label Item	Description
Flash Hazard Boundary	<u>The distance from an arcing fault within which unprotected skin could receive a 2nd degree burn. Generally considered the distance from an exposed arc source where the incident energy equals 1.2 cal/cm2.</u>
Limited Approach	<u>An approach limit at a distance from an exposed live part within which a shock hazard exists (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).</u>
Restricted Approach	<u>A shock protection boundary to be crossed by only qualified persons (at a distance from a live exposed part) which, due to its proximity to a shock hazard, requires the use of shock protection techniques and equipment when crossed (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).</u>
Prohibited Approach	<u>An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part. Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location.</u>

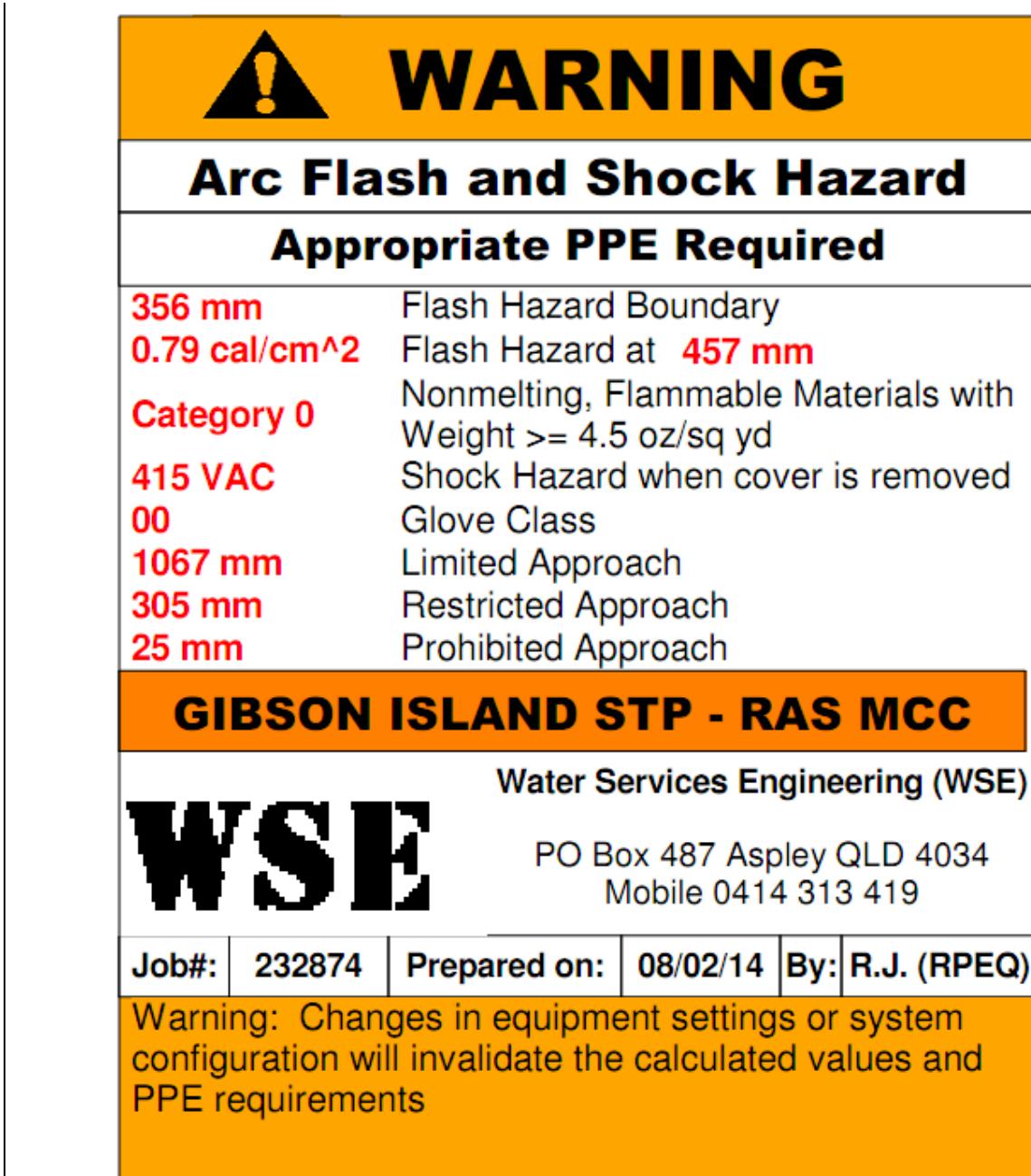


Figure 1619 – RAS MCC - Arc Flash Label

The Arc Flash Category for RAS MCC with the recommended settings is Category 0. It is recommended to apply this label on the front door of the SWBD.

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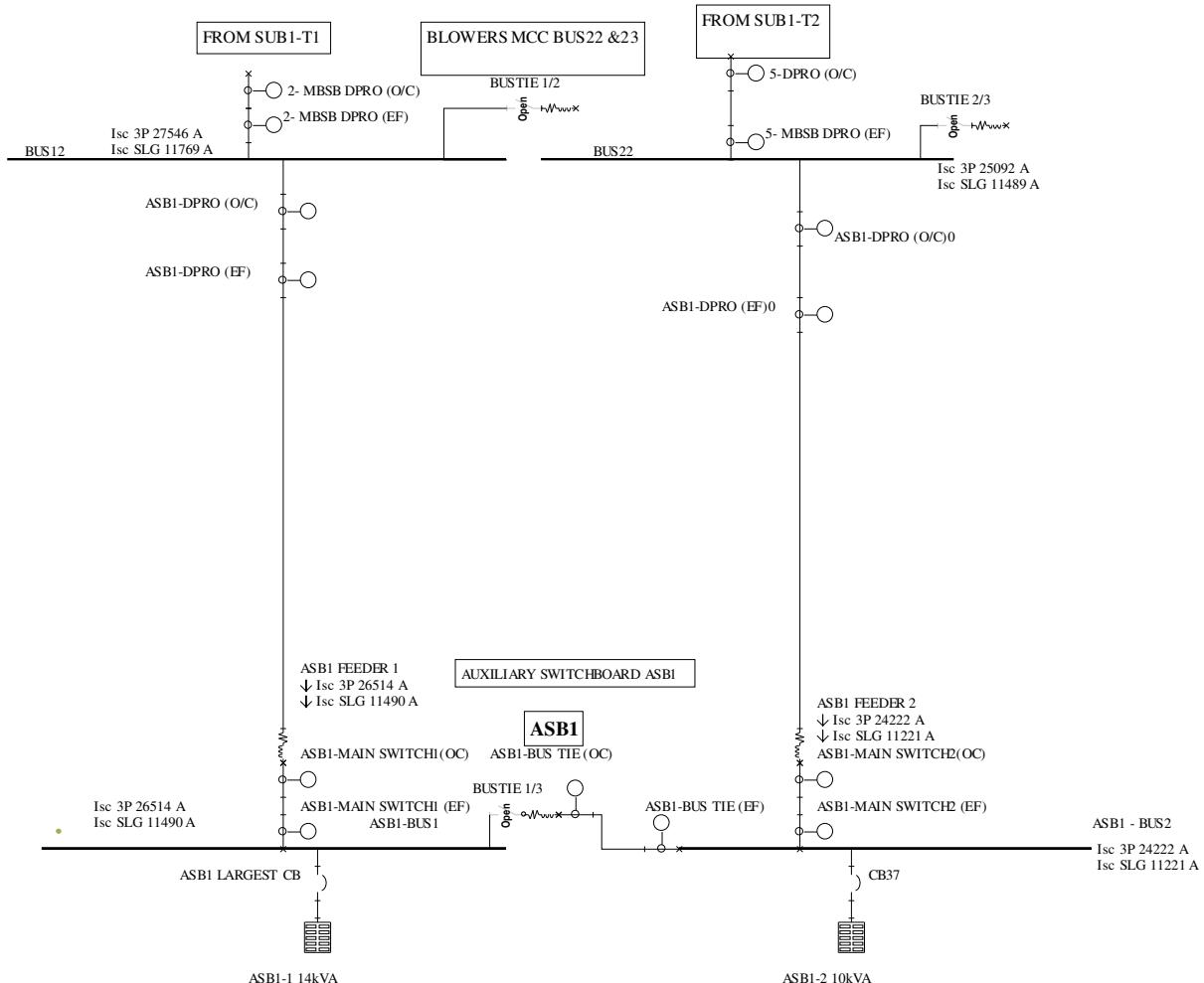
POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

7 BLOWERS MAIN SWITCHBOARD MBSB 415V POWER SYSTEM ANALYSIS

7.1 Feeders to Auxiliaries Switchboard ASB1 Protection Coordination

The following one-line diagram depicts ASB1- Bus 1 Power System Topology with short circuit fault currents:



| **Figure 1745 – Auxiliaries Switchboard ASB1-Bus 1&2 415V Fault Levels**

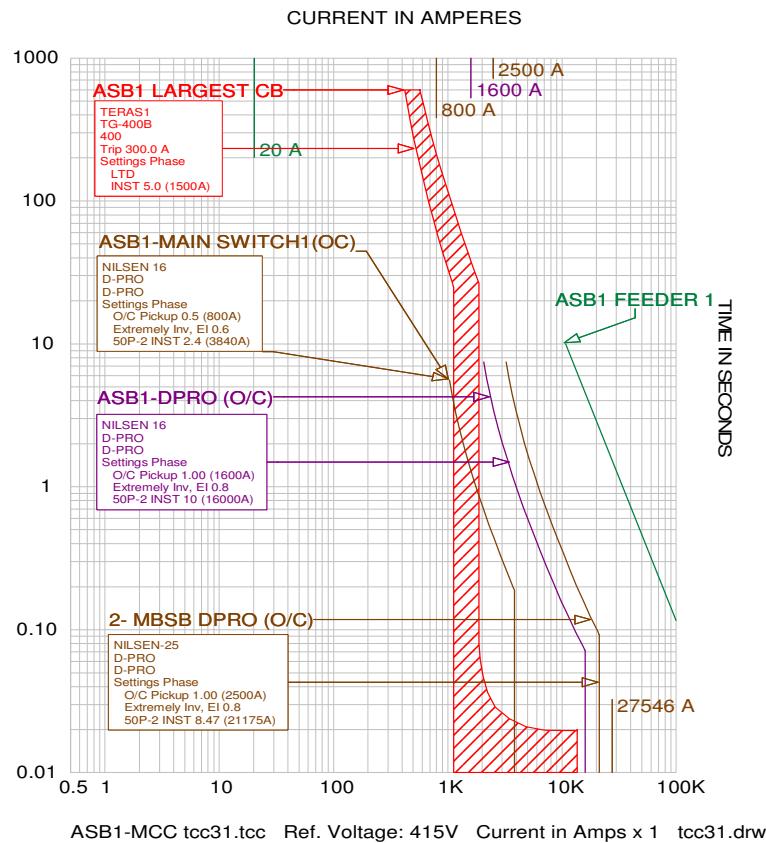
Shown in the above one-line diagram are the 3 phase (3P) and single phase to ground (SLG) short circuit fault currents on the ASB1-BUS1 and ASB1-BUS2. Due to very close fault levels on both busbars, and possibility of supplying both busbars from one feeder, the protection devices on both busbars will be coordinated to the highest fault levels of **3P=26.514kA** and **SLG=11.490kA**. Therefore the protection devices settings on ASB1-BUS2 will be similar to ASB1-BUS1.

Shown in the following diagrams is the Time Current Curves (TCC) for the major protection devices on the ASB1-BUS1 and upstream up to the Main Blower Switchboard MBSB.

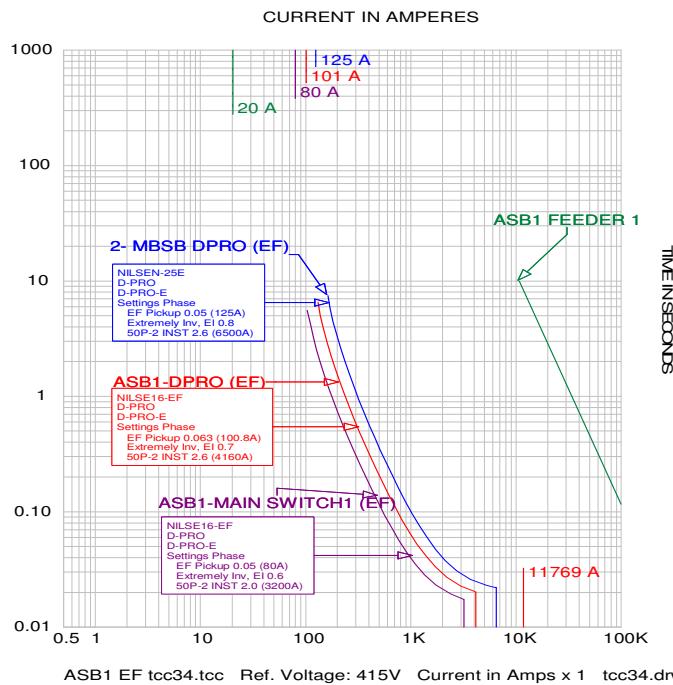
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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP



| Figure 1816 – ASB1 – BUS1 3Phase Fault Protection Time Current Curves



| Figure 1917 - ASB1 Earth Fault Protection Time Current Curves

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

7.1.1 Auxiliaries Switchboard - ASB1 - Protection Device Setting Parameters

The following CAPTOR Report provides protection device settings shown on the Time Current Curves in Figures 16&17 of this report:

05 May 2012	12:31:47		
TCC Name:	ASB1-MCC tcc31.tcc		
Reference Voltage:	415 V		
Current Scale:	X 10^0		
TCC Notes:			
TCC Comment:			
Fault Duty Option:	Study Result - Bus Fault Current		

Device Name:	ASB1 LARGEST CB	TCC Name:	ASB1-MCC tcc31.tcc
Bus Name:	ASB1-BUS1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	250-400A		
Type:	TG-400B		
AIC Rating:	56kA	Fault Duty:	26513.8A
Frame:	400 415V 400A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Trip:	300A		
Setting: 1) LTD			
2) INST	5.0	(1500A)	

Device Name:	ASB1 FEEDER 1	TCC Name:	ASB1-MCC tcc31.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	240	Qty/Ph:	3
Material:	Copper	Cont. Temp:	90 deg C.
		Damage Temp:	250 deg C.

Device Name:	ASB1-DPRO (O/C)	TCC Name:	ASB1-MCC tcc31.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN 16		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	27545.6A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup	1.00	(1600A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	10	(16000A)	@10.0X, 0.072s

Device Name:	ASB1-DPRO (EF)	TCC Name:	ASB1 EF tcc34.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSE16-EF		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	11769.4A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.063	(100.8A)	Test Points: @2.0X, 1.512s
2) Extremely Inv, EI	0.7		@5.0X, 0.204s
3) 50P-2 INST	2.6	(4160A)	@10.0X, 0.063s

Device Name:	2- MBSB DPRO (EF)	TCC Name:	ASB1 EF tcc34.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25E		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	11769.4A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.05	(125A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s

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3) 50P-2 INST 2.6 (6500A) @10.0X, 0.072s

 Device Name: ASB1 FEEDER 1 TCC Name: ASB1 EF tcc34.tcc
 Bus Name: BUS12 Bus Voltage: 415.0V
 Curve Multiplier: 1
 Time Adder: 0
 Qty/Ph: 3
 Cont. Temp: 90 deg C.
 Damage Temp: 250 deg C.

Time Multiplier: 1
 Description: Cable Damage Curve
 Size: 240
 Material: Copper

 Device Name: ASB1-MAIN SWITCH1 (EF) TCC Name: ASB1 EF tcc34.tcc
 Bus Name: ASB1-BUS1 Bus Voltage: 415.0V
 Function Name: Phase
 Manufacturer: NILSE16-EF
 Description: 50E/51E
 Type: D-PRO
 AIC Rating: N/A
 Current Rating: 1600A / 1A
 Time Multiplier: 1
 Setting: 1) EF Pickup 0.05 (80A) Class Desc: D-PRO-E
 2) Extremely Inv, EI 0.6 Fault Duty: 11490.1A
 3) 50P-2 INST 2.0 Curve Multiplier: 1
 Time Adder: 0
 Test Points: @2.0X, 1.296s
 @5.0X, 0.175s
 @10.0X, 0.054s

 Device Name: 2- MBSB DPR0 (O/C) TCC Name: ASB1-MCC tcc31.tcc
 Bus Name: BUS12 Bus Voltage: 415.0V
 Function Name: Phase
 Manufacturer: NILSEN-25
 Description: 50/51
 Type: D-PRO
 AIC Rating: N/A
 Current Rating: 2500A / 1A
 Time Multiplier: 1
 Setting: 1) O/C Pickup 1.00 (2500A) Class Desc: D-PRO
 2) Extremely Inv, EI 0.8 Fault Duty: 27545.6A
 3) 50P-2 INST 8.47 Curve Multiplier: 1
 Time Adder: 0
 Test Points: @2.0X, 1.729s
 @5.0X, 0.234s
 @10.0X, 0.072s

 Device Name: ASB1-MAIN SWITCH1(OC) TCC Name: ASB1-MCC tcc31.tcc
 Bus Name: ASB1-BUS1 Bus Voltage: 415.0V
 Function Name: Phase
 Manufacturer: NILSEN 16
 Description: 50/51
 Type: D-PRO
 AIC Rating: N/A
 Current Rating: 1600A / 1A
 Time Multiplier: 1
 Setting: 1) O/C Pickup 0.5 (800A) Class Desc: D-PRO
 2) Extremely Inv, EI 0.6 Fault Duty: 26513.8A
 3) 50P-2 INST 2.4 Curve Multiplier: 1
 Time Adder: 0
 Test Points: @2.0X, 1.296s
 @5.0X, 0.175s
 @10.0X, 0.054s

7.1.2 Blowers Switchboards - ASB1 - Arc Flash Evaluation

The following Arc Flash Evaluation Study has been carried out to provide PPE Requirements for the Gibson Island STP Blowers Auxiliaries ASB1- 415V power supplies and switchboard.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	
1	Bus Name	Protective	Bus	Bus	Prot Dev	Prot Dev	Trip/	Breaker	Ground	Equip	Gap	Arc Flash	Working	Incident	PPE Level	Label #	Cable Length	
2	Device	kV	Bolted	Arcing	Bolted	Arcing	Delay	Opening		Type	(mm)	Boundary	Distance	Energy			From Trip Device	
3	Name	Fault	Fault	Fault	Fault	Time	Time/Tol			(mm)	(mm)	(cal/cm2)					(m)	
4		(kA)	(kA)	(kA)	(kA)	(sec.)	(sec.)											
5	ASB1 - BUS2	ASB1-MAIN SWITCH2 (EF)	0.415	24.23	12.26	24.23	12.26	0.02	0.060	Yes	PNL	25	851	457	3.3	Category 1	# 0001	10.00
6	ASB1-BUS1	ASB1-MAIN SWITCH1 (EF)	0.415	26.52	13.20	26.52	13.20	0.02	0.060	Yes	PNL	25	893	457	3.6	Category 1	# 0002	10.00
11	BUS12 (MBSB)	2- MBSB DPR0 (EF)	0.415	27.55	13.62	23.70	11.71	0.02	0.060	Yes	PNL	25	912	457	3.7	Category 1	# 0007	
12	BUS22 (MBSB)	5- MBSB DPR0 (EF)	0.415	25.10	12.62	23.72	11.93	0.02	0.060	Yes	PNL	25	867	457	3.4	Category 1	# 0008	

Figure 2048 - Arc Flash Calculation & PPE Description Table

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The highest PPE Level on this switchboard is Category 1 at the Switchboards Busbars. The following label is recommended to be shown on the switchboards front door for PPE Requirements (shown below are descriptions of terminologies shown the label):

<u>Label Item</u>	<u>Description</u>
<u>Flash Hazard Boundary</u>	The distance from an arcing fault within which unprotected skin could receive a 2nd degree burn. Generally considered the distance from an exposed arc source where the incident energy equals 1.2 cal/cm ² .
<u>Limited Approach</u>	An approach limit at a distance from an exposed live part within which a shock hazard exists (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).
<u>Restricted Approach</u>	A shock protection boundary to be crossed by only qualified persons (at a distance from a live exposed part) which, due to its proximity to a shock hazard, requires the use of shock protection techniques and equipment when crossed (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).
<u>Prohibited Approach</u>	An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part. Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location.

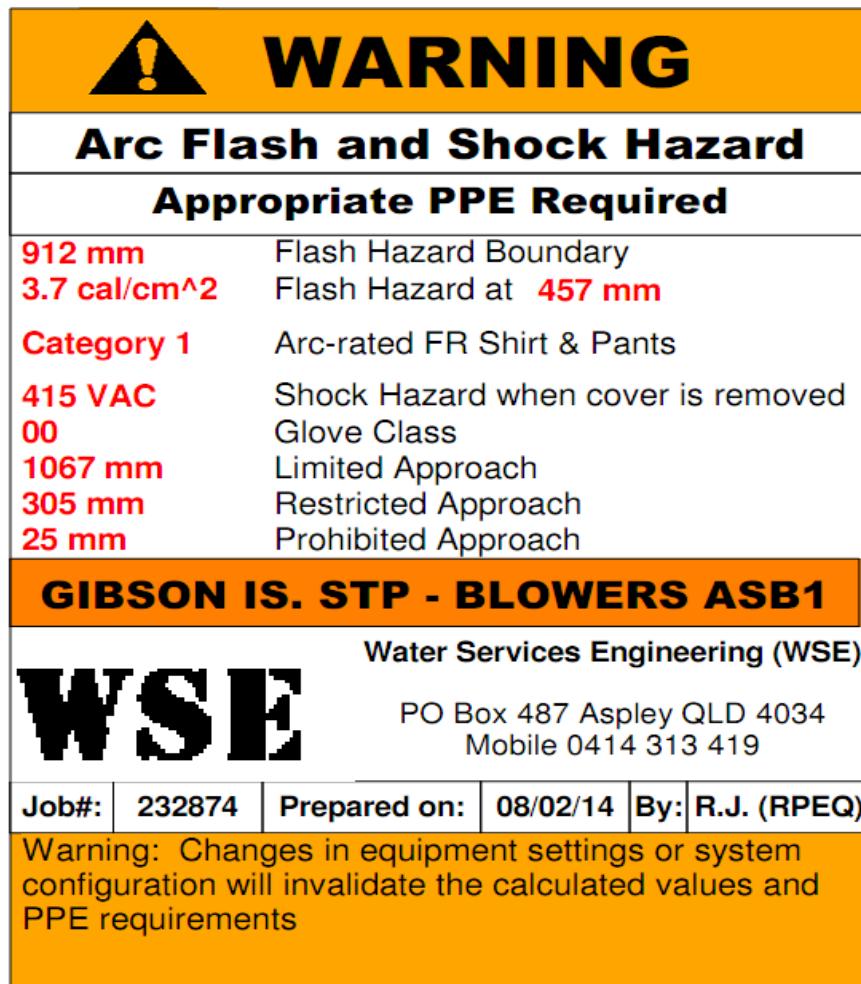


Figure 21 - Blowers Aux. ASB1 Label

7.2 Feeders to Auxiliaries Switchboard ASB3 Protection Coordination

The following one-line diagram depicts ASB3 Power System Topology with short circuit fault currents:

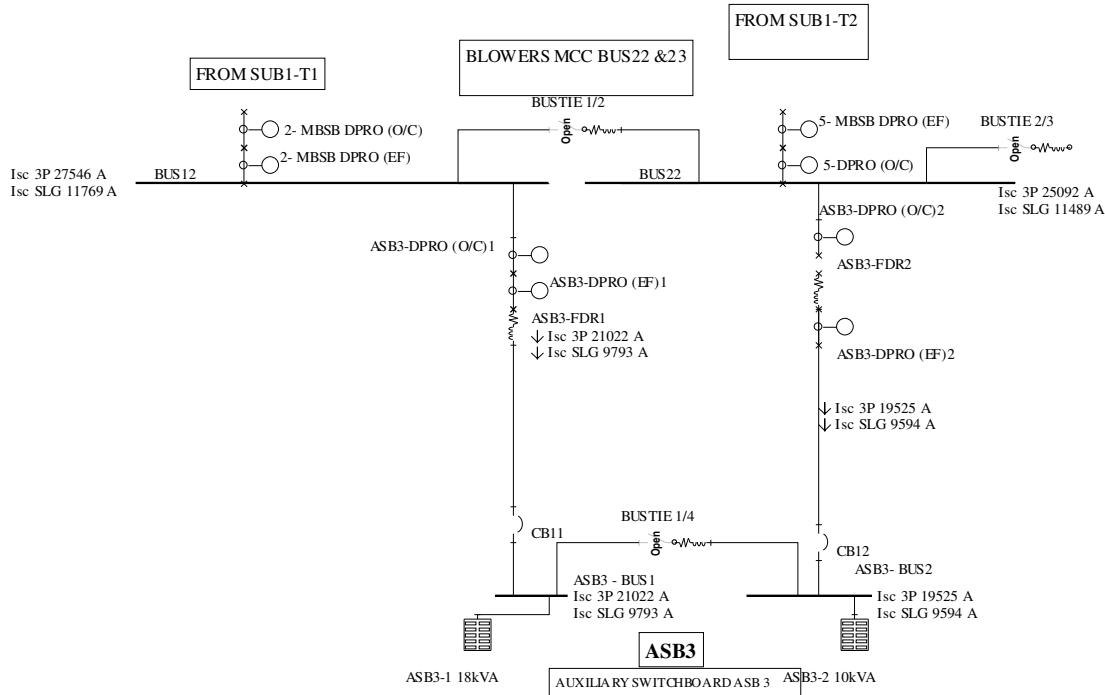


Figure 2218 – Auxiliaries Switchboard ASB3-Bus 1&2 415V Fault Levels

Shown in the above one-line diagram are the 3 phase (3P) and single phase to ground (SLG) short circuit fault currents on the ASB3-BUS1 and ASB3-BUS2. Due to very close fault levels on both busbars, and possibility of supplying both busbars from one feeder, the protection devices on both busbars will be coordinated to the highest fault levels of **3P=21.022kA** and **SLG=9.793kA**. Therefore the protection devices settings on ASB3-BUS2 will be similar to ASB3-BUS1.

Shown in the following diagrams is the Time Current Curves (TCC) for the major protection devices on the ASB3-BUS1 and upstream up to the Main Blower Switchboard MBSB.

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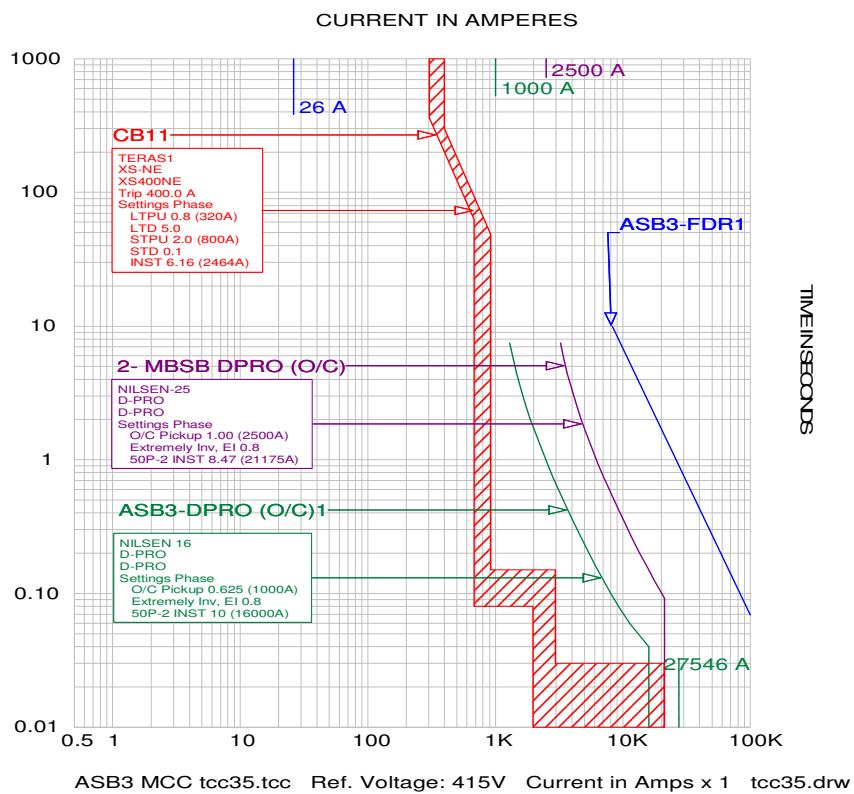


Figure 2319 – ASB3 – BUS1 3Phase Fault Protection Time Current Curves

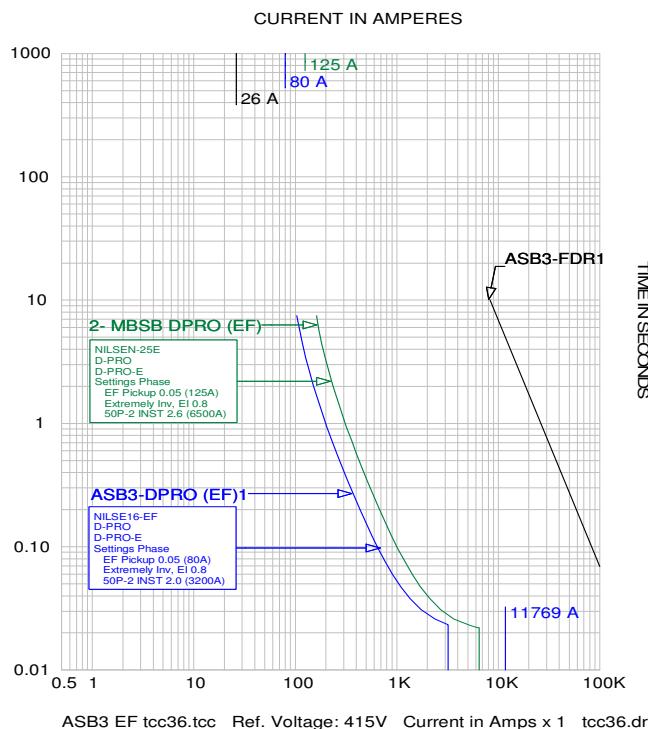


Figure 2420 – ASB3 Earth Fault Protection Time Current Curves

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7.2.1 Auxiliaries Switchboard - ASB3 - Protection Device Setting Parameters

The following CAPTOR Report provides protection device settings shown on the Time Current Curves in Figures 19&20:

05 May 2012
Project Name: QUU Gibson Island STP
TCC Name: ASB3 MCC tcc35.tcc
Reference Voltage: 415 V
Current Scale: X 10^0
TCC Notes:
TCC Comment:
Fault Duty Option: Study Result - Bus Fault Current

Device Name:	CB11	TCC Name:	ASB3 MCC tcc35.tcc
Bus Name:	ASB3 - BUS1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	TemBreak		
Type:	XS-NE		
AIC Rating:	50kA	Fault Duty:	21021.8A
Frame:	XS400NE 415V 400A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Sensor:	400A		
Plug:			
Setting:	1) LTPU 0.8	(320A)	
	2) LTD 5.0		
	3) STPU 2.0	(800A)	
	4) STD 0.1		
	5) INST 6.16	(2464A)	

Device Name:	ASB3-FDR1	TCC Name:	ASB3 MCC tcc35.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	185	Qty/Ph:	2
Material:	Copper	Cont. Temp:	90 deg C.
		Damage Temp:	250 deg C.

Device Name:	ASB3-DPRO (O/C)1	TCC Name:	ASB3 MCC tcc35.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN 16		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	27545.6A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting:	1) O/C Pickup 0.625	(1000A)	Test Points: @2.0X, 1.729s
	2) Extremely Inv, EI 0.8		@5.0X, 0.234s
	3) 50P-2 INST 10	(16000A)	@10.0X, 0.072s

Device Name:	ASB3-DPRO (EF)1	TCC Name:	ASB3 EF tcc36.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSE16-EF		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	11769.4A
Current Rating:	1600A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting:	1) EF Pickup 0.05	(80A)	Test Points: @2.0X, 1.729s
	2) Extremely Inv, EI 0.8		@5.0X, 0.234s
	3) 50P-2 INST 2.0	(3200A)	@10.0X, 0.072s

Device Name:	2- MBSB DPRO (EF)	TCC Name:	ASB3 EF tcc36.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25E		
Description:	50E/51E		

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Type:	D-PRO		Class Desc:	D-PRO-E
AIC Rating:	N/A		Fault Duty:	11769.4A
Current Rating:	2500A / 1A		Curve Multiplier:	1
Time Multiplier:	1		Time Adder:	0
Setting: 1) EF Pickup	0.05	(125A)	Test Points:	@2.0X, 1.729s
2) Extremely Inv, EI	0.8			@5.0X, 0.234s
3) 50P-2 INST	2.6	(6500A)		@10.0X, 0.072s

Device Name:	2- MBSB DPRO (O/C)	TCC Name:	ASB3 MCC tcc35.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	27545.6A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup	1.00	(2500A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	8.47	(21175A)	@10.0X, 0.072s

7.2.2 Auxiliaries Switchboard – ASB3 – Arc Flash Evaluation

The following Arc Flash Evaluation Study has been carried out to provide PPE Requirements for the Gibson Island STP Auxiliaries Switchboard ASB3 415V power supplies and switchboard.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Bus Name	Protective	Bus	Bus	Bus	Prot Dev	Prot Dev	Trip/ Arcing	Breaker	Ground	Equip	Gap	Arc Flash	Working	Incident	PPE Level	Label #	Cable Length
2		Device	kV	Bolted	Arcing	Bolted	Arcing	Delay	Opening		Type				Energy			From Trip Device
3		Name		Fault	Fault	Fault	Fault	Time	Time/Tol						(cal/cm2)			(m)
4				(kA)	(kA)	(kA)	(kA)	(sec.)	(sec.)									
1	ASB3 - BUS1	ASB3-DPRO (EF)1	0.415	21.02	10.92	21.02	10.92	0.02	0.060	Yes	PNL	25	788	457	2.9	Category 1	# 0003	45.00
7	ASB3 - BUS2	ASB3-DPRO (EF)2	0.415	19.53	10.28	19.53	10.28	0.02	0.060	Yes	PNL	25	757	457	2.7	Category 1	# 0004	45.00

Figure 2548 - Arc Flash Calculation & PPE Description Table

The highest PPE Level on this switchboard is Category 1 at the Switchboard Busbars. The following label is recommended to be shown on the switchboard front door for PPE Requirements (shown below are descriptions of terminologies shown the label):

Label Item	Description
<u>Flash Hazard Boundary</u>	The distance from an arcing fault within which unprotected skin could receive a 2nd degree burn. Generally considered the distance from an exposed arc source where the incident energy equals 1.2 cal/cm2.
<u>Limited Approach</u>	An approach limit at a distance from an exposed live part within which a shock hazard exists (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).
<u>Restricted Approach</u>	A shock protection boundary to be crossed by only qualified persons (at a distance from a live exposed part) which, due to its proximity to a shock hazard, requires the use of shock protection techniques and equipment when crossed (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).
<u>Prohibited Approach</u>	An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part. Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location.

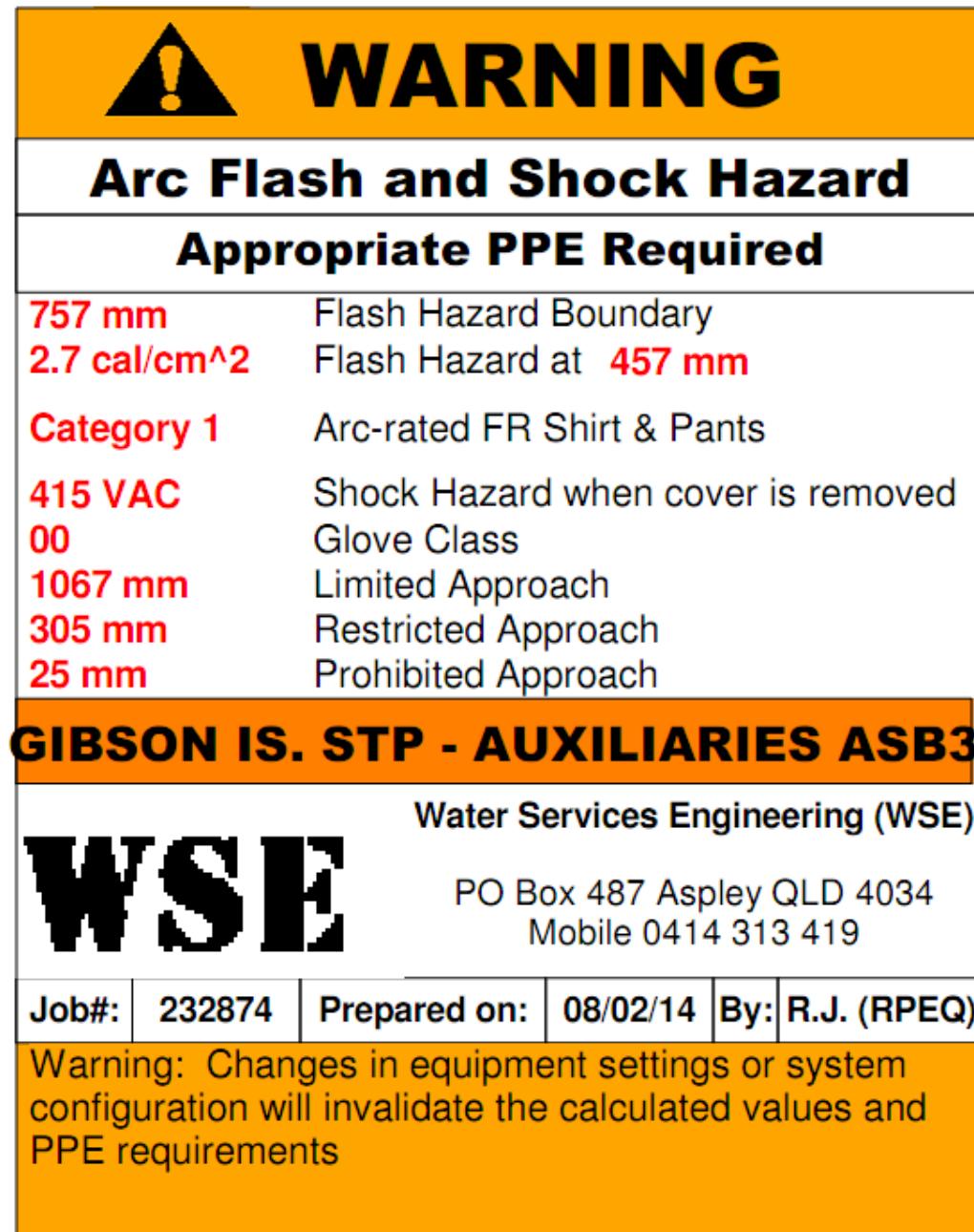


Figure 2649 – Auxiliaries Switchboard Recommended Arc Flash Label

The Arc Flash Category for this ASB3 Switchboard with the recommended settings is Category 1. It is recommended to apply this label on the front door of the SWBD.

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7.3 Blowers 1, 2,3 & 4 on MBSB Switchboard Protection Coordination

The following one-line diagram depicts Blowers 1,2,3 & 4 Power System Topology with short circuit fault currents:

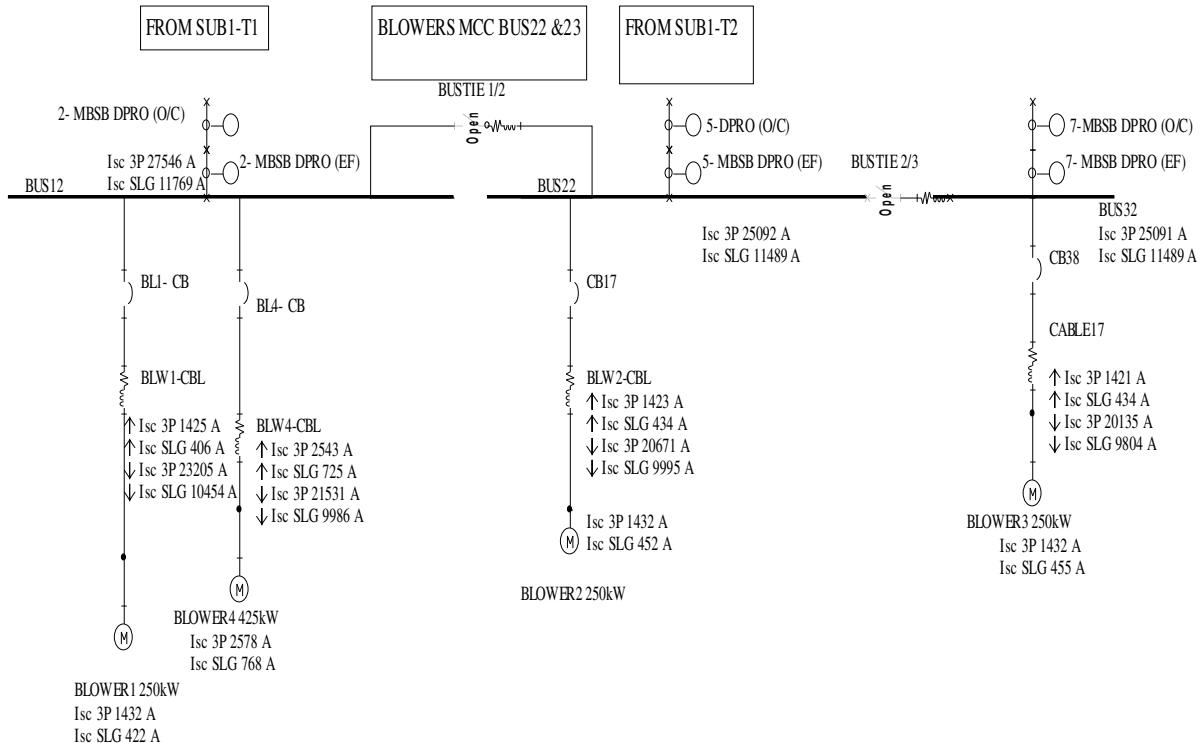


Figure 2724 – Blowers 1,2,3&4 on MBSB- 415V Fault Levels

Shown in the above one-line diagram are the 3 phase (3P) and single phase to ground (SLG) short circuit fault currents on the MBSB Bus 12, Bus22 and Bus 32 for Blowers Switchboard, as there is possibility of closing Bus-Ties and running all blowers from one feeder, the highest 3 Phase of **27.546kA** and SLG of **11.769kA** have been selected for protection coordination of all blowers.

Shown in the following diagrams is the Time Current Curves (TCC) for the major protection devices on the MBSB-BUS12.

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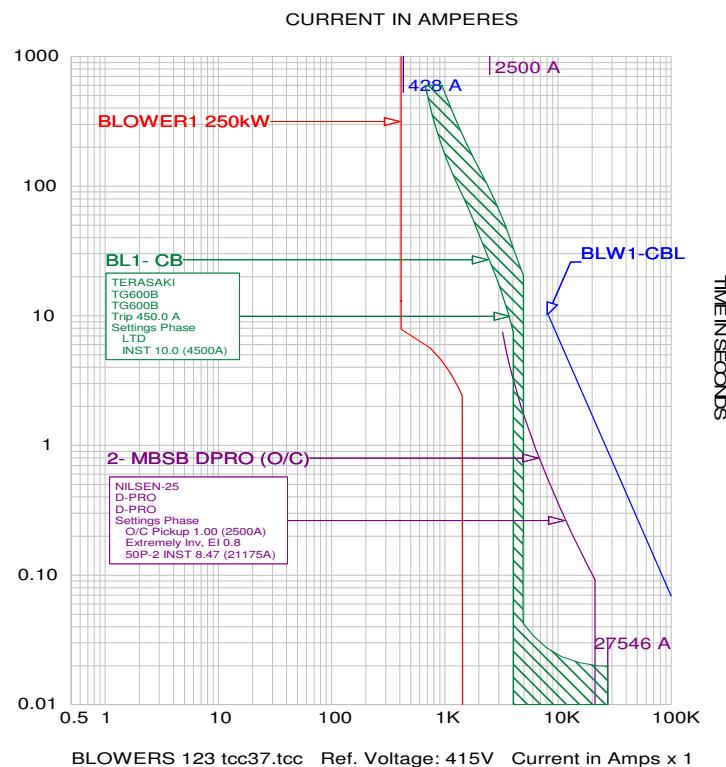


Figure 2822 – Blowers 1,2 & 3 - 3Phase Fault Current Protection Time Current Curves

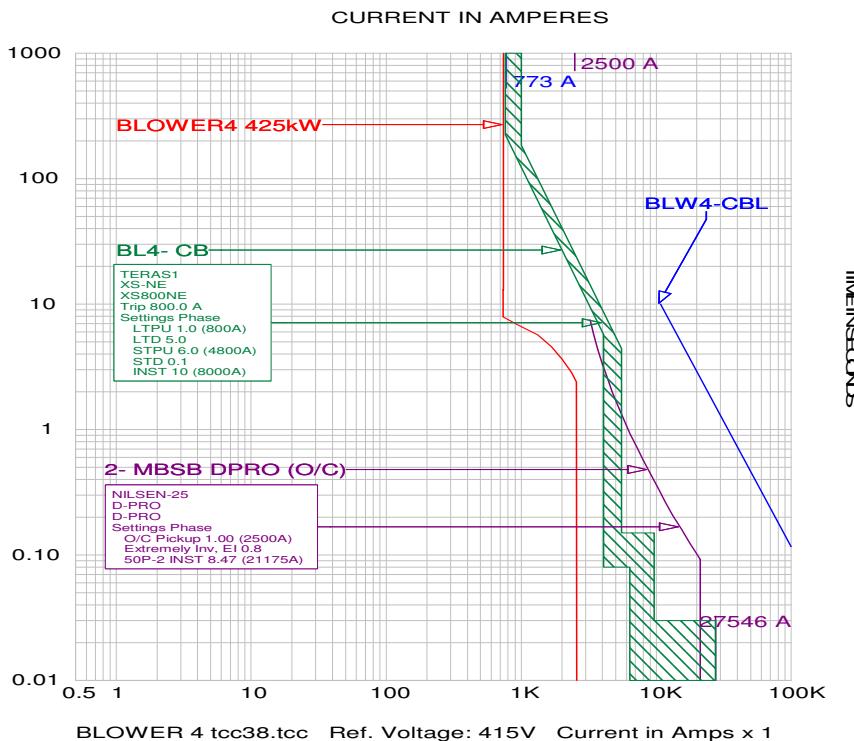


Figure 2923- Blower 4 3Phase Fault Current Protection Time Current Curves

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7.3.1 Blowers 1,2,3 and 4 - Protection Device Setting Parameters

The following CAPTOR Report provides protection device settings shown on the Time Current Curves in Figures 22 & 23 above:

05 May 2012
TCC Name: BLOWERS 123 tcc37.tcc
Reference Voltage: 415 V
Current Scale: X 10^0
TCC Notes:
TCC Comment:
Fault Duty Option: Study Result - Bus Fault Current

Device Name: BLOWER1 250kW	TCC Name: BLOWERS 123 tcc37.tcc
Bus Name: BUS-0104	Bus Voltage: 415.0V
Time Multiplier: 1	Curve Multiplier: 1
Description: Motor Starting Curve	Inrush: 3.5 (1432.1A)
Rated Size: 250kW (1 of 1 Plotted)	FLA+Load Adder: 409.2A + 0.0A
Power Factor: 0.85	Starting Time: 10.00s
Efficiency: 0.93	Full Voltage (Curve)

Device Name: BLW1-CBL	TCC Name: BLOWERS 123 tcc37.tcc
Bus Name: BUS12	Bus Voltage: 415.0V
Time Multiplier: 1	Curve Multiplier: 1
Description: Cable Damage Curve	Time Adder: 0
Size: 185	Qty/Ph: 2
Material: Copper	Cont. Temp: 90 deg C.
	Damage Temp: 250 deg C.

Device Name: BL1- CB	TCC Name: BLOWERS 123 tcc37.tcc
Bus Name: BUS12	Bus Voltage: 415.0V
Function Name: Phase	
Manufacturer: TERASAKI	
Description: 450-600A	
Type: TG600B	
AIC Rating: 65kA	Fault Duty: 27545.6A
Frame: TG600B 415V 600A	Curve Multiplier: 1
Time Multiplier: 1	Time Adder: 0
Trip: 450A	
Setting: 1) LTD	
2) INST	10.0 (4500A)

Device Name: 2- MBSB DPRO (O/C)	TCC Name: BLOWERS 123 tcc37.tcc
Bus Name: BUS12	Bus Voltage: 415.0V
Function Name: Phase	
Manufacturer: NILSEN-25	
Description: 50/51	
Type: D-PRO	Class Desc: D-PRO
AIC Rating: N/A	Fault Duty: 27545.6A
Current Rating: 2500A / 1A	Curve Multiplier: 1
Time Multiplier: 1	Time Adder: 0
Setting: 1) O/C Pickup	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	@5.0X, 0.234s
3) 50P-2 INST	@10.0X, 0.072s

TCC Name: BLOWER 4 tcc38.tcc	
Reference Voltage: 415 V	
Current Scale: X 10^0	
TCC Notes:	
TCC Comment:	
Fault Duty Option: Study Result - Bus Fault Current	

Device Name: BLOWER4 425kW	TCC Name: BLOWER 4 tcc38.tcc
Bus Name: BUS-0103	Bus Voltage: 415.0V
Time Multiplier: 1	Curve Multiplier: 1
Description: Motor Starting Curve	Inrush: 3.5 (2577.8A)
Rated Size: 450kW (1 of 1 Plotted)	FLA+Load Adder: 736.5A + 0.0A
Power Factor: 0.85	Starting Time: 10.00s
Efficiency: 0.93	Full Voltage (Curve)

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Device Name:	BLW4-CBL	TCC Name:	BLOWER 4 tcc38.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	240	Qty/Ph:	2
Material:	Copper	Cont. Temp:	90 deg C.
		Damage Temp:	250 deg C.

Device Name:	BL4- CB	TCC Name:	BLOWER 4 tcc38.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	TemBreak		
Type:	XS-NE	Fault Duty:	27545.6A
AIC Rating:	50kA	Curve Multiplier:	1
Frame:	XS800NE 415V 800A	Time Adder:	0
Time Multiplier:	1		
Sensor:	800A		
Plug:			
Setting: 1)	LTPU	1.0	(800A)
2)	LTD	5.0	
3)	STPU	6.0	(4800A)
4)	STD	0.1	
5)	INST	10	(8000A)

Device Name:	2- MBSB DPRO (O/C)	TCC Name:	BLOWER 4 tcc38.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25		
Description:	50/51	Class Desc:	D-PRO
Type:	D-PRO	Fault Duty:	27545.6A
AIC Rating:	N/A	Curve Multiplier:	1
Current Rating:	2500A / 1A	Time Adder:	0
Time Multiplier:	1	Test Points:	@2.0X, 1.729s
Setting: 1)	O/C Pickup	1.00	@5.0X, 0.234s
2)	Extremely Inv, EI	0.8	
3)	50P-2 INST	8.47	@10.0X, 0.072s

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7.4 Blowers Main Switchboard - MBSB Protection Coordination

The following one-line diagram depicts Blowers Main Switchboard MBSB Power System Topology with short circuit fault currents:

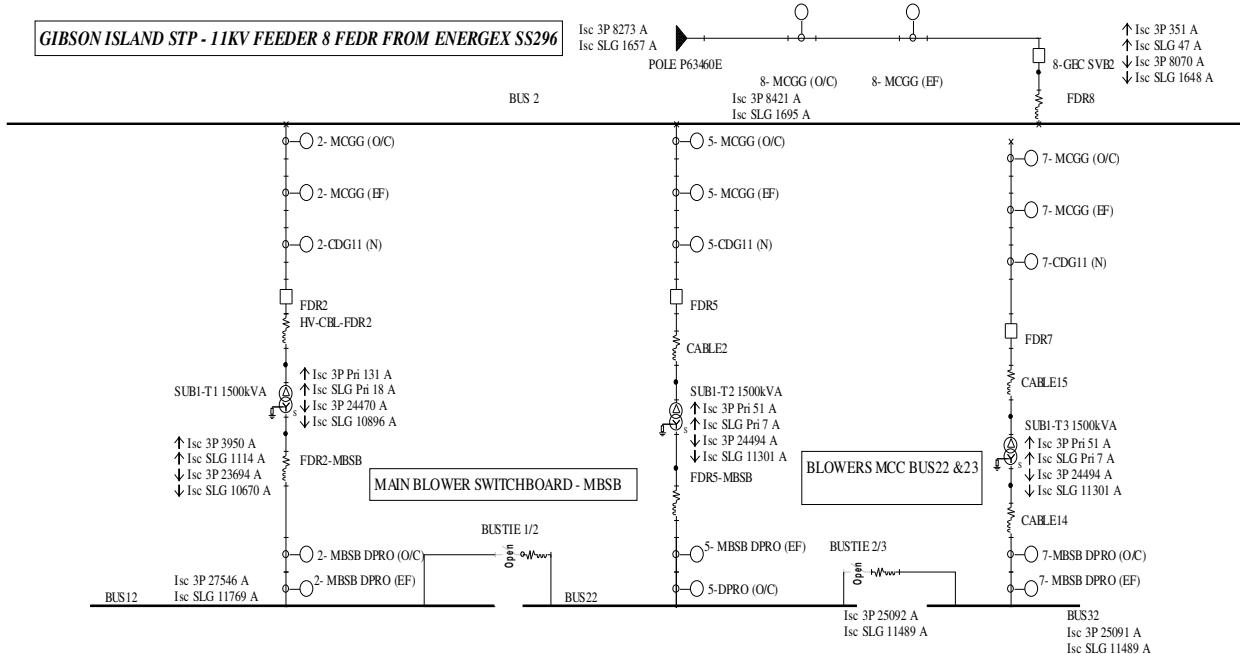


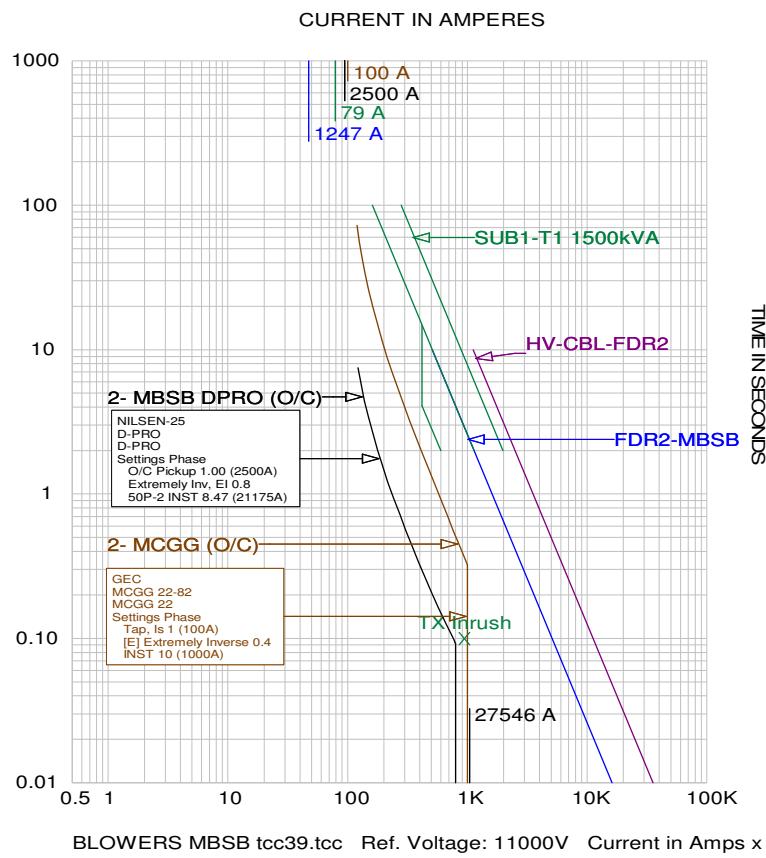
Figure 3024 – Blowers Main Switchboard MBSB- 415V Fault Levels

Shown in the above one-line diagram are the 3 phase (3P) and single phase to ground (SLG) short circuit fault currents on the MBSB Bus 12, Bus22 and Bus 32 for Blowers Switchboard, as there is possibility of closing Bus-Ties and running all blowers from one feeder, the highest 3 Phase of **27.546kA** and SLG of **11.769kA** on Feeder 2 have been selected for protection coordination of all Blowers Main Switchboard Incomers Feeders 2, 5 &7. Shown in the following diagrams is the Time Current Curves (TCC) for the major protection devices on the MBSB-BUS12.

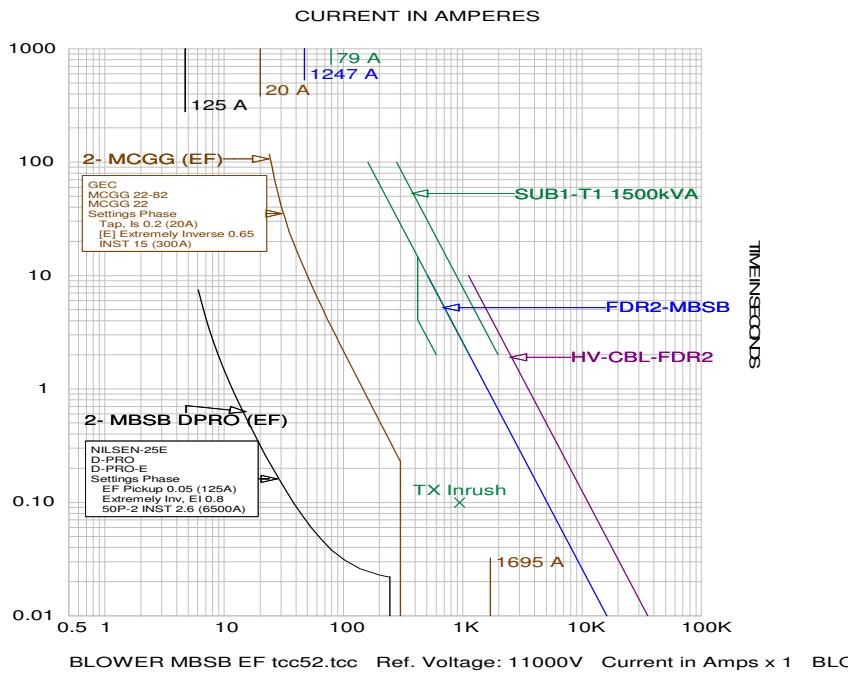
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| Figure 3125 – Blowers Main Switchboard MBSB - 3Phase Fault Current Protection Time Current Curves



| Figure 3226 - Blowers MBSB EF Time Current Curves

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7.4.1 Blowers Main Switchboard MBSB Incomers- Protection Device Setting Parameters

The following CAPTOR Report provides protection device settings shown on the Time Current Curves in Figures 25 and 26:

05 May 2012
TCC Name: BLOWERS MBSB tcc39.tcc
Reference Voltage: 11000 V
Current Scale: X 10^0
TCC Notes:
TCC Comment:
Fault Duty Option: Study Result - Bus Fault Current

Device Name:	2- MBSB DPRO (O/C)	TCC Name:	BLOWERS MBSB tcc39.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	27545.6A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup	1.00	(2500A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	8.47	(21175A)	@10.0X, 0.072s

Device Name:	FDR2-MBSB	TCC Name:	BLOWERS MBSB tcc39.tcc
Bus Name:	BUS-0005	Bus Voltage:	415.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	300	Qty/Ph:	6
Material:	Copper	Cont. Temp:	90 deg C.
		Damage Temp:	250 deg C.

Device Name:	SUB1-T1 1500kVA	TCC Name:	BLOWERS MBSB tcc39.tcc
Bus Name:	BUS-0004	Bus Voltage:	11000.0V / 415V
Time Multiplier:	1	Curve Multiplier:	1
Description:	2-Winding Transformer Damage Curve	Time Adder:	0
Nominal Size:	1500.0kVA	Rated Volts:	11000 LL/415 LL
Impedance (%Z):	7.6139	Pri Connection:	Delta
Inrush Factor:	12.0x	Sec Connection:	Wye-Ground

Device Name:	HV-CBL-FDR2	TCC Name:	BLOWERS MBSB tcc39.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	25	Qty/Ph:	1
Material:	Copper	Cont. Temp:	90 deg C.
		Damage Temp:	250 deg C.

Device Name:	2- MCGG (O/C)	TCC Name:	BLOWERS MBSB tcc39.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	1	(100A)	Test Points: @2.0X, 10.667s
2) [E] Extremely Invers	0.4		@5.0X, 1.333s
3) INST	10	(1000A)	@10.0X, 0.323s

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QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

TCC Name: BLOWER MBSB EF tcc52.tcc
 Reference Voltage: 11000 V
 Current Scale: X 10^0
 TCC Notes:
 TCC Comment:
 Fault Duty Option: Study Result - Bus Fault Current

Device Name:	2- MBSB DPRO (EF)	TCC Name:	BLOWER MBSB EF tcc52.tcc
Bus Name:	BUS12	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25E		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	11769.4A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.05	(125A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	2.6	(6500A)	@10.0X, 0.072s

Device Name:	2- MCGG (EF)	TCC Name:	BLOWER MBSB EF
tcc52.tcc			
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	1695.1A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	0.2	(20A)	Test Points: @2.0X, 17.333s
2) [E] Extremely Invers	0.65		@5.0X, 2.167s
3) INST	15	(300A)	@10.0X, 0.525s

7.4.2 Blowers Switchboard - MBSB - Arc Flash Evaluation

The following Arc Flash Evaluation Study has been carried out to provide PPE Requirements for the Gibson Island STP Blowers Switchboard MBSB.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Bus Name	Protective	Bus	Bus	Bus	Prot Dev	Prot Dev	Trip/	Breaker	Ground	Equip	Gap	Arc Flash	Working	Incident	PPE Level	Label #	Cable Length
2		Device	kV	Bolted	Arcing	Bolted	Arcing	Delay	Opening		Type	(mm)	Boundary	Distance	Energy			From Trip Device
3		Name		Fault	Fault	Fault	Fault	Time	Time/Tol			(mm)	(mm)	(mm)	(cal/cm2)			(m)
4				(kA)	(kA)	(kA)	(kA)	(sec.)	(sec.)									
5	ASB1 - BUS2	ASB1-MAIN SWITCH2 (EF)	0.415	24.23	12.26	24.23	12.26	0.02	0.060	Yes	PNL	25	851	457	3.3	Category 1	# 0001	10.00
6	ASB1-BUS1	ASB1-MAIN SWITCH1 (EF)	0.415	26.52	13.20	26.52	13.20	0.02	0.060	Yes	PNL	25	893	457	3.6	Category 1	# 0002	10.00
11	BUS12 (MBSB)	2- MBSB DPRO (EF)	0.415	27.55	13.62	23.70	11.71	0.02	0.060	Yes	PNL	25	912	457	3.7	Category 1	# 0007	
12	BUS22 (MBSB)	6- MBSB DPRO (EF)	0.415	25.10	12.62	23.72	11.93	0.02	0.060	Yes	PNL	25	867	457	3.4	Category 1	# 0008	

Figure 33 - Arc Flash Calculation & PPE Description Table

The highest PPE Level on this switchboard is Category 1 at the Switchboards Busbars. The following label is recommended to be shown on the switchboards front door for PPE Requirements (shown below are descriptions of terminologies shown the label):

Label Item	Description
Flash Hazard Boundary	The distance from an arcing fault within which unprotected skin could receive a 2nd degree burn. Generally considered the distance from an exposed arc source where the incident energy equals 1.2 cal/cm2.
Limited Approach	An approach limit at a distance from an exposed live part within which a shock hazard

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	<u>exists (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).</u>
<u>Restricted Approach</u>	<u>A shock protection boundary to be crossed by only qualified persons (at a distance from a live exposed part) which, due to its proximity to a shock hazard, requires the use of shock protection techniques and equipment when crossed (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).</u>
<u>Prohibited Approach</u>	<u>An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part. Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location.</u>



Figure 34 - Blowers Main Switchboard MBSB Label

The Arc Flash Category for this SWB with the recommended settings is Category 1. It is recommended to apply this label on the front door of the SWBD.

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8 MAIN SEWAGE PUMPS - MPSB 415V SWITCHBOARD POWER SYSTEM ANALYSIS

8.1 Feeders to Auxiliaries Switchboard ASB2 Protection Coordination

The following one-line diagram depicts ASB2- Bus 52 Power System Topology with short circuit fault currents:

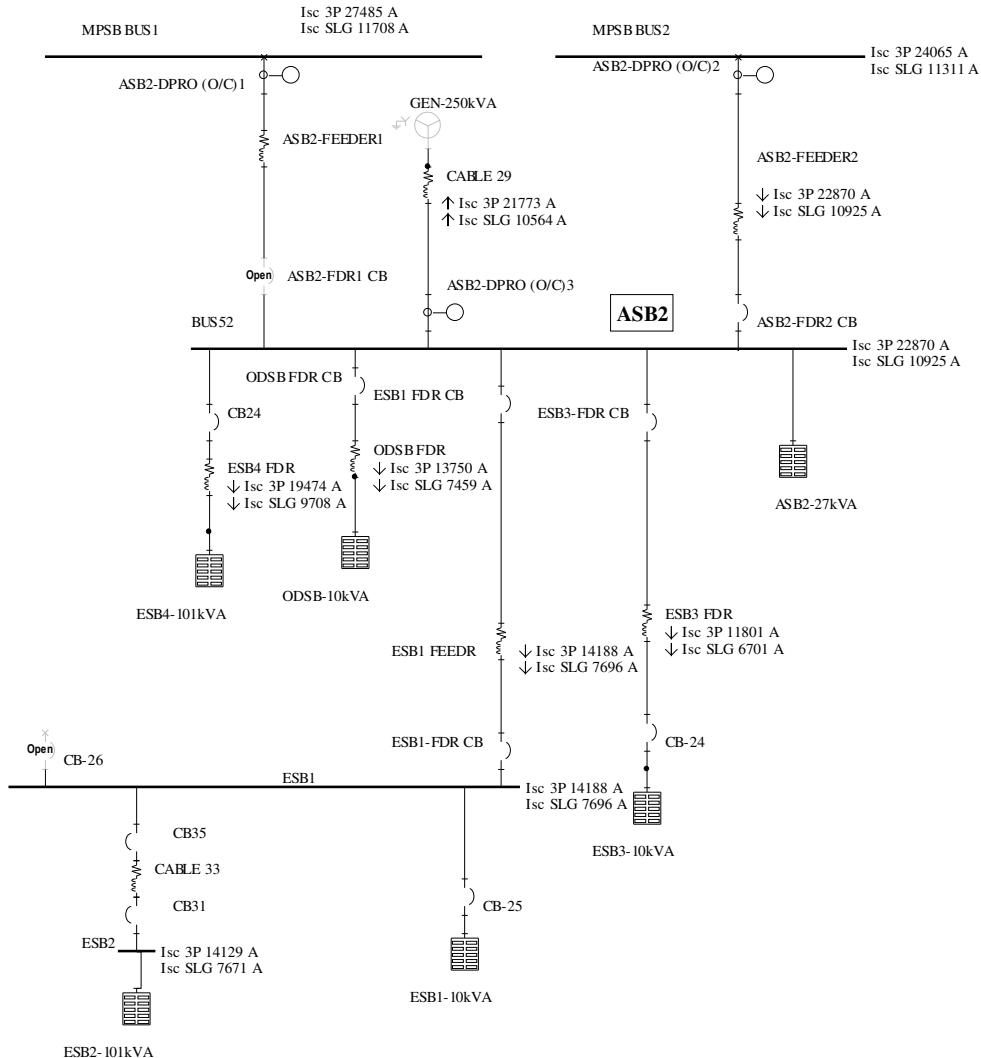
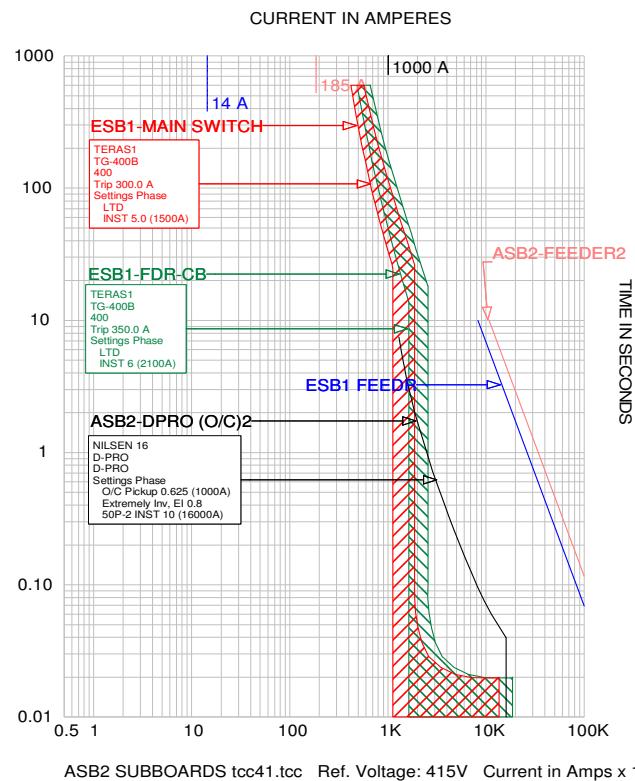


Figure 3527 – Auxiliaries Switchboard ASB2-Bus 52 415V Fault Levels

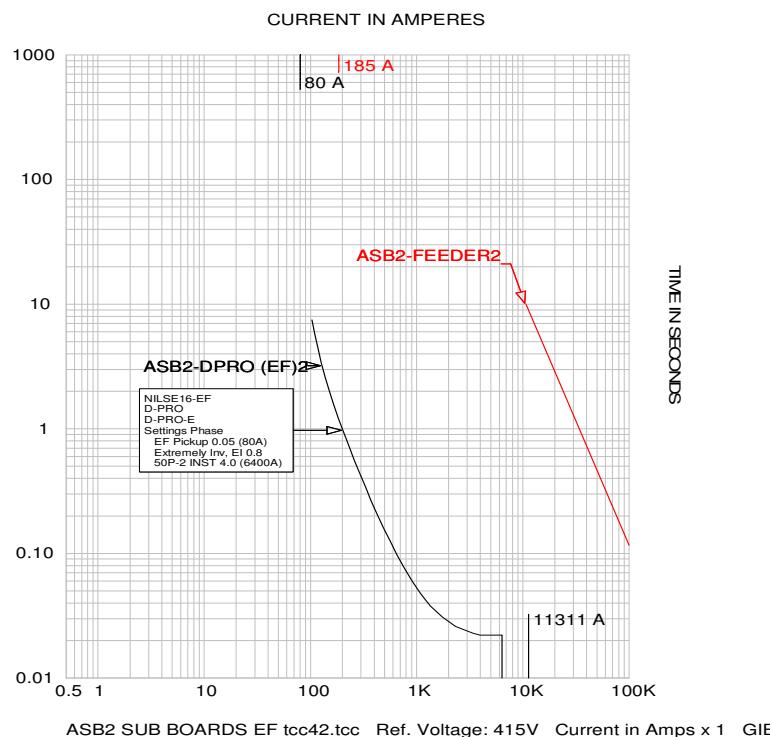
Shown in the above one-line diagram are the 3 phase (3P) and single phase to ground (SLG) short circuit fault currents on the ASB2, ESB4, ODSB, ESB1 and ESB3. ASB2 is feeding all of remaining sub-boards. On each sub-board the largest circuit breaker will be coordinated with its respective feeder's upstream circuit breaker in ASB2.

Shown in the following diagrams is the Time Current Curves (TCC) for the major protection devices on each sub-board up to the ASB2.

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| Figure 3628 – ASB2 – Sub-Boards 3Phase Fault Protection Time Current Curves



| Figure 3729 - ASB2 Sub boards Earth Protection Time Current Curves

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

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8.1.1 Auxiliaries Switchboard – ASB2 – Sub Boards Protection Device Setting Parameters

The following CAPTOR Report provides protection device settings shown on the Time Current Curves in Figures 28 and 29:

05 May 2012
TCC Name: ASB2 SUBBOARDS tcc41.tcc
Reference Voltage: 415 V
Current Scale: X 10^0
TCC Notes:
TCC Comment:
Fault Duty Option: Study Result - Bus Fault Current

Device Name:	ESB1-MAIN SWITCH	TCC Name:	ASB2 SUBBOARDS tcc41.tcc
Bus Name:	ESB1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	250-400A	Fault Duty:	14187.6A
Type:	TG-400B	Curve Multiplier:	1
AIC Rating:	56kA	Time Adder:	0
Frame:	400 415V 400A		
Time Multiplier:	1		
Trip:	300A		
Setting: 1) LTD			
2) INST	5.0	(1500A)	

Device Name:	ESB1 FEEDER	TCC Name:	ASB2 SUBBOARDS tcc41.tcc
Bus Name:	BUS52	Bus Voltage:	415.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	185	Qty/Ph:	2
Material:	Copper	Cont. Temp:	90 deg C.
		Damage Temp:	250 deg C.

Device Name:	ESB1-FDR-CB	TCC Name:	ASB2 SUBBOARDS tcc41.tcc
Bus Name:	BUS52	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	250-400A	Fault Duty:	22870.0A
Type:	TG-400B	Curve Multiplier:	1
AIC Rating:	56kA	Time Adder:	0
Frame:	400 415V 400A		
Time Multiplier:	1		
Trip:	350A		
Setting: 1) LTD			
2) INST	6	(2100A)	

Device Name:	ASB2-DPRO (O/C)2	TCC Name:	ASB2 SUBBOARDS tcc41.tcc
Bus Name:	MPSB BUS2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN 16		
Description:	50/51	Class Desc:	D-PRO
Type:	D-PRO	Fault Duty:	24064.9A
AIC Rating:	N/A	Curve Multiplier:	1
Current Rating:	1600A / 1A	Time Adder:	0
Time Multiplier:	1	Test Points:	@2.0X, 1.729s
Setting: 1) O/C Pickup	0.625		@5.0X, 0.234s
2) Extremely Inv, EI	0.8		@10.0X, 0.072s
3) 50P-2 INST	10	(16000A)	

Device Name:	ASB2-FEEDER2	TCC Name:	ASB2 SUBBOARDS tcc41.tcc
Bus Name:	MPSB BUS2	Bus Voltage:	415.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	240	Qty/Ph:	3
Material:	Copper	Cont. Temp:	90 deg C.
		Damage Temp:	250 deg C.

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TCC Name: ASB2 SUB BOARDS EF tcc42.tcc
 Reference Voltage: 415 V
 Current Scale: X 10^0
 TCC Notes:
 TCC Comment:
 Fault Duty Option: Study Result - Bus Fault Current

Device Name: ASB2-DPRO (EF) 2	TCC Name: ASB2 SUB BOARDS EF tcc42.tcc
Bus Name: MPSB BUS2	Bus Voltage: 415.0V
Function Name: Phase	
Manufacturer: NILSE16-EF	
Description: 50E/51E	
Type: D-PRO	Class Desc: D-PRO-E
AIC Rating: N/A	Fault Duty: 11310.8A
Current Rating: 1600A / 1A	Curve Multiplier: 1
Time Multiplier: 1	Time Adder: 0
Setting: 1) EF Pickup 0.05 (80A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI 0.8	@5.0X, 0.234s
3) 50P-2 INST 4.0 (6400A)	@10.0X, 0.072s

8.1.2 Auxiliaries Switchboard – ASB2 – Arc Flash Evaluation

The following Arc Flash Evaluation Study has been carried out to provide PPE Requirements for the Gibson Island STP Auxiliaries Switchboard ASB3 415V power supplies and switchboard.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Bus Name	Protective Bus	Bus	Bus	Prot Dev	Prot Dev	Trip/ Arcing	Delay	Breaker	Ground	Equip	Gap	Arc Flash	Working	Incident	PPE Level	Label #	Cable Length
2	Device	KV	Bolted	Arcing	Bolted	Arcing	Opening			Type	(mm)	Boundary	Distance	Energy			From Trip Device	
3	Name		Fault	Fault	Fault	Fault	Time	Time/Tol									(m)	
4			(kA)	(kA)	(kA)	(kA)	(sec.)	(sec.)										
15	ASB2	ASB2-DPRO (EF)1	0.415	44.98	20.33	22.52	10.18	0.02	0.060 Yes	PNL	25	1187	457	5.7	Category 2	# 0011	15.00	

Figure 3848 - Arc Flash Calculation & PPE Description Table

The highest PPE Level on this switchboard is Category 2 at the Switchboard Busbars. The following label is recommended to be shown on the switchboard front door for PPE Requirements (shown below are descriptions of terminologies shown the label):

Label Item	Description
<u>Flash Hazard Boundary</u>	The distance from an arcing fault within which unprotected skin could receive a 2nd degree burn. Generally considered the distance from an exposed arc source where the incident energy equals 1.2 cal/cm ² .
<u>Limited Approach</u>	An approach limit at a distance from an exposed live part within which a shock hazard exists (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).
<u>Restricted Approach</u>	A shock protection boundary to be crossed by only qualified persons (at a distance from a live exposed part) which, due to its proximity to a shock hazard, requires the use of shock protection techniques and equipment when crossed (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).
<u>Prohibited Approach</u>	An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part. Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location.

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QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

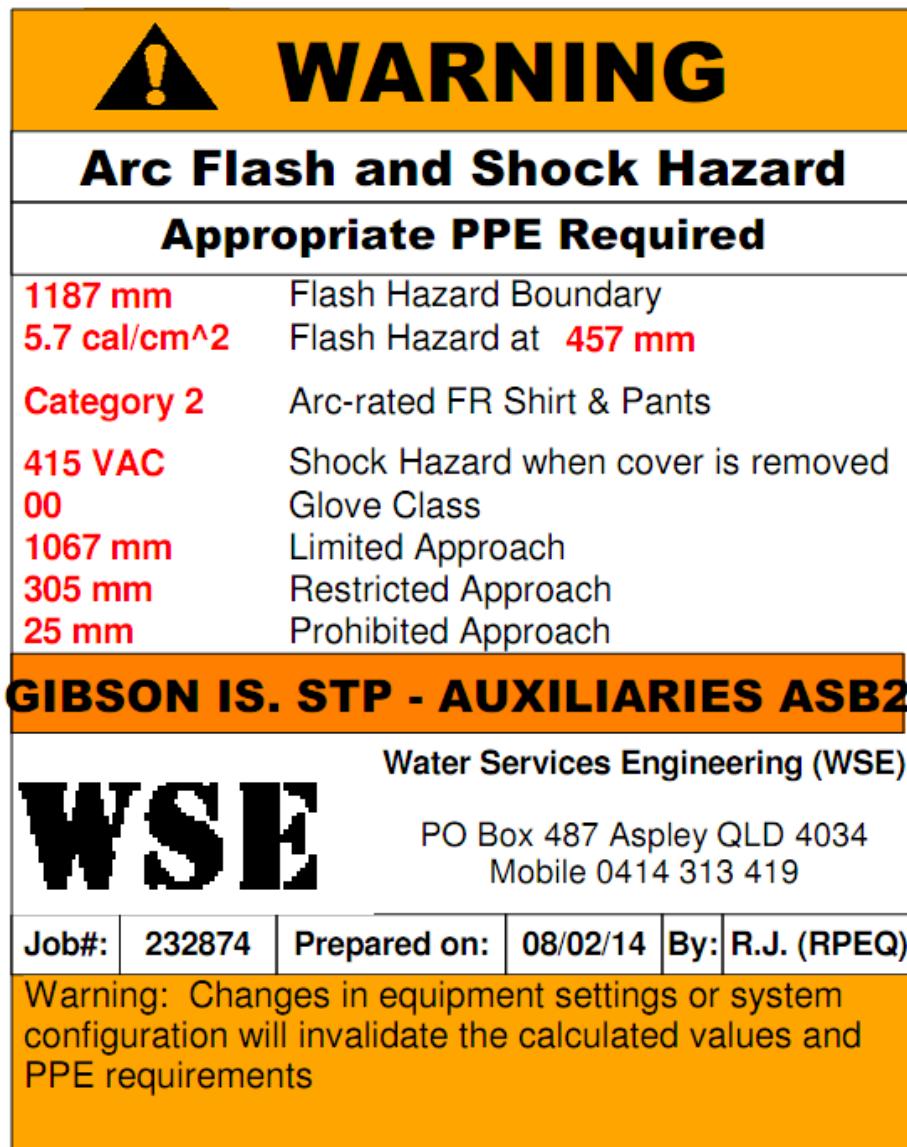


Figure 3949 – Auxiliaries Switchboard ASB2 Recommended Arc Flash Label

The Arc Flash Category for this SWB with the recommended settings is Category 2. It is recommended to apply this label on the front door of the SWBD.

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

8.2 Sewage Pumps 1,2 &3 Protection Coordination

The following one-line diagram depicts MPSB Bus 1& Bus2 Power System Topology with short circuit fault currents:

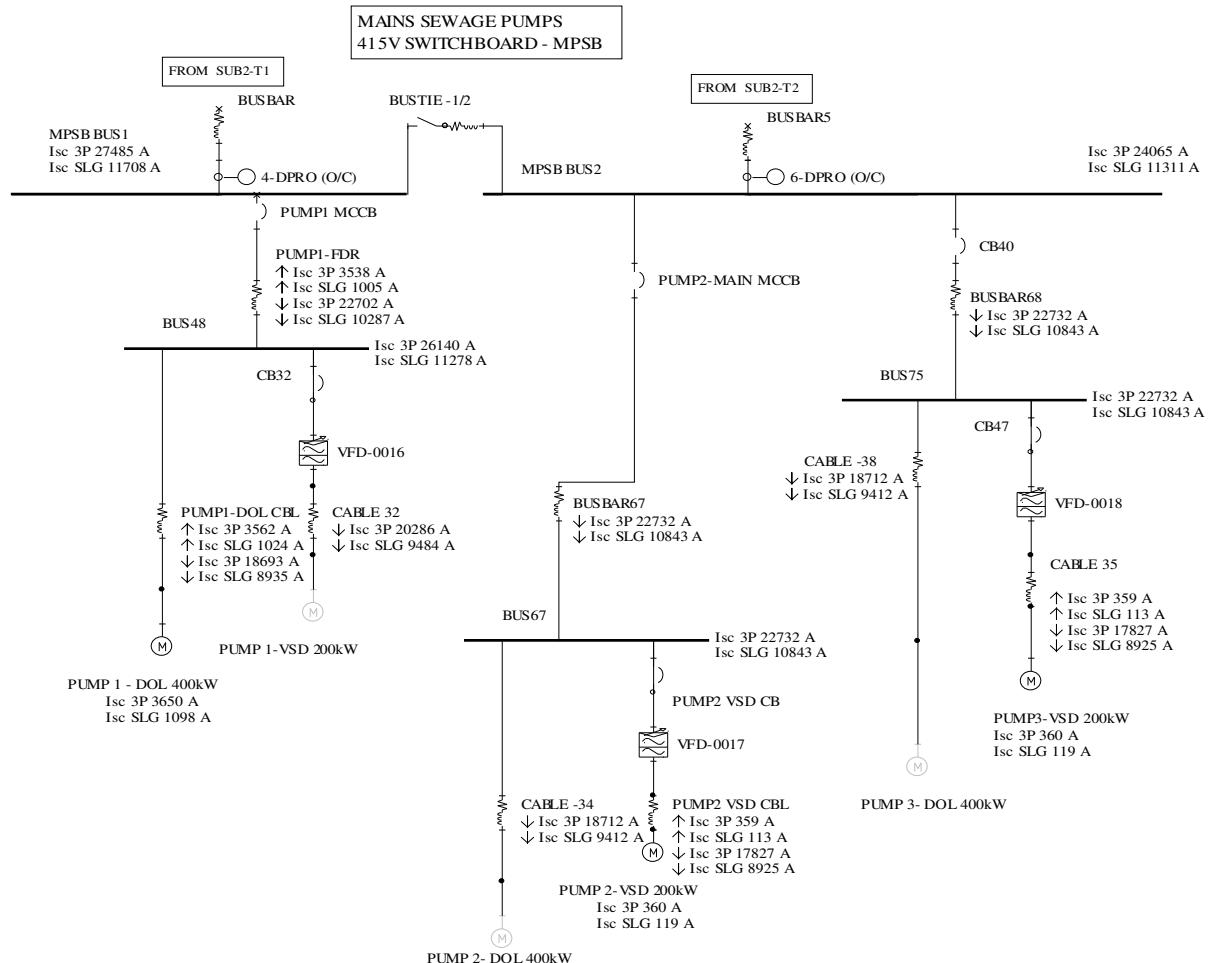


Figure 4030 – Main Sewage Pumps 415 Switchboard – MPSB Fault Levels

Shown in the above one-line diagram are the 3 phase (3P) and single phase to ground (SLG) short circuit fault currents on the MPSB - BUS1 and BUS2. Due to very close fault levels on both busbars, and possibility of supplying both busbars from one feeder, the protection devices on both busbars will be coordinated to the highest fault levels of **3P=27.485kA** and **SLG=11.708kA**.

Shown in the following diagrams is the Time Current Curves (TCC) for the major protection devices on the MPSB -BUS1 & BUS2 up to the Main Feeders from Sub-Station Transformers.

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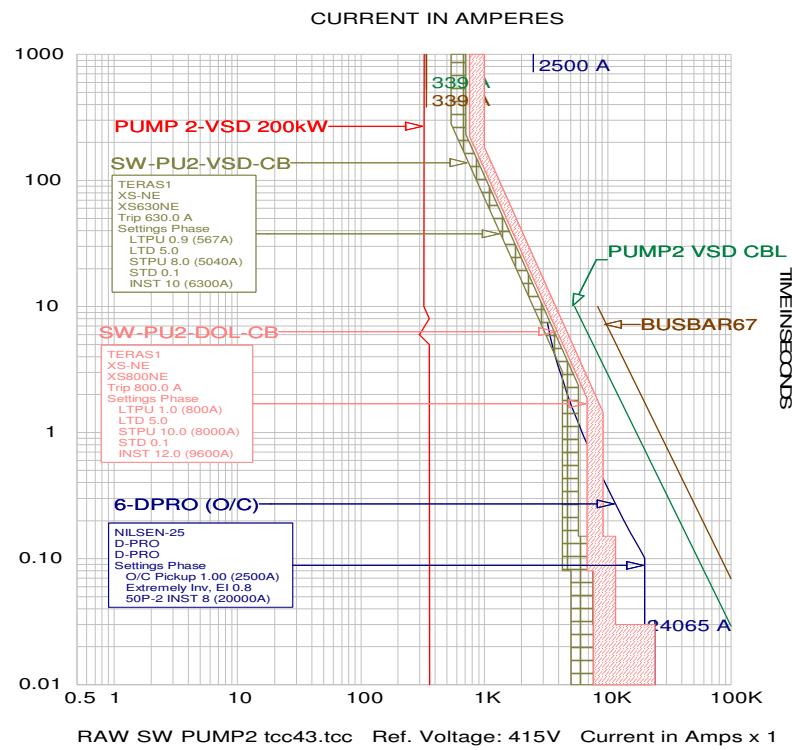


Figure 4134 – Raw Sewage Pump2 - 3Phase Fault Protection Time Current Curves

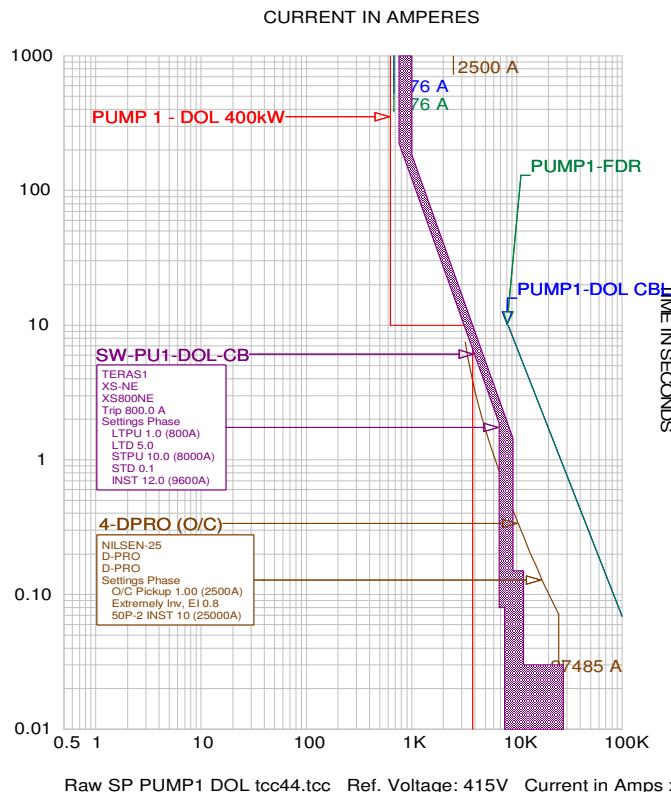


Figure 4232 - Raw Sewage Pump1 DOL- 3Phase Fault Protection Time Current Curves

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

8.2.1 Sewage Pumps 1,2&3 – Protection Device Setting Parameters

The following CAPTOR Report provides protection device settings shown on the Time Current Curves in Figures 31 and 32:

05 May 2012			
TCC Name:	RAW SW PUMP2 tcc43.tcc	TCC Name:	RAW SW PUMP2 tcc43.tcc
Reference Voltage:	415 V	Bus Voltage:	415.0V
Current Scale:	X 10^0	Curve Multiplier:	1
TCC Notes:		Time Adder:	0
TCC Comment:		Inrush:	1.1 (360.1A)
Fault Duty Option:	Study Result - Bus Fault Current	FLA+Load Adder:	327.3A + 0.0A
-----		Starting Time:	10.00s
Device Name:	PUMP 2-VSD 200kW	Full Voltage (Square Transient)	
Bus Name:	BUS-0171		
Time Multiplier:	1		
Description:	Motor Starting Curve		
Rated Size:	200kW (1 of 1 Plotted)		
Power Factor:	0.85		
Efficiency:	0.93		

Device Name:	PUMP2 VSD CBL	TCC Name:	RAW SW PUMP2 tcc43.tcc
Bus Name:	BUS-0143	Bus Voltage:	415.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	120	Qty/Ph:	3
Material:	Copper	Cont. Temp:	90 deg C.
Damage Temp:	250 deg C.		

Device Name:	BUSBAR67	TCC Name:	RAW SW PUMP2 tcc43.tcc
Bus Name:	MPSB BUS2	Bus Voltage:	415.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	185	Qty/Ph:	3
Material:	Copper	Cont. Temp:	90 deg C.
Damage Temp:	250 deg C.		

Device Name:	SW-PU2-DOL-CB	TCC Name:	RAW SW PUMP2 tcc43.tcc
Bus Name:	MPSB BUS2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	TemBreak		
Type:	XS-NE		
AIC Rating:	50kA	Fault Duty:	24064.9A
Frame:	XS800NE 415V 800A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Sensor:	800A		
Plug:			
Setting: 1) LTPU	1.0	(800A)	
2) LTD	5.0		
3) STPU	10.0	(8000A)	
4) STD	0.1		
5) INST	12.0	(9600A)	

Device Name:	6-DPRO (O/C)	TCC Name:	RAW SW PUMP2 tcc43.tcc
Bus Name:	MPSB BUS2	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25		
Description:	50/51		
Type:	D-PRO	Class Desc:	D-PRO
AIC Rating:	N/A	Fault Duty:	24064.9A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) O/C Pickup	1.00	(2500A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	8	(20000A)	@10.0X, 0.072s

Device Name:	SW-PU2-VSD-CB	TCC Name:	RAW SW PUMP2 tcc43.tcc
Bus Name:	BUS67	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	TemBreak		

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Type:	XS-NE	Fault Duty:	22731.8A
AIC Rating:	50kA	Curve Multiplier:	1
Frame:	XS630NE 415V 630A	Time Adder:	0
Time Multiplier:	1		
Sensor:	630A		
Plug:			
Setting: 1)	LTPU	0.9	(567A)
2)	LTD	5.0	
3)	STPU	8.0	(5040A)
4)	STD	0.1	
5)	INST	10	(6300A)

TCC Name: Raw SP PUMP1 DOL tcc44.tcc

Reference Voltage: 415 V

Current Scale: X 10^0

TCC Notes:

TCC Comment:

Fault Duty Option: Study Result - Bus Fault Current

Device Name:	PUMP 1 - DOL 400kW	TCC Name:	Raw SP PUMP1 DOL tcc44.tcc
Bus Name:	BUS-0107	Bus Voltage:	400.0V

Time Multiplier: 1

Description: Motor Starting Curve

Rated Size: 400kW (1 of 1 Plotted)

Power Factor: 0.85

Efficiency: 0.93

Curve Multiplier:	1
-------------------	---

Time Adder: 0

Inrush: 6.0 (3928.1A)

FLA+Load Adder: 654.7A + 0.0A

Starting Time: 10.00s

Full Voltage

Device Name:	PUMP1-DOL CBL	TCC Name:	Raw SP PUMP1 DOL tcc44.tcc
Bus Name:	BUS48	Bus Voltage:	415.0V

Time Multiplier: 1

Description: Cable Damage Curve

Size: 185

Material: Copper

Curve Multiplier:	1
-------------------	---

Time Adder: 0

Qty/Ph: 3

Cont. Temp: 90 deg C.

Damage Temp: 250 deg C.

Device Name:	PUMP1-FDR	TCC Name:	Raw SP PUMP1 DOL tcc44.tcc
Bus Name:	MPSB BUS1	Bus Voltage:	415.0V

Time Multiplier: 1

Description: Cable Damage Curve

Size: 185

Material: Copper

Curve Multiplier:	1
-------------------	---

Time Adder: 0

Qty/Ph: 3

Cont. Temp: 90 deg C.

Damage Temp: 250 deg C.

Device Name:	SW-PU1-DOL-CB	TCC Name:	Raw SP PUMP1 DOL tcc44.tcc
Bus Name:	MPSB BUS1	Bus Voltage:	415.0V

Function Name: Phase

Manufacturer: TERAS1

Description: TemBreak

Type: XS-NE

AIC Rating: 50kA

Frame: XS800NE 415V 800A

Time Multiplier: 1

Sensor: 800A

Fault Duty:	27484.8A
-------------	----------

Curve Multiplier: 1

Time Adder: 0

Plug:

Setting: 1) LTPU 1.0 (800A)

2) LTD 5.0

3) STPU 10.0 (8000A)

4) STD 0.1

5) INST 12.0 (9600A)

Class Desc:	D-PRO
-------------	-------

Fault Duty:	27484.8A
-------------	----------

Curve Multiplier: 1

Time Adder: 0

Test Points: @2.0X, 1.729s

@5.0X, 0.234s

@10.0X, 0.072s

Device Name:	4-DPRO (O/C)	TCC Name:	Raw SP PUMP1 DOL tcc44.tcc
Bus Name:	MPSB BUS1	Bus Voltage:	415.0V

Function Name: Phase

Manufacturer: NILSEN-25

Description: 50/51

Type: D-PRO

AIC Rating: N/A

Current Rating: 2500A / 1A

Time Multiplier: 1

Setting: 1) O/C Pickup 1.00 (2500A)

2) Extremely Inv, EI 0.8 (2500A)

3) 50P-2 INST 10 (25000A)

Class Desc:	D-PRO
-------------	-------

Fault Duty:	27484.8A
-------------	----------

Curve Multiplier: 1

Time Adder: 0

Test Points: @2.0X, 1.729s

@5.0X, 0.234s

@10.0X, 0.072s

8.3 Main Sewage Pumps Switchboard - MPSB Protection Coordination

The following one-line diagram depicts Main Sewage Pumps Switchboard MPSB Power System Topology with short circuit fault currents:

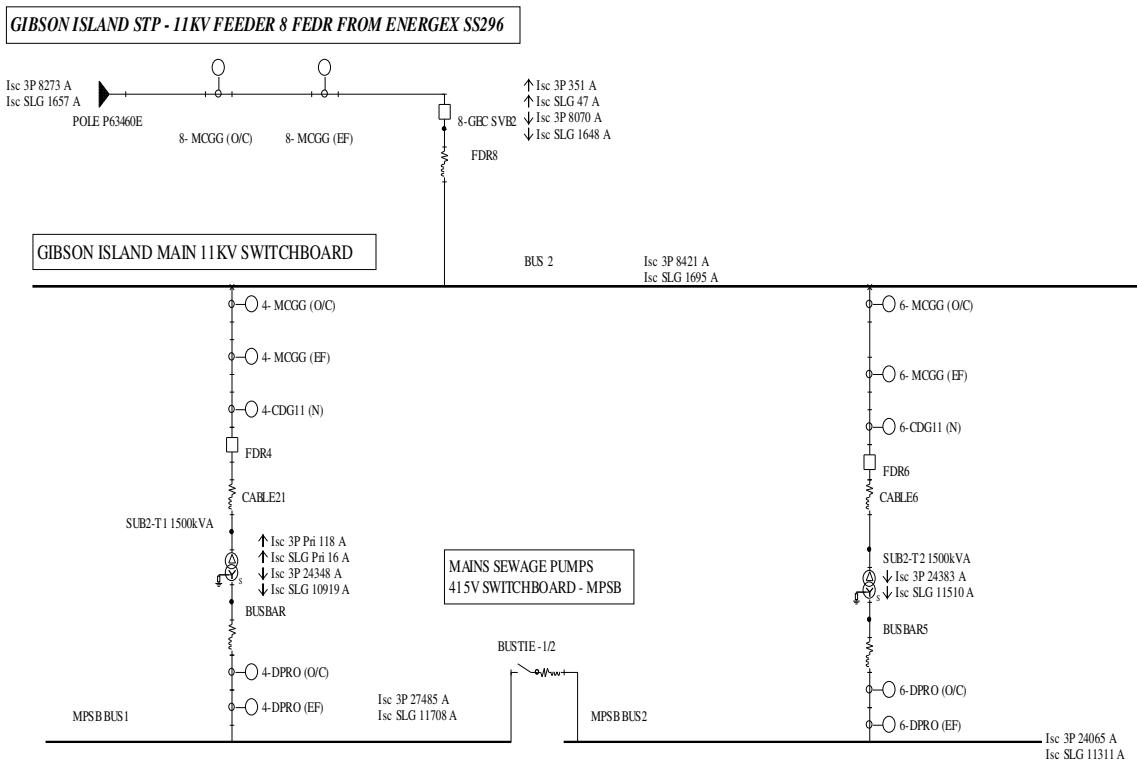
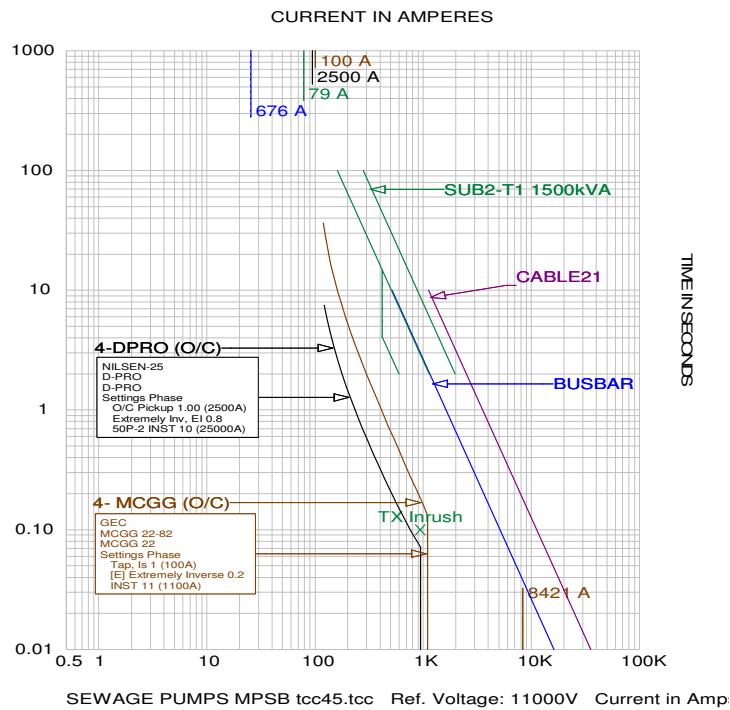


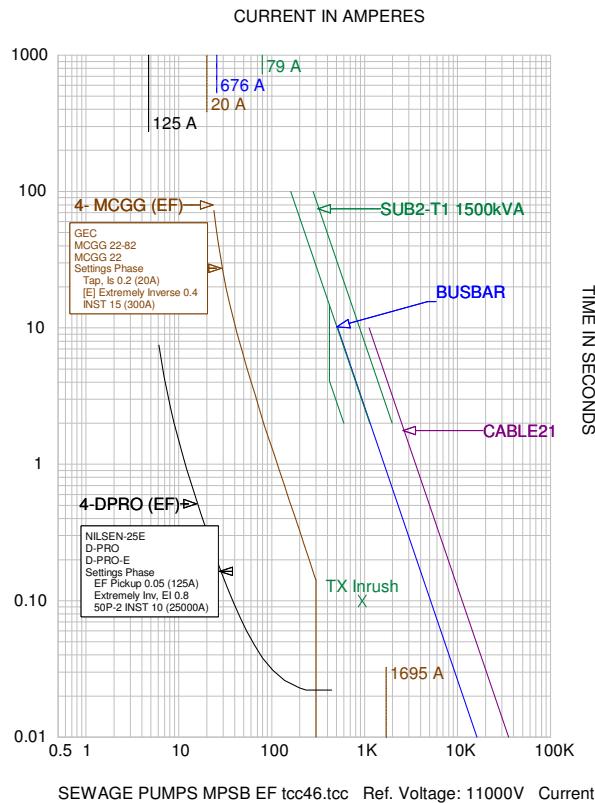
Figure 4333 – Main Sewage Pumps Switchboard MPSB- 415V Fault Levels

Shown in the above one-line diagram are the 3 phase (3P) and single phase to ground (SLG) short circuit fault currents on the MPSB Bus 1 & Bus2 for Sewage Pumps Switchboard, as there is possibility of closing Bus-Tie and running all pumps from one feeder, the highest 3 Phase fault current of **27.485kA** and SLG of **11.708kA** on Bus1 have been selected for protection coordination of all Sewage Pumps Main Switchboard Incomers Feeders 4 &6. Shown in the following diagrams is the Time Current Curves (TCC) for the major protection devices on the MPSB-BUS1.

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| Figure 4434 – Sewage Pumps Main Switchboard MPSB - 3Phase Fault Current Protection Time Current Curves



| Figure 4535 - Sewage Pumps Main Switchboard MPSB - Single Phase to Ground Fault Protection Time Current Curves

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8.3.1 Sewage Pumps Main Switchboard MPSB Incomers- Protection Device Setting Parameters

The following CAPTOR Report provides protection device settings shown on the Time Current Curves in Figures 34 and 35:

05 May 2012
TCC Name: SEWAGE PUMPS MPSB tcc45.tcc
Reference Voltage: 11000 V
Current Scale: X 10^0
TCC Notes:
TCC Comment:
Fault Duty Option: Study Result - Bus Fault Current

Device Name:	4-DPRO (O/C)	TCC Name:	SEWAGE PUMPS MPSB tcc45.tcc
Bus Name:	MPSB BUS1	Bus Voltage:	415.0V
Function Name:	Phase	Class Desc:	D-PRO
Manufacturer:	NILSEN-25	Fault Duty:	27484.8A
Description:	50/51	Curve Multiplier:	1
Type:	D-PRO	Time Adder:	0
AIC Rating:	N/A	Test Points:	@2.0X, 1.729s
Current Rating:	2500A / 1A		@5.0X, 0.234s
Time Multiplier:	1		@10.0X, 0.072s
Setting: 1) O/C Pickup	1.00	(2500A)	
2) Extremely Inv, EI	0.8		
3) 50P-2 INST	10	(25000A)	

Device Name:	BUSBAR	TCC Name:	SEWAGE PUMPS MPSB tcc45.tcc
Bus Name:	BUS-0013	Bus Voltage:	415.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	400	Qty/Ph:	6
Material:	Copper	Cont. Temp:	55 deg C.
		Damage Temp:	130 deg C.

Device Name:	SUB2-T1 1500kVA	TCC Name:	SEWAGE PUMPS MPSB tcc45.tcc
Bus Name:	BUS-0009	Bus Voltage:	11000.0V / 415V
Time Multiplier:	1	Curve Multiplier:	1
Description:	2-Winding Transformer Damage Curve	Time Adder:	0
Nominal Size:	1500.0kVA	Rated Volts:	11000 LL/415 LL
Impedance (%Z):	7.6139	Pri Connection:	Delta
Inrush Factor:	12.0x	Sec Connection:	Wye-Ground

Device Name:	CABLE21	TCC Name:	SEWAGE PUMPS MPSB tcc45.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	25	Qty/Ph:	1
Material:	Copper	Cont. Temp:	90 deg C.
		Damage Temp:	250 deg C.

Device Name:	4- MCGG (O/C)	TCC Name:	SEWAGE PUMPS MPSB tcc45.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase	Class Desc:	MCGG 22
Manufacturer:	GEC	Fault Duty:	8420.6A
Description:	50/51	Curve Multiplier:	1
Type:	MCGG 22-82	Time Adder:	0
AIC Rating:	N/A	Test Points:	@2.0X, 5.333s
Current Rating:	100A / 5A		@5.0X, 0.667s
Time Multiplier:	1		@10.0X, 0.162s
Setting: 1) Tap, Is	1	(100A)	
2) [E] Extremely Invers	0.2		
3) INST	11	(1100A)	

TCC Name: SEWAGE PUMPS MPSB EF tcc46.tcc
Reference Voltage: 11000 V
Current Scale: X 10^0
TCC Notes:
TCC Comment:
Fault Duty Option: Study Result - Bus Fault Current

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Device Name:	4-DPRO (EF)	TCC Name:	SEWAGE PUMPS MPSB EF tcc46.tcc
Bus Name:	MPSB BUS1	Bus Voltage:	415.0V
Function Name:	Phase		
Manufacturer:	NILSEN-25E		
Description:	50E/51E		
Type:	D-PRO	Class Desc:	D-PRO-E
AIC Rating:	N/A	Fault Duty:	11708.4A
Current Rating:	2500A / 1A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) EF Pickup	0.05	(125A)	Test Points: @2.0X, 1.729s
2) Extremely Inv, EI	0.8		@5.0X, 0.234s
3) 50P-2 INST	10	(25000A)	@10.0X, 0.072s

Device Name:	4- MCGG (EF)	TCC Name:	SEWAGE PUMPS MPSB EF
Bus Name:	tcc46.tcc	Bus Voltage:	11000.0V
Function Name:	BUS 2		
Manufacturer:	Phase		
Description:	GEC		
Type:	50/51	Class Desc:	MCGG 22
AIC Rating:	MCGG 22-82	Fault Duty:	1695.1A
Current Rating:	N/A	Curve Multiplier:	1
Time Multiplier:	100A / 5A	Time Adder:	0
Setting: 1) Tap, Is	0.2	(20A)	Test Points: @2.0X, 10.667s
2) [E] Extremely Invers	0.4		@5.0X, 1.333s
3) INST	15	(300A)	@10.0X, 0.323s

8.3.2 Main Sewage Pump Station Switchboard - MPSB - Arc Flash Evaluation

The following Arc Flash Evaluation Study has been carried out to provide PPE Requirements for the Gibson Island STP Sewage Pump Station Switchboard MPSB.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Bus Name	Protective	Bus	Bus	Bus	Prot Dev	Prot Dev	Trip/	Breaker	Ground	Equip	Gap	Arc Flash	Working	Incident	PPE Level	Label #	Cable Length
2	Device	kV		Bolted	Arcing	Bolted	Arcing	Delay	Opening		Type	(mm)	Boundary	Distance	Energy			From Trip Device
3	Name		Fault	Fault	Fault	Fault	Fault	Time	Time/Tol				(mm)	(mm)	(cal/cm2)			(m)
4			(kA)	(kA)	(kA)	(kA)	(kA)	(sec.)	(sec.)									
21	MPSB BUS1 (RAW SEWAGE PUMPS MCC BUS BARS)	4-DPRO (EF)	0.415	47.19	21.15	21.75	9.75	0.022	0.060	Yes	PNL	25	1237	457	6.1	Category 2	# 0017	1.00
22	MPSB BUS2 (RAW SEWAGE PUMPS MCC BUS BARS)	MPSB-BUSTIE DPRO (EF)	0.415	47.18	21.15	25.06	11.23	0.02	0.060	Yes	PNL	25	1228	457	6.0	Category 2	# 0018	

Figure 4618 - Arc Flash Calculation & PPE Description Table

The highest PPE Level on this switchboard is level 2 at the Switchboard Busbars. The following label is recommended to be shown on the switchboard front door for PPE Requirements (shown below are descriptions of terminologies shown the label):

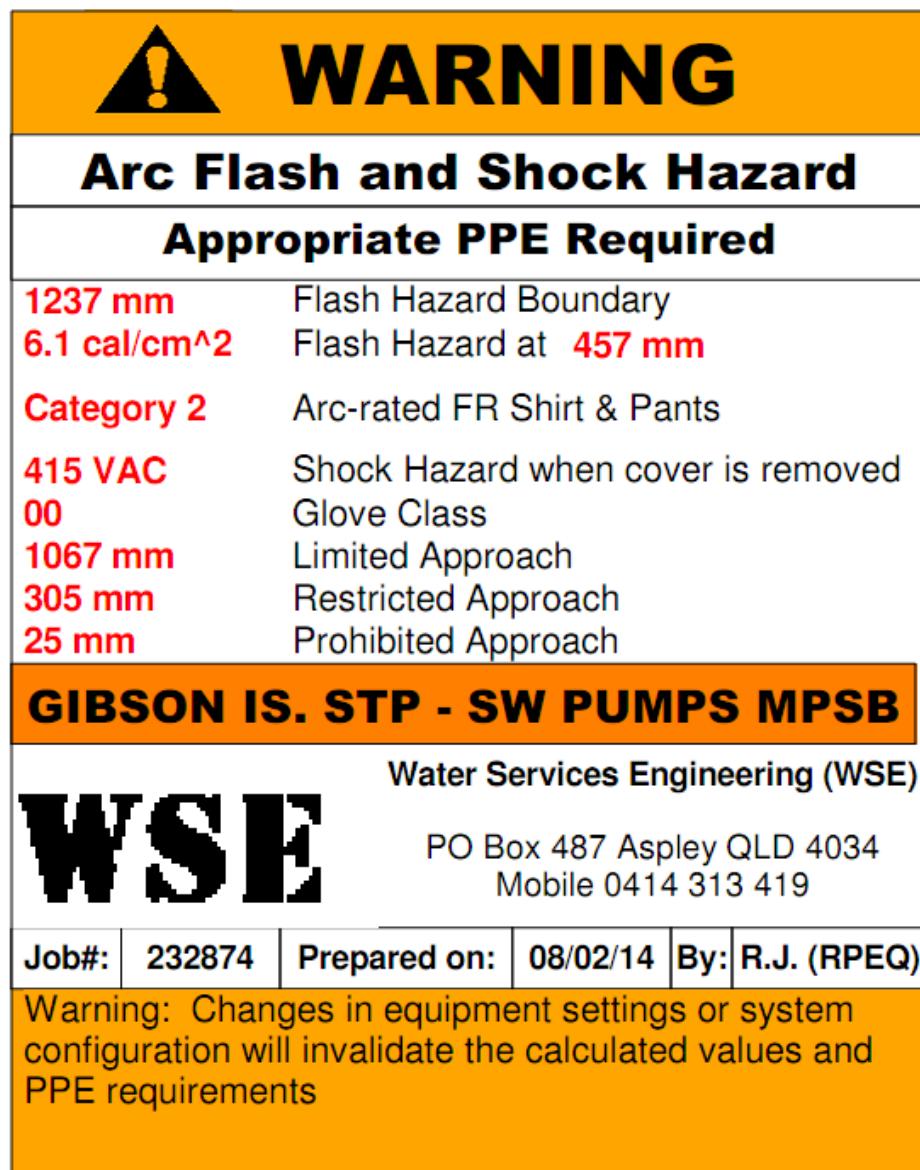
Label Item	Description
Flash Hazard Boundary	The distance from an arcing fault within which unprotected skin could receive a 2nd degree burn. Generally considered the distance from an exposed arc source where the incident energy equals 1.2 cal/cm2.
Limited Approach	An approach limit at a distance from an exposed live part within which a shock hazard exists (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).
Restricted Approach	A shock protection boundary to be crossed by only qualified persons (at a distance from a live exposed part) which, due to its proximity to a shock hazard, requires the use of shock protection techniques and equipment when crossed (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).
Prohibited Approach	An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part. Defined in NFPA 70E - Standard for

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[Electrical Safety in the Workplace](#) based on design voltage at the fault location.



[Figure 4719 – Sewage Pumps Switchboard MPSB - Recommended Arc Flash Label](#)

The Arc Flash Category for this SWB with the recommended settings is Level 2. It is recommended to apply this label on the front door of the SWBD.

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9 GIBSON ISLAND STP – BELT FILTER PRESS MCC POWER SYSTEM ANALYSIS

Power supply from the STP 11kV Main Switchboard to Belt Filter Press (BFP) MCC is shown below and next page on one line diagrams with the input data and load flow/voltage drop calculations:

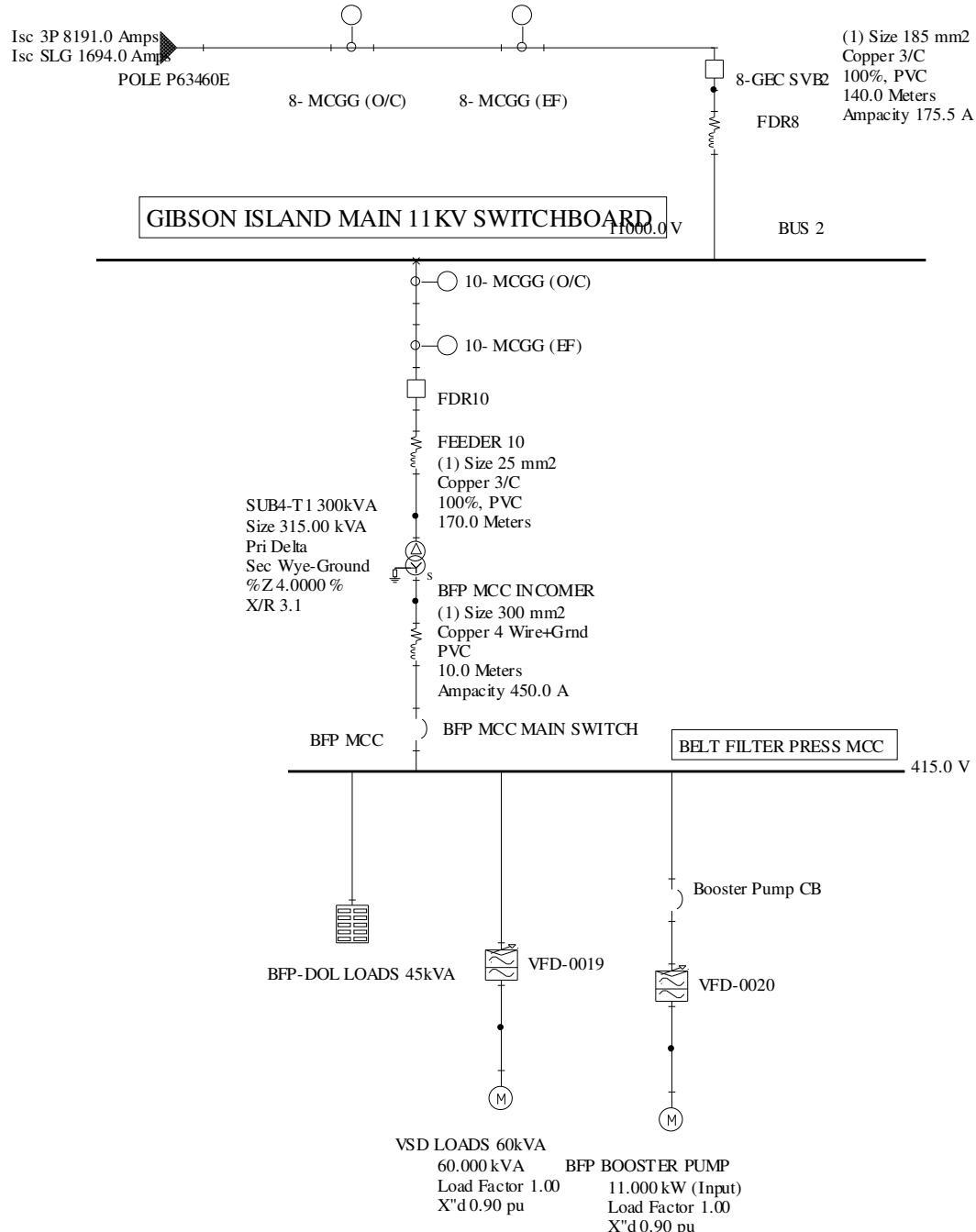


Figure 4836 – BFP MCC –One Line Diagram with Input Data

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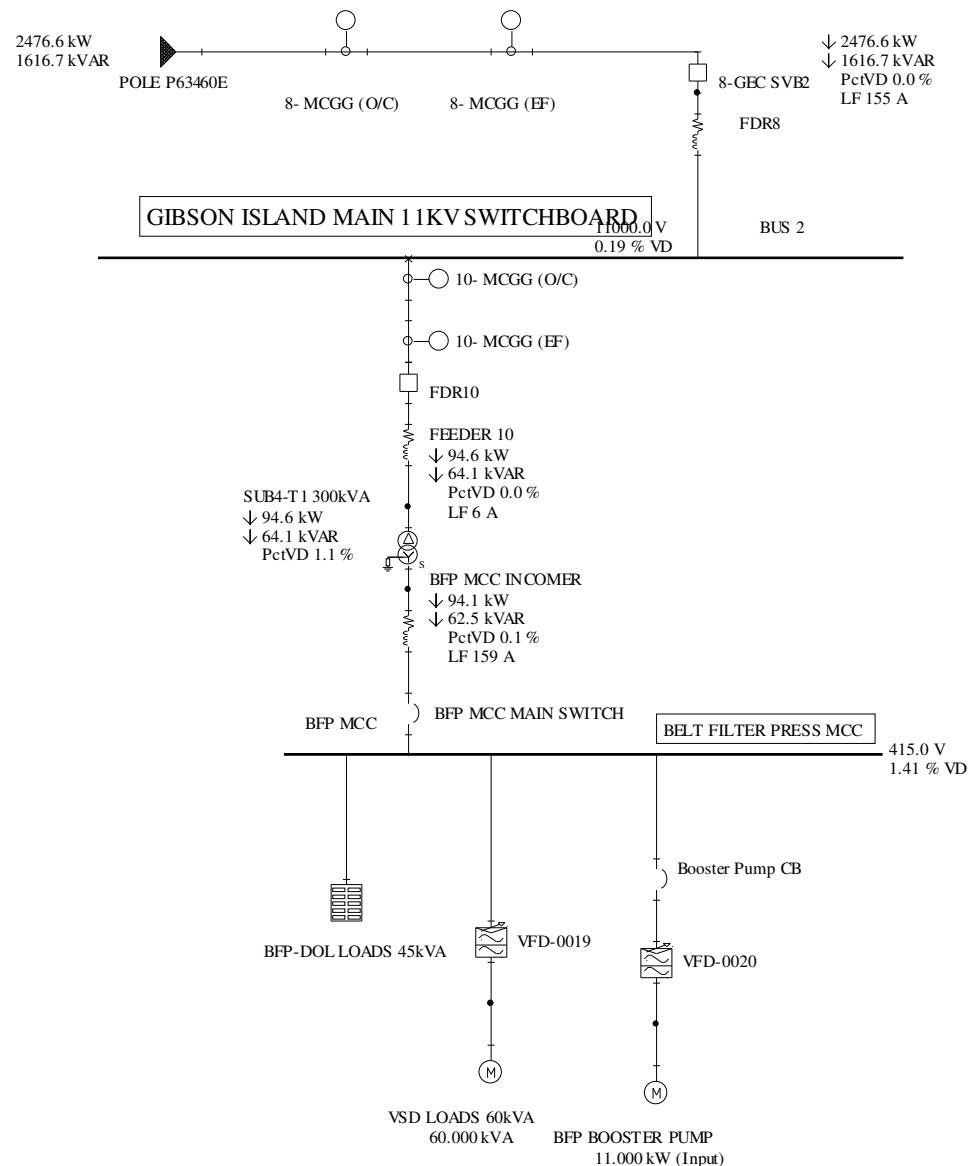


Figure 4937 – BFP MCC –One Line Diagram with Load Flow and Voltage Drop

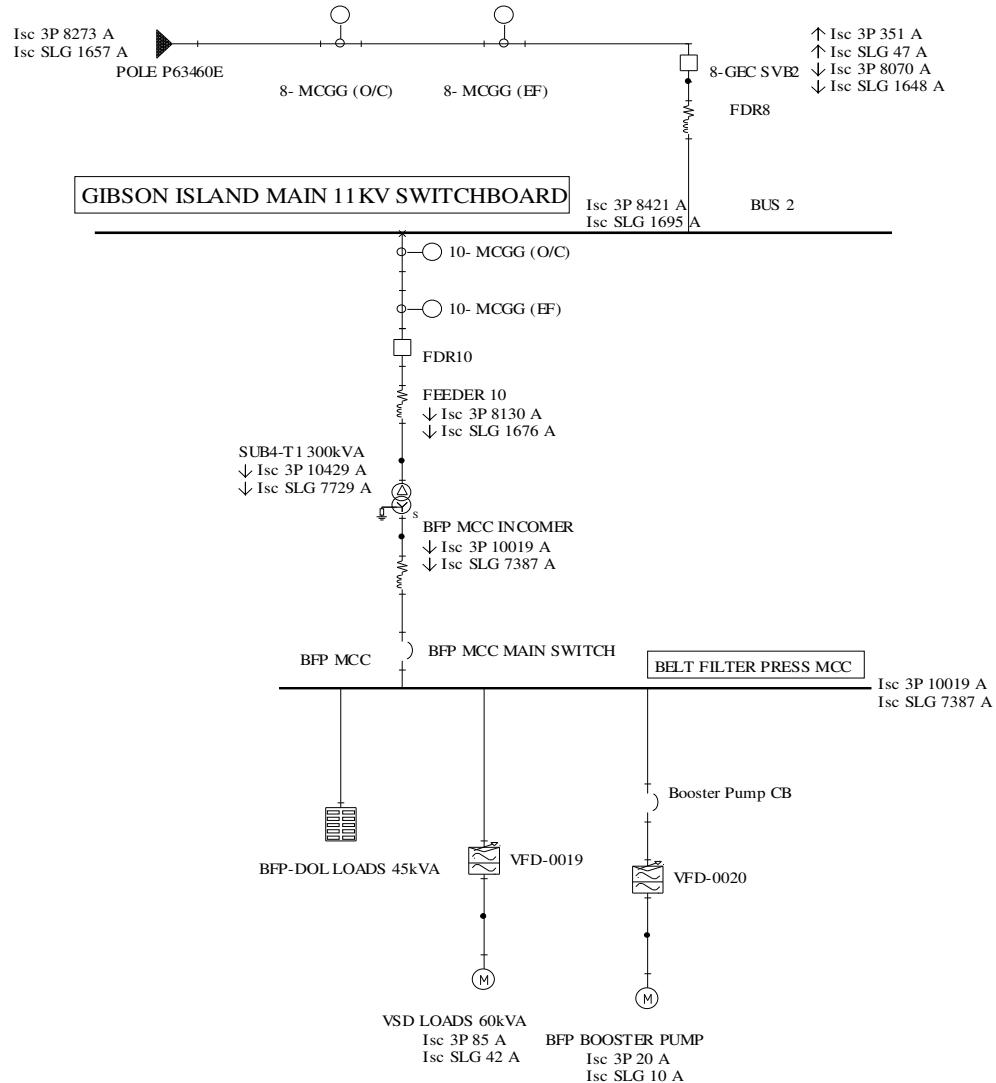
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9.1 BFP MCC Power System Analysis

Given the above listed equipment input data to the Power Tools DAPPER Software Program, the following one-line diagram depicts fault levels on the BFP MCC Power System Topology:



| **Figure 5038 – BFP MCC – 3 Phase and Single Phase to Ground Short Circuit Fault Levels**

Shown in the above one-line diagram are the 3 phase (3P) and single phase to ground (SLG) short circuit fault currents on the BFP MCC 415V Busbars.

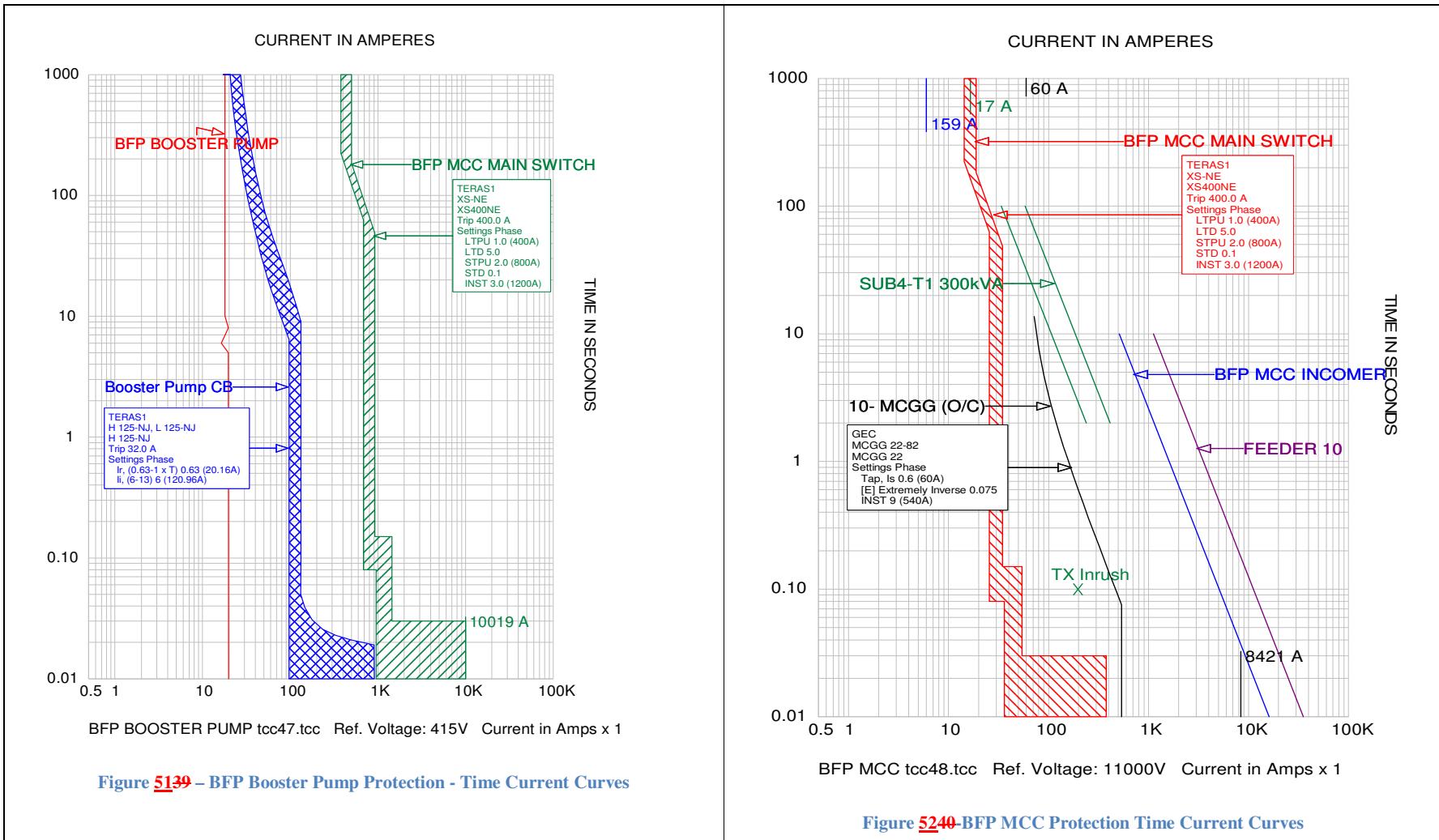
Shown in the following diagrams are the Time Current Curves (TCC) for the major protection devices at the Pump Station MCC that provide protection to the: Largest drive in the MCC and MCC Busbars. These Protection Devices settings are provided in the following pages in order to achieve the protection co-ordination shown on the TCC diagrams.

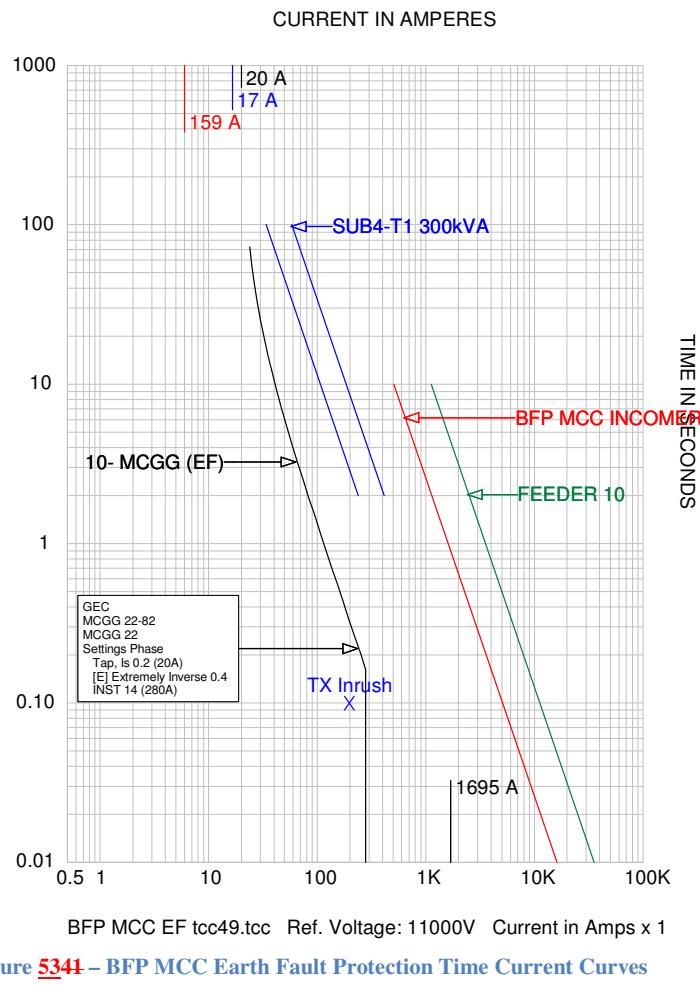
CAPTOR (Computer Aided Plotting for Time Over current Reporting) Software has been used for this Protection Coordination Study with the following output report.

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| Figure 5341 – BFP MCC Earth Fault Protection Time Current Curves

9.1.1 BFP - MCC Power System Analysis - Device Setting Parameters

The following CAPTOR Report provides protection device settings shown on the Time Current Curves in Figures 39, 40&41:

TCC Name:	BFP MCC tcc48.tcc	TCC Name:	BFP MCC tcc48.tcc
Reference Voltage:	11000 V	Bus Voltage:	415.0V
Current Scale:	X 10^0		
Fault Duty Option:	Study Result - Bus Fault Current		
Device Name:	BFP MCC MAIN SWITCH		
Bus Name:	BFP MCC		
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	TemBreak		
Type:	XS-NE		
AIC Rating:	50kA	Fault Duty:	10019.0A
Frame:	XS400NE 415V 400A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Sensor:	400A		
Plug:			
Setting:	1) LTPU 1.0 (400A)		
	2) LTD 5.0		
	3) STPU 2.0 (800A)		
	4) STD 0.1		
	5) INST 3.0 (1200A)		

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Device Name:	BFP MCC INCOMER	TCC Name:	BFP MCC tcc48.tcc
Bus Name:	BUS-0015	Bus Voltage:	415.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	300	Qty/Ph:	1
Material:	Copper	Cont. Temp:	90 deg C.
Damage Temp:	250 deg C.		

Device Name:	SUB4-T1 300kVA	TCC Name:	BFP MCC tcc48.tcc
Bus Name:	BUS-0011	Bus Voltage:	11000.0V / 415V
Time Multiplier:	1	Curve Multiplier:	1
Description:	2-Winding Transformer Damage Curve	Time Adder:	0
Nominal Size:	315.0kVA	Rated Volts:	11000 LL/415 LL
Impedance (%Z):	4.0000	Pri Connection:	Delta
Inrush Factor:	12.0x	Sec Connection:	Wye-Ground

Device Name:	FEEDER 10	TCC Name:	BFP MCC tcc48.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	25	Qty/Ph:	1
Material:	Copper	Cont. Temp:	90 deg C.
Damage Temp:	250 deg C.		

Device Name:	10- MCGG (O/C)	TCC Name:	BFP MCC tcc48.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	0.6	(60A)	Test Points: @2.0X, 2.000s
2) [E] Extremely Invers	0.075		@5.0X, 0.250s
3) INST	9	(540A)	@10.0X, 0.061s

Device Name:	10- MCGG (EF)	TCC Name:	BFP MCC EF
tcc49.tcc		Bus Voltage:	11000.0V
Bus Name:	BUS 2		
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	1695.1A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	0.2	(20A)	Test Points: @2.0X, 10.667s
2) [E] Extremely Invers	0.4		@5.0X, 1.333s
3) INST	14	(280A)	@10.0X, 0.323s

Device Name:	BFP BOOSTER PUMP	TCC Name:	BFP BOOSTER PUMP
tcc47.tcc		Bus Voltage:	415.0V
Bus Name:	BUS-0146	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Description:	Motor Starting Curve	Inrush:	1.1 (19.8A)
Rated Size:	11kW (1 of 1 Plotted)	FLA+Load Adder:	18.0A + 0.0A
Power Factor:	0.85	Starting Time:	10.00s
Efficiency:	0.93	Full Voltage (Square Transient)	

Device Name:	Booster Pump CB	TCC Name:	BFP BOOSTER PUMP
tcc47.tcc		Bus Voltage:	415.0V
Bus Name:	BFP MCC		
Function Name:	Phase		
Manufacturer:	TERAS1		
Description:	20-125A		
Type:	H 125-NJ, L 125-NJ		
AIC Rating:	125kA	Fault Duty:	10019.0A
Frame:	H 125-NJ 415V 125A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Trip:	32A		
Setting: 1) Ir, (0.63-1 x T)	0.63	(20.2A)	
2) Ii, (6-13)	6	(121A)	

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9.1.2 Belt Filter Press Switchboard – BFP MCC – Arc Flash Evaluation

The following Arc Flash Evaluation Study has been carried out to provide PPE Requirements for the Gibson Island STP Belt Filter Press Switchboard BFP MCC.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Bus Name	Protective	Bus	Bus	Prot Dev	Trip/	Breaker	Ground	Equip	Gap	Arc Flash	Working	Incident	PPE Level	Label #	Cable Length	
2	Device	kV	Bolted	Arcing	Bolted	Arcing	Delay	Opening	Type	(mm)	Boundary	Distance	Energy			From Trip Device	
3	Name		Fault	Fault	Fault	Fault	Time	Time/Tol		(mm)	(mm)	(cal/cm2)				(m)	
4			(kA)	(kA)	(kA)	(sec.)	(sec.)										
9	BFP MCC	BFP MCC MAIN SWITCH	0.415	10.02	5.96	10.02	5.95	0.03	0.000	Yes	PNL	25	291	457	1	Category 0	# 0005

Figure 5418 - Arc Flash Calculation & PPE Description Table

The highest PPE Level on this switchboard is level 0 at the Switchboard Busbars. The following label is recommended to be shown on the switchboard front door for PPE Requirements (shown below are descriptions of terminologies shown the label):

<u>Label Item</u>	<u>Description</u>
<u>Flash Hazard Boundary</u>	<u>The distance from an arcing fault within which unprotected skin could receive a 2nd degree burn. Generally considered the distance from an exposed arc source where the incident energy equals 1.2 cal/cm2.</u>
<u>Limited Approach</u>	<u>An approach limit at a distance from an exposed live part within which a shock hazard exists (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).</u>
<u>Restricted Approach</u>	<u>A shock protection boundary to be crossed by only qualified persons (at a distance from a live exposed part) which, due to its proximity to a shock hazard, requires the use of shock protection techniques and equipment when crossed (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).</u>
<u>Prohibited Approach</u>	<u>An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part. Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location.</u>

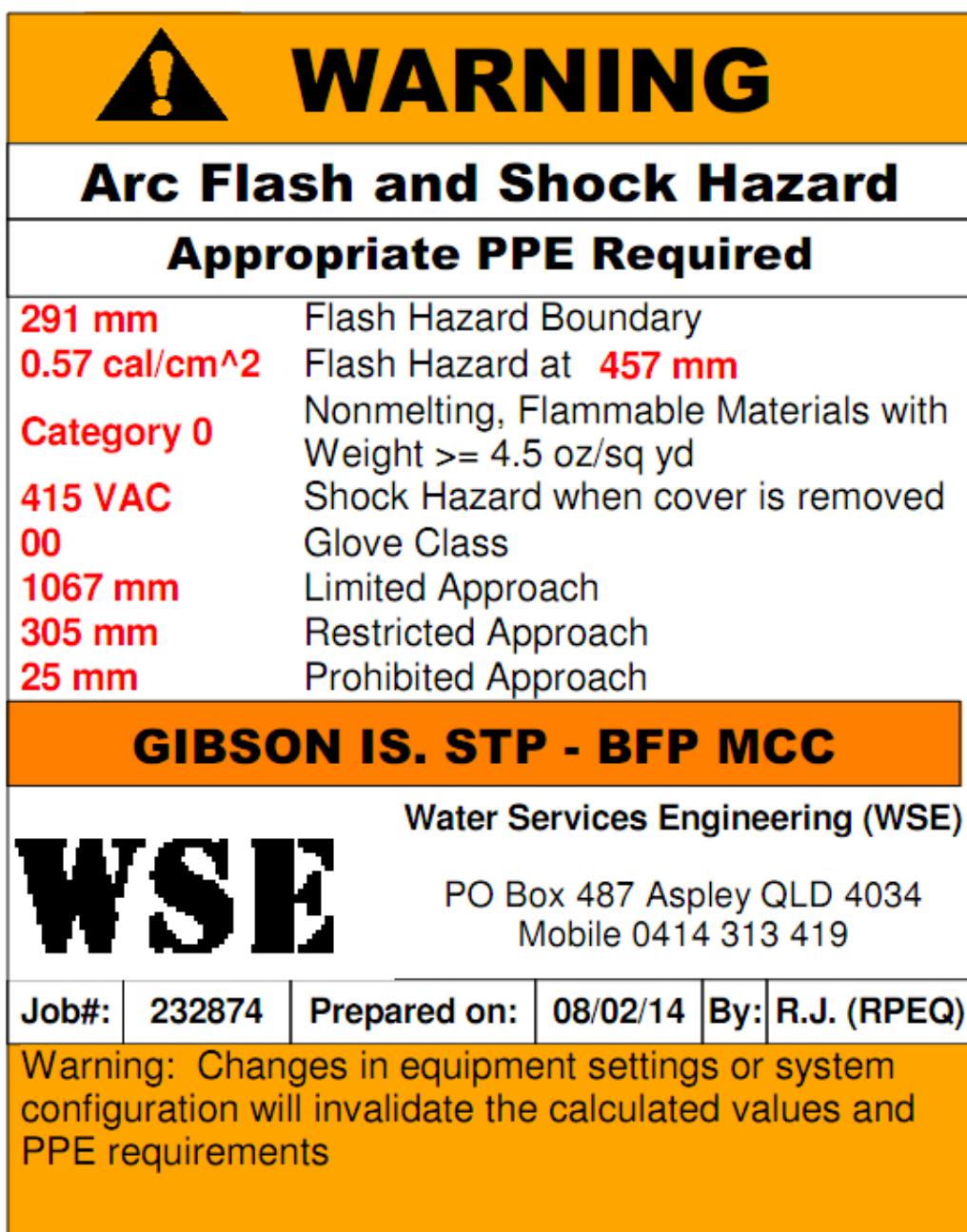


Figure 5519 – Belt Filter Press MCC Recommended Arc Flash Label

The Arc Flash Category for this SWB with the recommended settings is Category 0. It is recommended to apply this label on the front door of the SWBD.

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

10 GIBSON ISLAND STP - 11kV MAIN SWITCHBOARD POWER SYSTEM ANALYSIS

Power supply from the Energex 11kV Sub Station SS296 is fed into the Gibson Island STP 11kV Main Switchboard as shown below on line diagrams complete with Input Data and Load Flow/Voltage Drop calculations:

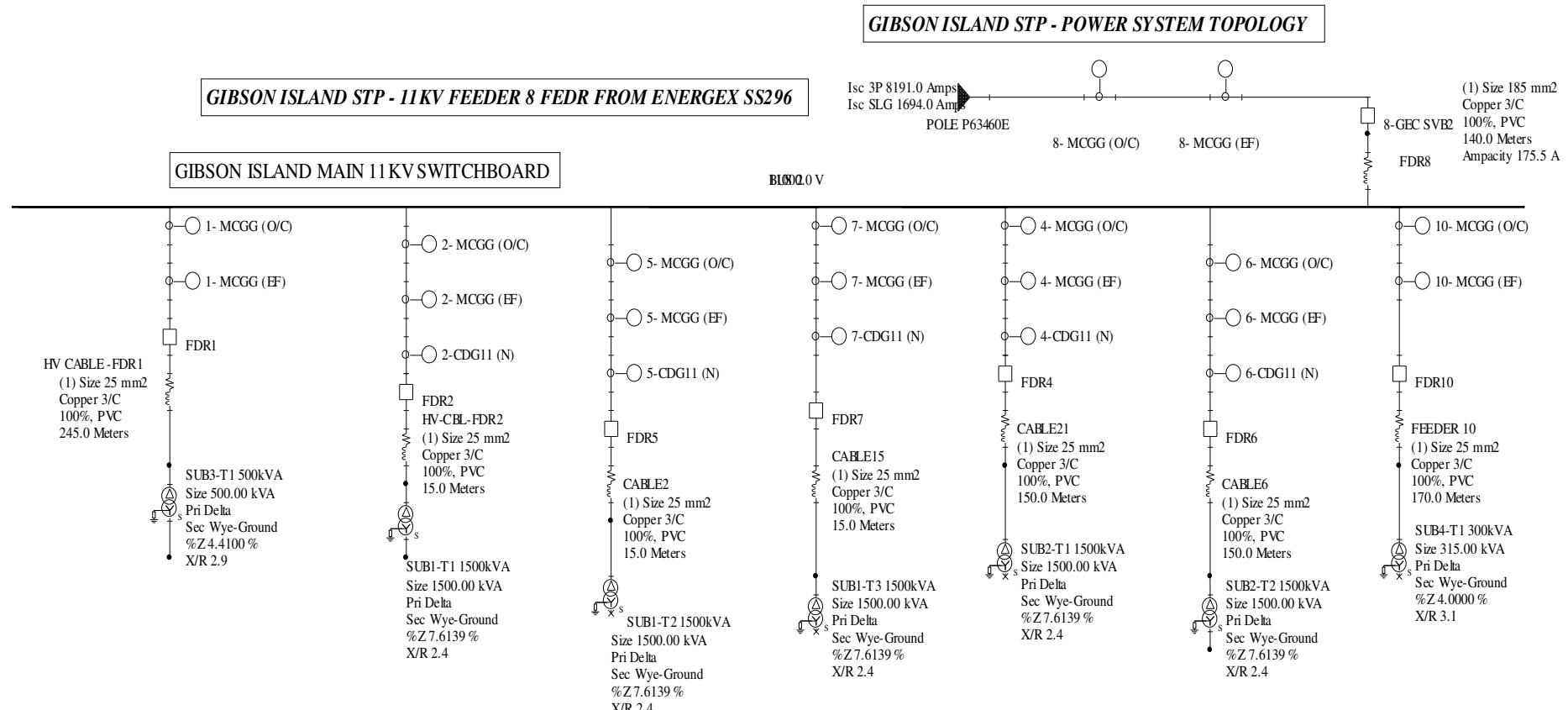


Figure 5642 – 11kV Main Switchboard - Input Data

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QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

GIBSON ISLAND STP - POWER SYSTEM TOPOLOGY

GIBSON ISLAND STP - 11KV FEEDER 8 FEDR FROM ENERGEX SS296

GIBSON ISLAND MAIN 11KV SWITCHBOARD

BUS 2
11000.0 V
0.19 % VD

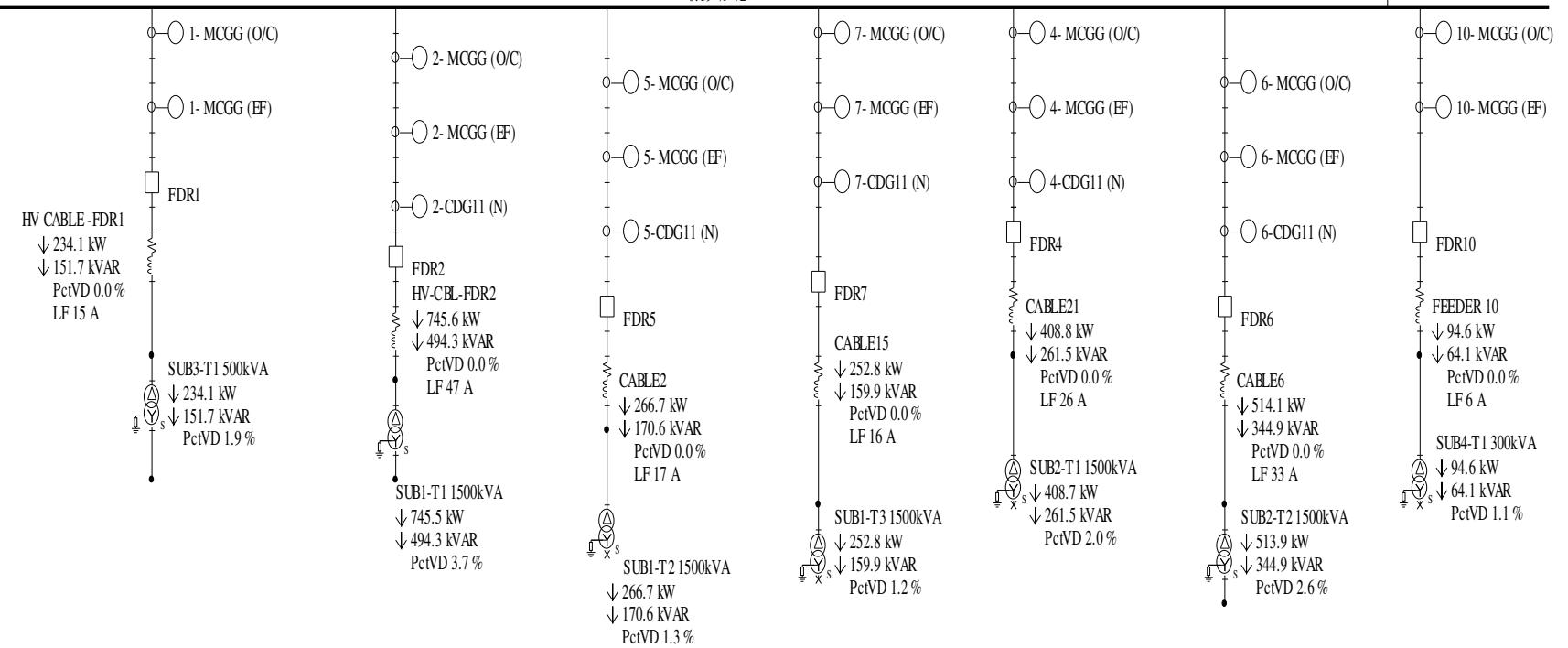


Figure 5743 - 11kV Main Switchboard Load Flow & Voltage Drop

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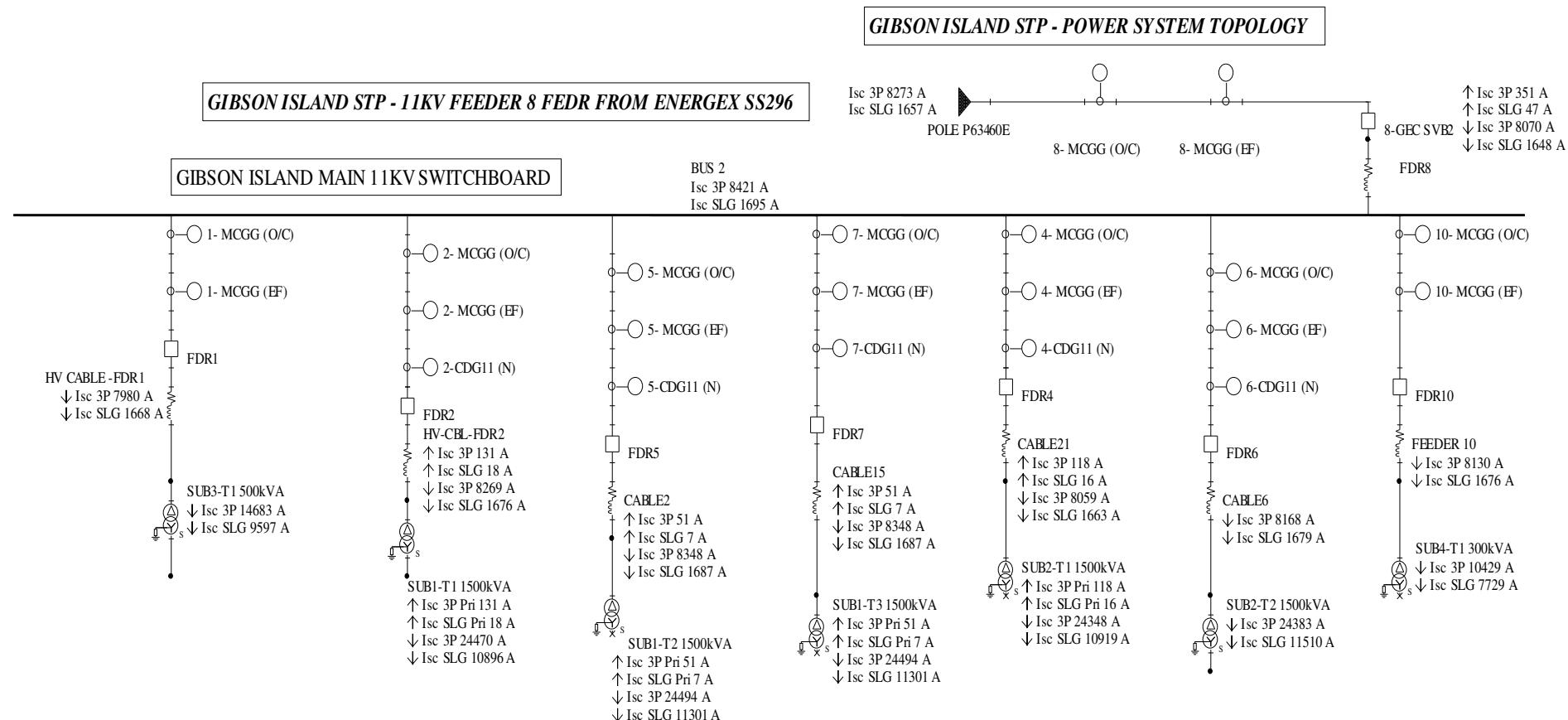


Figure 5844- 11kV Main Switchboard Short Circuit Fault Currents

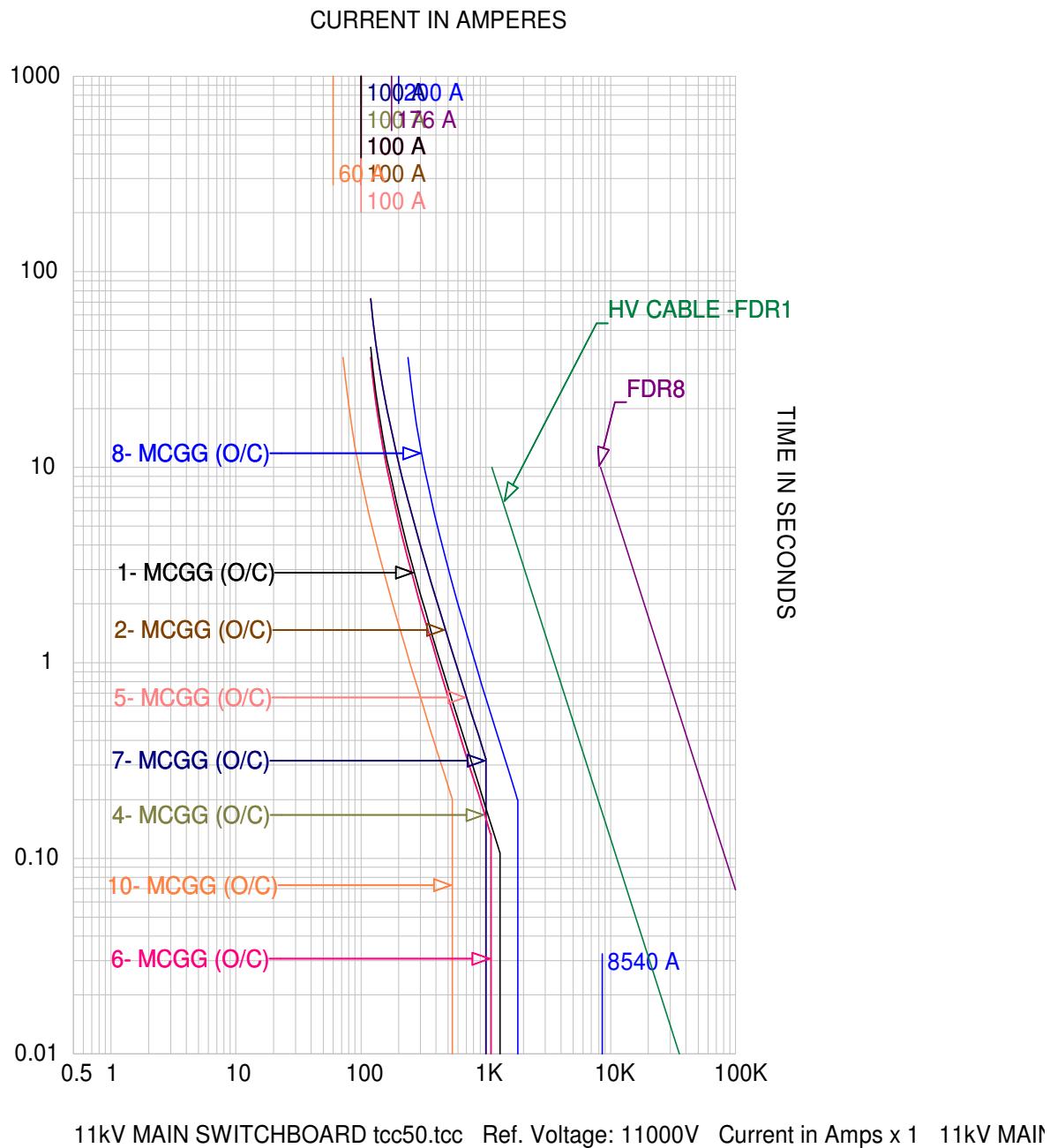
Shown in the following diagram is the Time Current Curves (TCC) for the major protection devices at the 11kV Main Switchboard which comes from the previous sections that provide protection each downstream MCC. These Protection Devices settings are provided in the following pages in order to achieve the protection co-ordination shown on the TCC diagram.

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

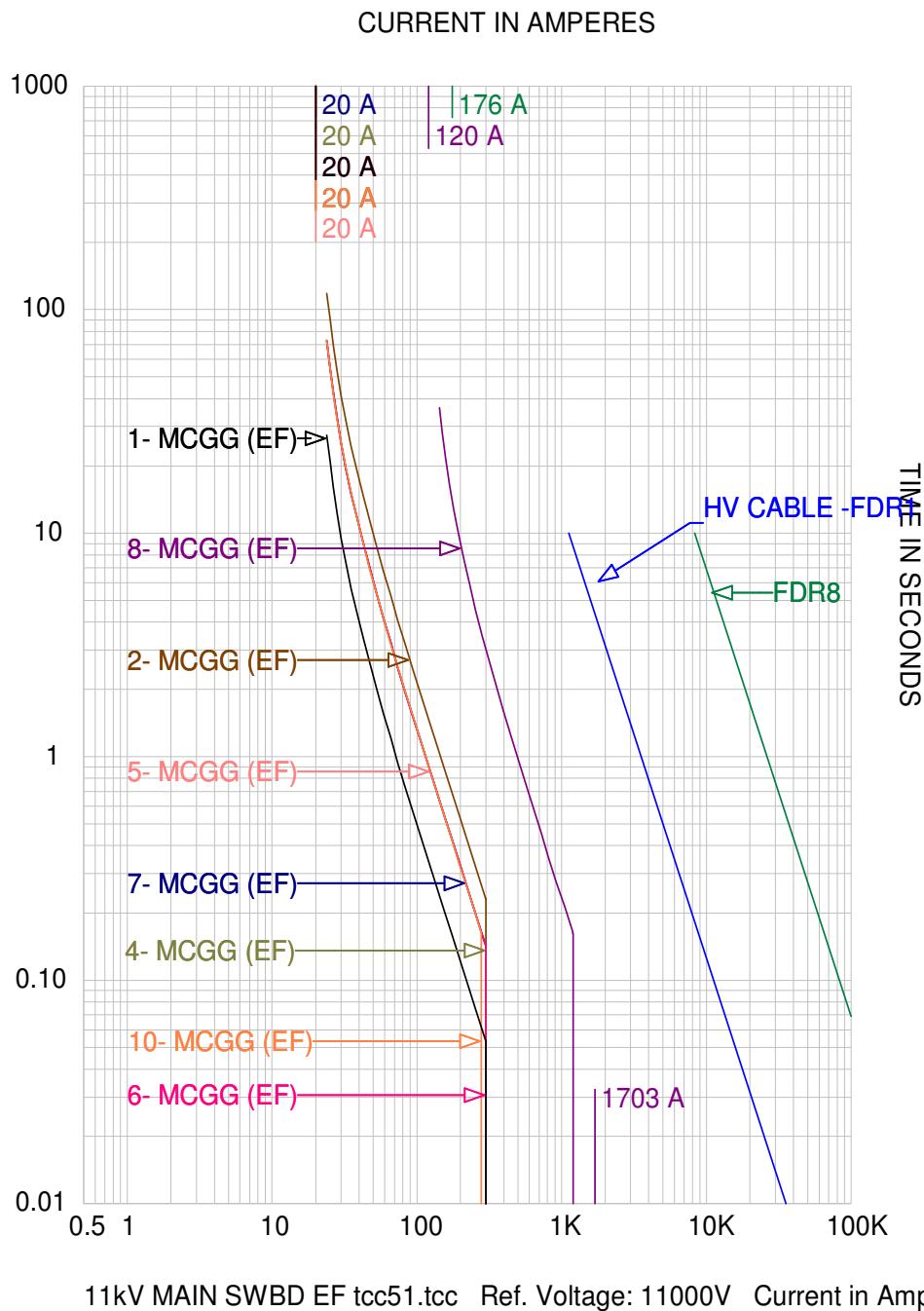
QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

CAPTOR (Computer Aided Plotting for Time Over current Reporting) Software has been used for this Protection Coordination Study with the following output report.



| Figure 5945 - 11kV Main Switchboard - 3 Phase Fault Currents Protection Time Current Curves

As shown on Figure 45 above the Main Incomer Feeder 8 protection relay has been set to provide backup protection for all 11kV feeders and protect the 11kV Main Switchboard but NOT to trip before any of the downstream protection devices.



| Figure [60606](#) – 11kV Main Switchboard Earth Fault Protection - Time Current Curves

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

10.1.1 11kV Main Switchboard Power System Analysis – Device Setting Parameters

The following CAPTOR Report provides protection device settings shown on the Time Current Curves in Figure 45 and 46:

05 May 2012
TCC Name: 11kV MAIN SWITCHBOARD tcc50.tcc
Reference Voltage: 11000 V
Current Scale: X 10^0
TCC Notes:
TCC Comment:
Fault Duty Option: Study Result - Bus Fault Current

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL, INTERPRETATION,
AND APPLICATION BY A REGISTERED ENGINEER ONLY.
SKM DISCLAIMS ANY RESPONSIBILITY AND LIABILITY RESULTING
FROM THE USE AND INTERPRETATION OF THIS SOFTWARE.

CAPTOR (Computer Aided Plotting for Time Overcurrent Reporting)
COPYRIGHT SKM SYSTEMS ANALYSIS, INC. 1983-2007

Device Name:	1- MCGG (O/C)	TCC Name:	11kV MAIN SWITCHBOARD tcc50.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	1	(100A)	Test Points: @2.0X, 6.000s
2) [E] Extremely Invers	0.225		@5.0X, 0.750s
3) INST	13	(1300A)	@10.0X, 0.182s

Device Name:	8- MCGG (O/C)	TCC Name:	11kV MAIN SWITCHBOARD tcc50.tcc
Bus Name:	BUS-0071	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8540.5A
Current Rating:	200A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	1	(200A)	Test Points: @2.0X, 5.333s
2) [E] Extremely Invers	0.2		@5.0X, 0.667s
3) INST	9	(1800A)	@10.0X, 0.162s

Device Name:	HV CABLE -FDR1	TCC Name:	11kV MAIN SWITCHBOARD tcc50.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	25	Qty/Ph:	1
Material:	Copper	Cont. Temp:	90 deg C.
		Damage Temp:	250 deg C.

Device Name:	FDR8	TCC Name:	11kV MAIN SWITCHBOARD tcc50.tcc
Bus Name:	BUS-0071	Bus Voltage:	11000.0V
Time Multiplier:	1	Curve Multiplier:	1
Description:	Cable Damage Curve	Time Adder:	0
Size:	185	Qty/Ph:	1
Material:	Copper	Cont. Temp:	90 deg C.
		Damage Temp:	250 deg C.

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

Device Name:	2- MCGG (O/C)	TCC Name:	11kV MAIN SWITCHBOARD tcc50.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	1	(100A)	Test Points: @2.0X, 10.667s
2) [E] Extremely Invers	0.4		@5.0X, 1.333s
3) INST	10	(1000A)	@10.0X, 0.323s

Device Name:	5- MCGG (O/C)	TCC Name:	11kV MAIN SWITCHBOARD tcc50.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	1	(100A)	Test Points: @2.0X, 10.667s
2) [E] Extremely Invers	0.4		@5.0X, 1.333s
3) INST	10	(1000A)	@10.0X, 0.323s

Device Name:	7- MCGG (O/C)	TCC Name:	11kV MAIN SWITCHBOARD tcc50.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	1	(100A)	Test Points: @2.0X, 10.667s
2) [E] Extremely Invers	0.4		@5.0X, 1.333s
3) INST	10	(1000A)	@10.0X, 0.323s

Device Name:	4- MCGG (O/C)	TCC Name:	11kV MAIN SWITCHBOARD tcc50.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	1	(100A)	Test Points: @2.0X, 5.333s
2) [E] Extremely Invers	0.2		@5.0X, 0.667s
3) INST	11	(1100A)	@10.0X, 0.162s

Device Name:	6- MCGG (O/C)	TCC Name:	11kV MAIN SWITCHBOARD tcc50.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	1	(100A)	Test Points: @2.0X, 5.333s
2) [E] Extremely Invers	0.2		@5.0X, 0.667s
3) INST	11	(1100A)	@10.0X, 0.162s

Device Name:	10- MCGG (O/C)	TCC Name:	11kV MAIN SWITCHBOARD tcc50.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		

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QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	8420.6A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	0.6	(60A)	Test Points: @2.0X, 5.333s
2) [E] Extremely Invers	0.2		@5.0X, 0.667s
3) INST	9	(540A)	@10.0X, 0.162s

TCC Name: 11kV MAIN SWBD EF tcc51.tcc
 Reference Voltage: 11000 V
 Current Scale: X 10^0
 TCC Notes:
 TCC Comment:
 Fault Duty Option: Study Result - Bus Fault Current

Device Name:	1- MCGG (EF)	TCC Name:	11kV MAIN SWBD EF tcc51.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	1695.1A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	0.2	(20A)	Test Points: @2.0X, 4.000s
2) [E] Extremely Invers	0.15		@5.0X, 0.500s
3) INST	15	(300A)	@10.0X, 0.121s

Device Name:	8- MCGG (EF)	TCC Name:	11kV MAIN SWBD EF tcc51.tcc
Bus Name:	BUS-0071	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	1703.5A
Current Rating:	200A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	0.6	(120A)	Test Points: @2.0X, 5.333s
2) [E] Extremely Invers	0.2		@5.0X, 0.667s
3) INST	10	(1200A)	@10.0X, 0.162s

Device Name:	2- MCGG (EF)	TCC Name:	11kV MAIN SWBD EF tcc51.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	1695.1A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	0.2	(20A)	Test Points: @2.0X, 17.333s
2) [E] Extremely Invers	0.65		@5.0X, 2.167s
3) INST	15	(300A)	@10.0X, 0.525s

Device Name:	5- MCGG (EF)	TCC Name:	11kV MAIN SWBD EF tcc51.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	1695.1A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1) Tap, Is	0.2	(20A)	Test Points: @2.0X, 10.667s
2) [E] Extremely Invers	0.4		@5.0X, 1.333s
3) INST	15	(300A)	@10.0X, 0.323s

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QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

Device Name:	7- MCGG (EF)	TCC Name:	11kV MAIN SWBD EF tcc51.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	1695.1A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1)	Tap, Is	0.2	(20A)
2)	[E] Extremely Invers	0.4	
3)	INST	15	(300A)
		Test Points:	@2.0X, 10.667s @5.0X, 1.333s @10.0X, 0.323s

Device Name:	4- MCGG (EF)	TCC Name:	11kV MAIN SWBD EF tcc51.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	1695.1A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1)	Tap, Is	0.2	(20A)
2)	[E] Extremely Invers	0.4	
3)	INST	15	(300A)
		Test Points:	@2.0X, 10.667s @5.0X, 1.333s @10.0X, 0.323s

Device Name:	6- MCGG (EF)	TCC Name:	11kV MAIN SWBD EF tcc51.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	1695.1A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1)	Tap, Is	0.2	(20A)
2)	[E] Extremely Invers	0.4	
3)	INST	15	(300A)
		Test Points:	@2.0X, 10.667s @5.0X, 1.333s @10.0X, 0.323s

Device Name:	10- MCGG (EF)	TCC Name:	11kV MAIN SWBD EF tcc51.tcc
Bus Name:	BUS 2	Bus Voltage:	11000.0V
Function Name:	Phase		
Manufacturer:	GEC		
Description:	50/51		
Type:	MCGG 22-82	Class Desc:	MCGG 22
AIC Rating:	N/A	Fault Duty:	1695.1A
Current Rating:	100A / 5A	Curve Multiplier:	1
Time Multiplier:	1	Time Adder:	0
Setting: 1)	Tap, Is	0.2	(20A)
2)	[E] Extremely Invers	0.4	
3)	INST	14	(280A)
		Test Points:	@2.0X, 10.667s @5.0X, 1.333s @10.0X, 0.323s

10.1.2 11kV Main Switchboard – Arc Flash Evaluation

The following Arc Flash Evaluation Study has been carried out to provide PPE Requirements for the Gibson Island STP 11kV Main Switchboard.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	
1	Bus Name	Protective	Bus	Bus	Prot Dev	Prot Dev	Trip/ Arcing	Breaker	Ground	Equip	Gap	Arc Flash	Working	Incident	PPE Level	Label #	Cable Length	
2	Device		kV	Bolted			Bolted			Type	(mm)	Boundary	Distance	Energy			From Trip Device	
3		Name		Fault	Fault	Fault	Fault	Time	Time/Tol									
4				(kA)	(kA)	(kA)	(kA)	(sec.)	(sec.)								(m)	
10	BUS 2 (11kV Main Switchboard)	8- MCGG (O/C)	11.00	8.44	8.21	8.07	7.86	0.02	0.100	Yes	SWG	153	948	914	1.2	Category 1	# 0006	140.00

Figure 6148 - Arc Flash Calculation & PPE Description Table

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The highest PPE Level on this switchboard is level 1 at the Switchboard Busbars. The following label is recommended to be shown on the switchboard front door for PPE Requirements (shown below are descriptions of terminologies shown the label):

Label Item	Description
<u>Flash Hazard Boundary</u>	<u>The distance from an arcing fault within which unprotected skin could receive a 2nd degree burn. Generally considered the distance from an exposed arc source where the incident energy equals 1.2 cal/cm².</u>
<u>Limited Approach</u>	<u>An approach limit at a distance from an exposed live part within which a shock hazard exists (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).</u>
<u>Restricted Approach</u>	<u>A shock protection boundary to be crossed by only qualified persons (at a distance from a live exposed part) which, due to its proximity to a shock hazard, requires the use of shock protection techniques and equipment when crossed (Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location).</u>
<u>Prohibited Approach</u>	<u>An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part. Defined in NFPA 70E - Standard for Electrical Safety in the Workplace based on design voltage at the fault location.</u>

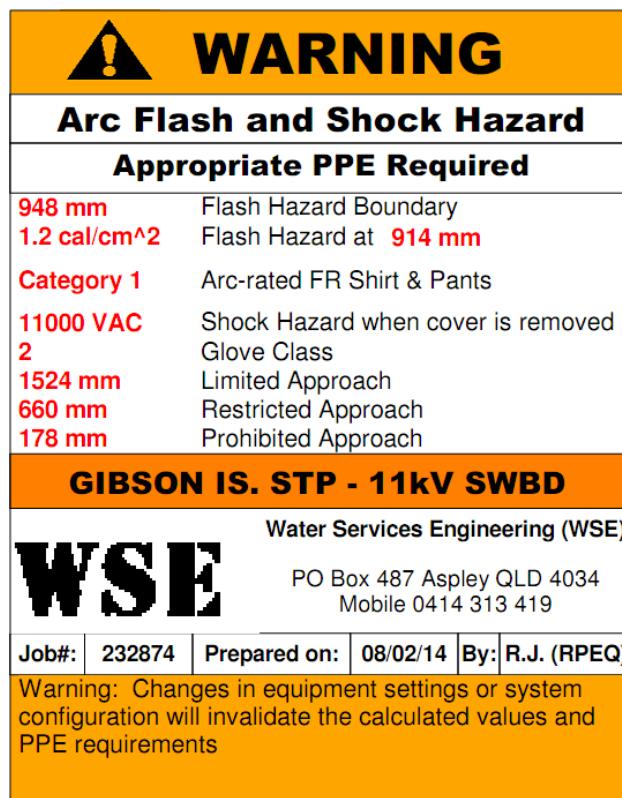


Figure 6249 – 11kV Main Switchboard Recommended Arc Flash Label

The Arc Flash Category for this SWB with the recommended settings is Category 1. It is recommended to apply this label on the front door of the SWBD.

WATER SERVICES ENGINEERING (WSE) PTY. LTD.

POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

Questions and Answers on Arc Flash Hazard:

Q1 - We need to know the hazard distances with the switchboard door closed i.e. no exposure to live parts?

Response: with the switchboard doors closed, there is no arc flash hazard on a Level 0 switchboard, the only hazard is touch potential hazard due to 415V being inside cabinet that could end up with a phase to frame short circuit (for whatever reason). This needs to be addressed by having correct CB settings to ensure prospective touch voltage does not rise beyond dangerous levels (Figure B4 of AS3000:2007) AND must be addressed by putting a warning sign on each switchboard as per signage requirements of Australian Standard AS3000. QUU must ensure this warning sign: “WARNING 415V DANGEROUS VOLTAGE BEHIND SWITCHBOARD DOOR” is clearly shown on each switchboard door where 415V is behind that door.

It is recommended to stick the “Arc Flash Hazard” label on the Escutcheon Plate of every compartment that has 415V live part behind. The label should be behind the switchboard front door to avoid any safety concern to the general public.

Q2 - QUU needs sufficient detail to allow communication to their maintenance staff. At the end of the day we need to understand if the arc flash presents a hazard to people walking past the switchboard with the door closed (i.e. general public), QUU staff with limited access (door open and starting a pump) and QUU staff with full access (i.e. electricians – door open and escutcheon open).

Response:

- a) On a Level 0 switchboard with doors closed, Arc Flash does not present any hazard to public walking past the switchboard nor QUU staff.
- b) For QUU staff with limited access (who have done switchboard key access training), they can open the front door to start a pump without any need to PPE, however it is recommended to put a fence, barrier or mobile barricade around the switchboard (outside the Limited Approach boundary) to prevent general public having access to a switchboard with its front doors open. QUU Staff with limited access MUST NOT open the escutcheon to get access to exposed live 415V parts of the switchboard.
- c) Escutcheon plates can only be opened by trained electricians using proper PPE as shown on the Arc Flash Hazard Label (Refer to Restricted Approach description).

Q3 - Can it be said that the “Limited Approach” distance is the minimum distance where the workers mobile barricades should go when working on these switchboards in publicly accessible places i.e. to prevent unqualified people from entering this zone when the switchboard door is open.

Response:

- a) Yes as per item b) in Question 2 – it is strongly recommended to put these barricades outside Limited Approach Boundary before opening the switchboard front doors.

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Description of Arc Flash Terminologies as per: *NFPA 70E - Standard for Electrical Safety in the Workplace*

<u>Item</u>	<u>Description</u>
<u>Flash Hazard Boundary</u>	The distance from an arcing fault within which unprotected skin could receive a 2nd degree burn. Generally considered the distance from an exposed arc source where the incident energy equals 1.2 cal/cm ² .
<u>Flash Hazard/ Incident Energy</u>	The amount of energy on a surface at a specific distance from a flash
<u>PPE Category</u>	Indicates the Personal Protective Equipment (PPE) required to prevent an incurable burn at the working distance from an exposed arc source during an arcing fault.
<u>PPE Category Level (x)</u>	<p>The following table shows the Category Levels:</p> <p>Level 0: Nonmelting, Flammable Materials with Weight >= 4.5 oz/sq yd, Safety Glasses or Goggles + Ear Canal Inserts, Leather Gloves, Safety glasses, Non-melting or untreated natural fiber (cotton/wool/rayon/silk > 4.5 oz/sq yd), shirt (long-sleeve), pants (long),, > 50V voltage rated tools + Class 0 (minimum) gloves, Dielectric shoes or insulating mat (step and touch potential).</p> <p>Level 1: Arc-rated FR Shirt & Pants, Hardhat + Safety Glasses or Goggles + Ear Canal Inserts, Leather Gloves, Leather work shoes, Safety glasses, electrically rated hard hat with hood and face shield., 17 J/sq cm, FR shirt (long-sleeve) plus FR pants (long), or FR coverall, rainwear as needed., > 50V voltage rated tools + Class 0 (minimum) gloves and leather protectors (flash) as needed., Leather shoes (flash) as needed. Dielectric shoes or insulating mat (step and touch potential).</p> <p>Level 2: Arc-rated FR Shirt & Pants, Hardhat + Safety Glasses or Goggles + Ear Canal Inserts, Leather Gloves, Leather work shoes, Safety glasses, electrically rated hard hat with hood and face shield. Hearing protection., 34 J/sq cm, cotton underwear T-shirt and briefs or shorts, FR shirt (long-sleeve) plus FR pants (long), or FR coverall/coat, rainwear as needed., > 50V voltage rated tools + Class 0 (minimum) gloves and leather protectors (flash),, Leather shoes (flash) as needed. Dielectric shoes or insulating mat (step and touch potential).</p> <p>Level 3: Arc-rated FR Shirt & Pants & Arc Flash Suit, Hardhat + FR hard hat liner + Safety Glasses or Goggles + Ear Canal Inserts, Arc-rated Gloves, Leather work shoes, Safety glasses, electrically rated hard hat with hood and face shield. Hearing protection., 105 J/sq cm, cotton underwear T-shirt and briefs or shorts, FR shirt (long-sleeve) plus FR pants (long), or FR coverall/coat, rainwear as needed., > 50V voltage rated tools + Class 0 (minimum) gloves and leather protectors (flash),, Leather shoes (flash) as needed. Dielectric shoes or insulating mat (step and touch potential).</p> <p>Level 4: Arc-rated FR Shirt & Pants & Arc Flash Suit, Hardhat + FR hard hat liner + Safety Glasses or Goggles + Ear Canal Inserts, Arc-rated Gloves, Leather work shoes, Safety glasses, electrically rated hard hat with hood and face shield. Hearing protection., 167 J/sq cm, cotton underwear T-shirt and briefs or shorts, FR shirt (long-sleeve) plus FR pants (long), or FR coverall/coat, rainwear as needed., > 50V voltage rated tools + Class 0 (minimum) gloves and leather protectors (flash),, Leather shoes (flash) as needed. Dielectric shoes or insulating mat (step and touch potential).</p>

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QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

<u>Item</u>	<u>Description</u>														
	<u>Level Dangerous!: No FR Category Found, Do not work on live!, No FR Category Found, Arc Flash Incident Energy Exceeds the Rating of Category 4 PPE., No FR Category Found</u>														
<u>Shock Hazard when cover is removed</u>	<u>Voltage levels which pose potential shock hazard when switchboard door and escutcheon are open. Typically 415VAC.</u>														
<u>Glove Class</u>	<u>Glove Class is system voltage dependant as follows:</u> <table> <thead> <tr> <th><u>Glove Class</u></th> <th><u>Voltage</u></th> </tr> </thead> <tbody> <tr> <td><u>00</u></td> <td><u>500 V</u></td> </tr> <tr> <td><u>0</u></td> <td><u>1000 V</u></td> </tr> <tr> <td><u>1</u></td> <td><u>7500 V</u></td> </tr> <tr> <td><u>2</u></td> <td><u>17,000 V</u></td> </tr> <tr> <td><u>3</u></td> <td><u>26,500 V</u></td> </tr> <tr> <td><u>4</u></td> <td><u>36,000 V</u></td> </tr> </tbody> </table> <u>For a 415V system, the recommended Glove Class is 0 in <i>NFPA 70E - Standard for Electrical Safety in the Workplace</i></u>	<u>Glove Class</u>	<u>Voltage</u>	<u>00</u>	<u>500 V</u>	<u>0</u>	<u>1000 V</u>	<u>1</u>	<u>7500 V</u>	<u>2</u>	<u>17,000 V</u>	<u>3</u>	<u>26,500 V</u>	<u>4</u>	<u>36,000 V</u>
<u>Glove Class</u>	<u>Voltage</u>														
<u>00</u>	<u>500 V</u>														
<u>0</u>	<u>1000 V</u>														
<u>1</u>	<u>7500 V</u>														
<u>2</u>	<u>17,000 V</u>														
<u>3</u>	<u>26,500 V</u>														
<u>4</u>	<u>36,000 V</u>														
<u>Limited Approach</u>	<u>An approach limit at a distance from an exposed live part within which a shock hazard exists (Defined in <i>NFPA 70E - Standard for Electrical Safety in the Workplace</i> based on design voltage at the fault location).</u>														
<u>Restricted Approach</u>	<u>A shock protection boundary to be crossed by only qualified persons (at a distance from a live exposed part) which, due to its proximity to a shock hazard, requires the use of shock protection techniques and equipment when crossed (Defined in <i>NFPA 70E - Standard for Electrical Safety in the Workplace</i> based on design voltage at the fault location).</u>														
<u>Prohibited Approach</u>	<u>An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part. Defined in <i>NFPA 70E - Standard for Electrical Safety in the Workplace</i> based on design voltage at the fault location.</u>														

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

11 APPENDIX A: INPUT DATA REPORT

16 Apr 2012 20:42:47

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED ENGINEER ONLY
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SKM POWER*TOOLS FOR WINDOWS
INPUT DATA REPORT

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ALL PU VALUES ARE EXPRESSED ON A 100 MVA BASE.

FEEDER INPUT DATA							
CABLE NAME	FEEDER FROM NAME	FEEDER TO NAME	QTY	VOLTS /PH	LENGTH L-L	FEEDER SIZE	TYPE
ASB1 FEEDER 1	BUS12	ASB1-BUS1	3	415	10.0 METER	240	Copper
	Duct Material: Non-Magnetic	Insulation Type:			PVC	Insulation Class:	
	+/- Impedance: 0.0935 + J 0.0741	Ohms/1000 m			0.1810 + J 0.1435	PU	
	Z0 Impedance: 0.1486 + J 0.1886	Ohms/1000 m			0.2877 + J 0.3651	PU	
ASB1 FEEDER 2	BUS22	ASB1 - BUS2	3	415	10.0 METER	240	Copper
	Duct Material: Non-Magnetic	Insulation Type:			PVC	Insulation Class:	
	+/- Impedance: 0.0935 + J 0.0741	Ohms/1000 m			0.1810 + J 0.1435	PU	
	Z0 Impedance: 0.1486 + J 0.1886	Ohms/1000 m			0.2877 + J 0.3651	PU	
ASB2-FEEDER2	MPSB BUS2	BUS52	3	415	15.0 METER	240	Copper
	Duct Material: Non-Magnetic	Insulation Type:			PVC	Insulation Class:	
	+/- Impedance: 0.0935 + J 0.0741	Ohms/1000 m			0.2715 + J 0.2153	PU	
	Z0 Impedance: 0.1486 + J 0.1886	Ohms/1000 m			0.4315 + J 0.5477	PU	
ASB3-FDR1	BUS12	ASB3 - BUS1	2	415	45.0 METER	185	Copper
	Duct Material: Non-Magnetic	Insulation Type:			PVC	Insulation Class:	
	+/- Impedance: 0.1240 + J 0.0748	Ohms/1000 m			1.62 + J 0.9773	PU	
	Z0 Impedance: 0.1968 + J 0.1903	Ohms/1000 m			2.57 + J 2.49	PU	
ASB3-FDR2	BUS22	ASB3- BUS2	2	415	45.0 METER	185	Copper
	Duct Material: Non-Magnetic	Insulation Type:			PVC	Insulation Class:	
	+/- Impedance: 0.1240 + J 0.0748	Ohms/1000 m			1.62 + J 0.9772	PU	
	Z0 Impedance: 0.1969 + J 0.1903	Ohms/1000 m			2.57 + J 2.49	PU	
BFP MCC INCOMEBUS-0015	BFP MCC	1	415	10.0 METER	300	Copper	
	Duct Material: Non-Magnetic	Insulation Type:			PVC	Insulation Class:	
	+/- Impedance: 0.0764 + J 0.0738	Ohms/1000 m			0.4439 + J 0.4286	PU	
	Z0 Impedance: 0.1214 + J 0.1877	Ohms/1000 m			0.7048 + J 1.09	PU	

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BLW1-CBL	BUS12	BUS-0104	2	415	20.0 METER	185	Copper
	Duct Material:	Non-Magnetic		Insulation Type:	PVC	Insulation Class:	
+/-	Impedance:	0.1240 + J 0.0748	Ohms/1000 m		0.7201 + J 0.4343	PU	
Z0	Impedance:	0.1968 + J 0.1903	Ohms/1000 m		1.14 + J 1.10	PU	
BLW2-CBL	BUS22	BUS-0106	2	415	25.0 METER	185	Copper
	Duct Material:	Non-Magnetic		Insulation Type:	PVC	Insulation Class:	
+/-	Impedance:	0.1240 + J 0.0748	Ohms/1000 m		0.9001 + J 0.5429	PU	
Z0	Impedance:	0.1968 + J 0.1903	Ohms/1000 m		1.43 + J 1.38	PU	
BLW4-CBL	BUS12	BUS-0103	2	415	30.0 METER	240	Copper
	Duct Material:	Non-Magnetic		Insulation Type:	PVC	Insulation Class:	
+/-	Impedance:	0.0935 + J 0.0741	Ohms/1000 m		0.8144 + J 0.6458	PU	
Z0	Impedance:	0.1486 + J 0.1886	Ohms/1000 m		1.29 + J 1.64	PU	
BUSBAR	BUS-0013	MPSB BUS1	6	415	7.0 METER	400	Copper
	Duct Material:	Busway		Insulation Type:	Epoxy	Insulation Class:	Class B
+/-	Impedance:	0.0955 + J 0.0823	Ohms/1000 m		0.0647 + J 0.0557	PU	
Z0	Impedance:	0.5676 + J 0.4404	Ohms/1000 m		0.3845 + J 0.2984	PU	
BUSBAR5	BUS-0014	MPSB BUS2	6	415	7.0 METER	400	Copper
	Duct Material:	Busway		Insulation Type:	Epoxy	Insulation Class:	Class B
+/-	Impedance:	0.0955 + J 0.0823	Ohms/1000 m		0.0647 + J 0.0557	PU	
Z0	Impedance:	0.5676 + J 0.4404	Ohms/1000 m		0.3845 + J 0.2984	PU	
BUSBAR67	MPSB BUS2	BUS67	3	415	15.0 METER	185	Copper
	Duct Material:	Non-Magnetic		Insulation Type:	PVC	Insulation Class:	
+/-	Impedance:	0.1240 + J 0.0748	Ohms/1000 m		0.3600 + J 0.2172	PU	
Z0	Impedance:	0.1968 + J 0.1903	Ohms/1000 m		0.5715 + J 0.5524	PU	
BUSBAR68	MPSB BUS2	BUS75	3	415	15.0 METER	185	Copper
	Duct Material:	Non-Magnetic		Insulation Type:	PVC	Insulation Class:	
+/-	Impedance:	0.1240 + J 0.0748	Ohms/1000 m		0.3600 + J 0.2172	PU	
Z0	Impedance:	0.1968 + J 0.1903	Ohms/1000 m		0.5715 + J 0.5524	PU	
CABLE -34	BUS67	BUS-0112	3	415	55.0 METER	185	Copper
	Duct Material:	Non-Magnetic		Insulation Type:	PVC	Insulation Class:	
+/-	Impedance:	0.1240 + J 0.0748	Ohms/1000 m		1.32 + J 0.7963	PU	
Z0	Impedance:	0.1968 + J 0.1903	Ohms/1000 m		2.10 + J 2.03	PU	
CABLE -38	BUS75	BUS-0116	3	415	55.0 METER	185	Copper
	Duct Material:	Non-Magnetic		Insulation Type:	PVC	Insulation Class:	
+/-	Impedance:	0.1240 + J 0.0748	Ohms/1000 m		1.32 + J 0.7963	PU	
Z0	Impedance:	0.1968 + J 0.1903	Ohms/1000 m		2.10 + J 2.03	PU	
CABLE 29	BUS-0159	BUS52	3	415	15.0 METER	240	Copper
	Duct Material:	Non-Magnetic		Insulation Type:	PVC	Insulation Class:	
+/-	Impedance:	0.0935 + J 0.0741	Ohms/1000 m		0.2715 + J 0.2153	PU	
Z0	Impedance:	0.1486 + J 0.1886	Ohms/1000 m		0.4315 + J 0.5477	PU	
CABLE 32	BUS-0125	BUS-0126	3	400	55.0 METER	120	Copper

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	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:
	+/- Impedance: 0.1880 + J 0.0748 Ohms/1000 m		2.15 + J 0.8571 PU	
	Z0 Impedance: 0.2986 + J 0.1903 Ohms/1000 m		3.42 + J 2.18 PU	
CABLE 33	ESB1	ESB2	6 415 2.0 METER	95 Copper
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:
	+/- Impedance: 0.2431 + J 0.0771 Ohms/1000 m		0.0471 + J 0.0149 PU	
	Z0 Impedance: 0.3865 + J 0.1959 Ohms/1000 m		0.0748 + J 0.0379 PU	
CABLE 35	BUS-0144	BUS-0172	3 415 55.0 METER	120 Copper
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:
	+/- Impedance: 0.1880 + J 0.0748 Ohms/1000 m		2.00 + J 0.7963 PU	
	Z0 Impedance: 0.2986 + J 0.1903 Ohms/1000 m		3.18 + J 2.03 PU	
CABLE14	BUS-0026	BUS32	6 415 20.0 METER	300 Copper
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:
	+/- Impedance: 0.0764 + J 0.0738 Ohms/1000 m		0.1480 + J 0.1429 PU	
	Z0 Impedance: 0.1214 + J 0.1877 Ohms/1000 m		0.2349 + J 0.3632 PU	
CABLE15	BUS 2	BUS-0025	1 11000 15.0 METER	25 Copper
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:
	+/- Impedance: 0.5100 + J 0.0900 Ohms/1000 m		0.0063 + J 0.0011 PU	100%
	Z0 Impedance: 0.8108 + J 0.2290 Ohms/1000 m		0.0101 + J 0.0028 PU	
CABLE17	BUS32	BUS-0069	2 415 30.0 METER	185 Copper
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:
	+/- Impedance: 0.1240 + J 0.0748 Ohms/1000 m		1.08 + J 0.6515 PU	
	Z0 Impedance: 0.1968 + J 0.1903 Ohms/1000 m		1.71 + J 1.66 PU	
CABLE2	BUS 2	BUS-0006	1 11000 15.0 METER	25 Copper
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:
	+/- Impedance: 0.5100 + J 0.0900 Ohms/1000 m		0.0063 + J 0.0011 PU	100%
	Z0 Impedance: 0.8108 + J 0.2290 Ohms/1000 m		0.0101 + J 0.0028 PU	
CABLE21	BUS 2	BUS-0009	1 11000 150.0 METER	25 Copper
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:
	+/- Impedance: 0.5100 + J 0.0900 Ohms/1000 m		0.0632 + J 0.0112 PU	100%
	Z0 Impedance: 0.8108 + J 0.2290 Ohms/1000 m		0.1005 + J 0.0284 PU	
CABLE6	BUS 2	BUS-0010	1 11000 150.0 METER	25 Copper
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:
	+/- Impedance: 0.5100 + J 0.0900 Ohms/1000 m		0.0632 + J 0.0112 PU	100%
	Z0 Impedance: 0.8108 + J 0.2290 Ohms/1000 m		0.1005 + J 0.0284 PU	
ESB1 FEEDR	BUS52	ESB1	2 415 100.0 METER	185 Copper
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:
	+/- Impedance: 0.1240 + J 0.0748 Ohms/1000 m		3.60 + J 2.17 PU	
	Z0 Impedance: 0.1968 + J 0.1903 Ohms/1000 m		5.71 + J 5.52 PU	
ESB3 FDR	BUS52	BUS-0114	1 415 75.0 METER	185 Copper
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:
	+/- Impedance: 0.1240 + J 0.0748 Ohms/1000 m		5.40 + J 3.26 PU	

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	Z0	Impedance: 0.1968 + J 0.1903	Ohms/1000 m	8.57 + J	8.29	PU
ESB4 FDR	BUS52	BUS-0173	1 415 15.0 METER	185	Copper	
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:		
	+/- Impedance: 0.1240 + J 0.0748	Ohms/1000 m	1.08 + J	0.6515	PU	
	Z0 Impedance: 0.1968 + J 0.1903	Ohms/1000 m	1.71 + J	1.66	PU	
FDR1-RASB1	BUS-0008	RASB1	3 415 5.0 METER	240	Copper	
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:		
	+/- Impedance: 0.0935 + J 0.0741	Ohms/1000 m	0.0905 + J	0.0718	PU	
	Z0 Impedance: 0.1486 + J 0.1886	Ohms/1000 m	0.1438 + J	0.1826	PU	
FDR2-MBSB	BUS-0005	BUS12	6 415 20.0 METER	300	Copper	
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:		
	+/- Impedance: 0.0764 + J 0.0738	Ohms/1000 m	0.1480 + J	0.1429	PU	
	Z0 Impedance: 0.1214 + J 0.1877	Ohms/1000 m	0.2349 + J	0.3632	PU	
FDR5-MBSB	BUS-0012	BUS22	6 415 20.0 METER	300	Copper	
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:		
	+/- Impedance: 0.0764 + J 0.0738	Ohms/1000 m	0.1480 + J	0.1429	PU	
	Z0 Impedance: 0.1214 + J 0.1877	Ohms/1000 m	0.2349 + J	0.3632	PU	
FDR8	BUS-0071	BUS 2	1 11000 140.0 METER	185	Copper	
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:		100%
	+/- Impedance: 0.1201 + J 0.0748	Ohms/1000 m	0.0139 + J	0.0087	PU	
	Z0 Impedance: 0.1909 + J 0.1903	Ohms/1000 m	0.0221 + J	0.0220	PU	
FEEDER 10	BUS 2	BUS-0011	1 11000 170.0 METER	25	Copper	
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:		100%
	+/- Impedance: 0.5100 + J 0.0900	Ohms/1000 m	0.0717 + J	0.0126	PU	
	Z0 Impedance: 0.8108 + J 0.2290	Ohms/1000 m	0.1139 + J	0.0322	PU	
HV CABLE -FDR1	BUS 2	BUS-0007	1 11000 245.0 METER	25	Copper	
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:		100%
	+/- Impedance: 0.5100 + J 0.0900	Ohms/1000 m	0.1033 + J	0.0182	PU	
	Z0 Impedance: 0.8108 + J 0.2290	Ohms/1000 m	0.1642 + J	0.0464	PU	
HV-CBL-FDR2	BUS 2	BUS-0004	1 11000 15.0 METER	25	Copper	
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:		100%
	+/- Impedance: 0.5100 + J 0.0900	Ohms/1000 m	0.0063 + J	0.0011	PU	
	Z0 Impedance: 0.8108 + J 0.2290	Ohms/1000 m	0.0101 + J	0.0028	PU	
ODSB FDR	BUS52	BUS-0115	2 415 95.0 METER	150	Copper	
	Duct Material: Non-Magnetic	Insulation Type:	PVC	Insulation Class:		
	+/- Impedance: 0.1529 + J 0.0751	Ohms/1000 m	4.22 + J	2.07	PU	
	Z0 Impedance: 0.2428 + J 0.1909	Ohms/1000 m	6.70 + J	5.27	PU	

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FEEDER INPUT DATA

CABLE NAME	FEEDER FROM NAME	FEEDER TO NAME	QTY	VOLTS /PH	LENGTH L-L	FEEDER SIZE	TYPE
<hr/>							
PUMP1-DOL CBL	BUS48	BUS-0107	3	415	55.0 METER	185	Copper
	Duct Material: Non-Magnetic	Insulation Type:		PVC	Insulation Class:		
+/-	Impedance: 0.1240 + J 0.0748	Ohms/1000 m		1.32 + J 0.7963	PU		
Z0	Impedance: 0.1968 + J 0.1903	Ohms/1000 m		2.10 + J 2.03	PU		
PUMP1-FDR	MPSB BUS1	BUS48	3	415	15.0 METER	185	Copper
	Duct Material: Non-Magnetic	Insulation Type:		PVC	Insulation Class:		
+/-	Impedance: 0.1240 + J 0.0748	Ohms/1000 m		0.3600 + J 0.2172	PU		
Z0	Impedance: 0.1968 + J 0.1903	Ohms/1000 m		0.5715 + J 0.5524	PU		
PUMP2 VSD CBL	BUS-0143	BUS-0171	3	415	55.0 METER	120	Copper
	Duct Material: Non-Magnetic	Insulation Type:		PVC	Insulation Class:		
+/-	Impedance: 0.1880 + J 0.0748	Ohms/1000 m		2.00 + J 0.7963	PU		
Z0	Impedance: 0.2986 + J 0.1903	Ohms/1000 m		3.18 + J 2.03	PU		
RAS PUMPS CABLRASB1	BUS7		1	415	6.0 METER	240	Copper
	Duct Material: Non-Magnetic	Insulation Type:		PVC	Insulation Class:		
+/-	Impedance: 0.0935 + J 0.0741	Ohms/1000 m		0.3258 + J 0.2583	PU		
Z0	Impedance: 0.1486 + J 0.1886	Ohms/1000 m		0.5178 + J 0.6572	PU		

TRANSFORMER INPUT DATA

TRANSFORMER NAME	PRIMARY RECORD NO NAME	VOLTS L-L	* SECONDARY RECORD NO NAME	VOLTS L-L	FULL-LOAD KVA	NOMINAL KVA
<hr/>						
SUB1-T1 1500kV	BUS-0004	D 11000.0	BUS-0005	YG 415.00	1500.00	1500.00
	Pos. Seq. Z%:	2.90 + J 7.04	(Zpu 1.93 + j 4.69)		Shell Type	
	Zero Seq. Z%:	2.90 + J 7.04	(Sec 28.76 + j 4.69 Pri Open)			
	Taps	Pri. 0.000 % Sec. 0.000 %	Phase Shift (Pri. Leading Sec.):	30.00	Deg.	
	Secondary Neutral Z:	0.015 + J 0.000	Ohms			
SUB1-T2 1500kV	BUS-0006	D 11000.0	BUS-0012	YG 415.00	1500.00	1500.00
	Pos. Seq. Z%:	2.90 + J 7.04	(Zpu 1.93 + j 4.69)		Shell Type	
	Zero Seq. Z%:	2.90 + J 7.04	(Sec 28.76 + j 4.69 Pri Open)			
	Taps	Pri. 0.000 % Sec. 0.000 %	Phase Shift (Pri. Leading Sec.):	30.00	Deg.	
	Secondary Neutral Z:	0.015 + J 0.000	Ohms			
SUB1-T3 1500kV	BUS-0025	D 11000.0	BUS-0026	YG 415.00	1500.00	1500.00
	Pos. Seq. Z%:	2.90 + J 7.04	(Zpu 1.93 + j 4.69)		Shell Type	
	Zero Seq. Z%:	2.90 + J 7.04	(Sec 28.76 + j 4.69 Pri Open)			
	Taps	Pri. 0.000 % Sec. 0.000 %	Phase Shift (Pri. Leading Sec.):	30.00	Deg.	
	Secondary Neutral Z:	0.015 + J 0.000	Ohms			
SUB2-T1 1500kV	BUS-0009	D 11000.0	BUS-0013	YG 415.00	1500.00	1500.00
	Pos. Seq. Z%:	2.90 + J 7.04	(Zpu 1.93 + j 4.69)		Shell Type	
	Zero Seq. Z%:	2.90 + J 7.04	(Sec 28.76 + j 4.69 Pri Open)			

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Taps Pri. 0.000 % Sec. 0.000 % Phase Shift (Pri. Leading Sec.): 30.00 Deg.
 Secondary Neutral Z: 0.015 + J 0.000 Ohms

SUB2-T2 1500kV BUS-0010 D 11000.0 BUS-0014 YG 415.00 1500.00 1500.00
 Pos. Seq. Z%: 2.90 + J 7.04 (Zpu 1.93 + j 4.69) Shell Type
 Zero Seq. Z%: 2.90 + J 7.04 (Sec 28.76 + j 4.69 Pri Open)
 Taps Pri. 0.000 % Sec. 0.000 % Phase Shift (Pri. Leading Sec.): 30.00 Deg.
 Secondary Neutral Z: 0.015 + J 0.000 Ohms

SUB3-T1 500kVA BUS-0007 D 11000.0 BUS-0008 YG 415.00 500.00 500.00
 Pos. Seq. Z%: 1.45 + J 4.16 (Zpu 2.90 + j 8.33) Shell Type
 Zero Seq. Z%: 1.10 + J 3.85 (Sec 29.03 + j 7.69 Pri Open)
 Taps Pri. 0.000 % Sec. 0.000 % Phase Shift (Pri. Leading Sec.): 30.00 Deg.
 Secondary Neutral Z: 0.015 + J 0.000 Ohms

SUB4-T1 300kVA BUS-0011 D 11000.0 BUS-0015 YG 415.00 315.00 315.00
 Pos. Seq. Z%: 1.24 + J 3.80 (Zpu 3.93 + j 12.07) Shell Type
 Zero Seq. Z%: 1.24 + J 3.80 (Sec 30.76 + j 12.07 Pri Open)
 Taps Pri. 0.000 % Sec. 0.000 % Phase Shift (Pri. Leading Sec.): 30.00 Deg.
 Secondary Neutral Z: 0.015 + J 0.000 Ohms

VFD INPUT DATA											
NAME	VFD FROM NAME	VFD TO NAME	VOLTS	RATING	--CONTRIBUTION% OF RATING--			----BYPASS IMPEDANCE----			
					THREE PHASE	LINE-G	X/R	Z1%	X1/R1	Z0%	X0/R0
VFD-0008	BUS7	BUS-0101	415	110	LineSide: 0	0	8	0	8	0	8
				kW	LoadSide: 0	0	8	Bypass Z Not Applicable			
					Power Factor: 0.9 Efficiency: 0.9 Line Reactor: 0% Sevice Factor: 1	NOT in Bypass Mode					
VFD-0010	BUS7	BUS-0102	415	110	LineSide: 0	0	8	0	8	0	8
				kW	LoadSide: 0	0	8	Bypass Z Not Applicable			
					Power Factor: 0.9 Efficiency: 0.9 Line Reactor: 0% Sevice Factor: 1	NOT in Bypass Mode					
VFD-0016	BUS48	BUS-0125	415	250	LineSide: 0	0	8	0	8	0	8
				kW	LoadSide: 0	0	8	Bypass Z Not Applicable			
					Power Factor: 0.9 Efficiency: 0.9 Line Reactor: 0% Sevice Factor: 1	NOT in Bypass Mode					
VFD-0017	BUS67	BUS-0143	415	250	LineSide: 0	0	8	0	8	0	8
				kW	LoadSide: 0	0	8	Bypass Z Not Applicable			
					Power Factor: 0.9 Efficiency: 0.9 Line Reactor: 0% Sevice Factor: 1	NOT in Bypass Mode					
VFD-0018	BUS75	BUS-0144	415	250	LineSide: 0	0	8	0	8	0	8
				kW	LoadSide: 0	0	8	Bypass Z Not Applicable			
					Power Factor: 0.9 Efficiency: 0.9 Line Reactor: 0% Sevice Factor: 1	NOT in Bypass Mode					

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VFD-0019	BFP MCC	BUS-0145	415	60	LineSide: 0 kW LoadSide: 0	0 0 8 0 8 0 0 8	Bypass Z Not Applicable
Power Factor: 0.9 Efficiency: 0.9 Line Reactor: 0% Service Factor: 1 NOT in Bypass Mode							
VFD-0020	BFP MCC	BUS-0146	415	11	LineSide: 0 kW LoadSide: 0	0 0 8 0 8 0 0 8	Bypass Z Not Applicable
Power Factor: 0.9 Efficiency: 0.9 Line Reactor: 0% Service Factor: 1 NOT in Bypass Mode							
VFD-0011	BUS7	BUS-0105	415	110	LineSide: 0 kW LoadSide: 0	0 0 8 0 8 0 0 8	Bypass Z Not Applicable
Power Factor: 0.9 Efficiency: 0.9 Line Reactor: 0% Service Factor: 1 NOT in Bypass Mode							

GENERATION DATA

BUS NAME	GENERATION	VOLT	SIZE	InitKW	MaxKVAR	TYPE
BUS-0071	POLE P63460E	1.01 pu				SB

Three Phase Contribution: 8191.00 AMPS X/R : 17.24
 Line to Earth Contribution: 1694.00 AMPS X/R : 5.88
 Pos sequence impedance (100 MVA base) 0.0371 + J 0.6397 PU
 Zero sequence impedance (100 MVA base) 1.48 + J 7.88 PU

MOTOR LOAD DATA

BUS NAME	LOAD NAME	VOLT	SIZE	#	TYPE	EFF	PF
BUS-0069	BLOWER3 250kW	415	250.0*	1	KW	KVA 0.93	0.85 LAG
BUS-0101	RAS PUMP 1 110	415	110.0*	1	KW	KVA 0.93	0.85 LAG
BUS-0102	RAS PUMP 2 110	415	110.0*	1	KW	KVA 0.93	0.85 LAG
BUS-0103	BLOWER4 425kW	415	450.0*	1	KW	KVA 0.93	0.85 LAG
BUS-0104	BLOWER1 250kW	415	250.0*	1	KW	KVA 0.93	0.85 LAG
BUS-0106	BLOWER2 250kW	415	250.0*	1	KW	KVA 0.93	0.85 LAG
BUS-0107	PUMP 1 - DOL 4	415	400.0*	1	KW	KVA 0.93	0.85 LAG
BUS-0145	VSD LOADS 60kV	415	60.0*	1	kVA	KVA 0.93	0.85 LAG
BUS-0146	BFP BOOSTER PU	415	11.0*	1	KW	KVA 0.93	0.85 LAG
BUS-0171	PUMP 2-VSD 200	415	200.0*	1	KW	KVA 0.93	0.85 LAG
BUS-0172	PUMP3-VSD 200k	415	200.0*	1	KW	KVA 0.93	0.85 LAG
							HOUAYXAI GOLD/SILVER MINE

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12 APPENDIX B: FLOW AND VOLTAGE DROP REPORT

16 Apr 2012 20:42:47

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED ENGINEER ONLY
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LOAD FLOW AND VOLTAGE DROP ANALYSIS REPORT
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*** SOLUTION COMMENTS ***
=====

SOLUTION PARAMETERS

BRANCH VOLTAGE CRITERIA : 3.00 %
BUS VOLTAGE CRITERIA : 5.00 %

ACCELERATION FACTOR FOR 'PV' GENERATORS : 1.00
ACCELERATION FACTOR FOR CONSTANT KVA LOADS: 1.00
EXACT(ITERATIVE) SOLUTION : YES

UTILITY IMPEDANCE : YES
TRANSFORMER PHASE SHIFT : NO

ALL PU VALUES ARE EXPRESSED ON A 100 MVA BASE

LOAD FLOW IS BASED ON CALCULATED DEMAND LOAD RESULTS
FROM THE DEMAND LOAD ANALYSIS STUDY.
LOAD ANALYSIS INCLUDES ALL LOADS.

<<PERCENT VOLTAGE DROPS ARE BASED ON NOMINAL DESIGN VOLTAGES>>

SWING GENERATORS
SOURCE NAME VOLTAGE ANGLE
=====
POLE P63460E 1.010 0.00

LARGEST LOAD: 529.41 KVA
CONVERGENCE CRITERIA: 0.026 KVA
LARGEST BUS MISMATCH BUS-0103 43.750 KVA

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LARGEST BUS MISMATCH	BUS-0103	2.911 KVA
LARGEST BUS MISMATCH	BUS-0103	0.192 KVA
LARGEST BUS MISMATCH	BUS-0103	0.012 KVA

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS (SWING GENERATORS)

SOURCE	VOLTAGE	ANGLE	KW	KVAR	VD% (UTILITY IMPEDANCE)
--------	---------	-------	----	------	-------------------------

POLE P63460E	1.010	0.00	2476.56	1616.72	1.14 0.03710+J 0.63971
--------------	-------	------	---------	---------	------------------------

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

BUS: ASB1 - BUS2	DESIGN VOLTS:	415	BUS VOLTS:	408	%VD: 1.57
=====	PU BUS VOLTAGE:	0.984	ANGLE:	-1.4	DEGREES
	NET BRANCH DIVERSITY LOAD:	8.0 KW		6.0 KVAR	

LOAD FROM: BUS22	ASB1 FEEDER 2	FEEDER AMPS:	14.1	VOLTAGE DROP:	0.	%VD: 0.00
PROJECTED POWER FLOW:	8.0 KW	6.0 KVAR	10.0 KVA	PF:0.80	LAGGING	
LOSSES THRU FEEDER:	0.0 KW	0.0 KVAR	0.0 KVA			

==== BUS: ASB1-BUS1	DESIGN VOLTS:	415	BUS VOLTS:	398	%VD: 4.11
=====	PU BUS VOLTAGE:	0.959	ANGLE:	-2.4	DEGREES
	NET BRANCH DIVERSITY LOAD:	11.2 KW		8.4 KVAR	

LOAD FROM: BUS12	ASB1 FEEDER 1	FEEDER AMPS:	20.3	VOLTAGE DROP:	0.	%VD: 0.00
PROJECTED POWER FLOW:	11.2 KW	8.4 KVAR	14.0 KVA	PF:0.80	LAGGING	
LOSSES THRU FEEDER:	0.0 KW	0.0 KVAR	0.0 KVA			

==== BUS: ASB3 - BUS1	DESIGN VOLTS:	415	BUS VOLTS:	398	%VD: 4.14
=====	PU BUS VOLTAGE:	0.959	ANGLE:	-2.4	DEGREES
	NET BRANCH DIVERSITY LOAD:	14.4 KW		10.8 KVAR	

LOAD FROM: BUS12	ASB3-FDR1	FEEDER AMPS:	26.1	VOLTAGE DROP:	0.	%VD: 0.04
PROJECTED POWER FLOW:	14.4 KW	10.8 KVAR	18.0 KVA	PF:0.80	LAGGING	
LOSSES THRU FEEDER:	0.0 KW	0.0 KVAR	0.0 KVA			

==== BUS: ASB3- BUS2	DESIGN VOLTS:	415	BUS VOLTS:	408	%VD: 1.58
=====	PU BUS VOLTAGE:	0.984	ANGLE:	-1.4	DEGREES
	NET BRANCH DIVERSITY LOAD:	5.8 KW		4.3 KVAR	

LOAD FROM: BUS22	ASB3-FDR2	FEEDER AMPS:	10.1	VOLTAGE DROP:	0.	%VD: 0.01
PROJECTED POWER FLOW:	5.8 KW	4.3 KVAR	7.2 KVA	PF:0.80	LAGGING	
LOSSES THRU FEEDER:	0.0 KW	0.0 KVAR	0.0 KVA			

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

```
==== BUS: BFP MCC      DESIGN VOLTS:    415 BUS VOLTS:    409 %VD:  1.41
===== PU BUS VOLTAGE:  0.986      ANGLE: -1.4 DEGREES
NET BRANCH DIVERSITY LOAD:   32.0 KW    24.0 KVAR

LOAD FROM: BUS-0015      BFP MCC INCOME FEEDER AMPS: 159.2 VOLTAGE DROP:  0. %VD:  0.07
PROJECTED POWER FLOW:  94.0 KW    62.4 KVAR    112.8 KVA PF:0.83 LAGGING
LOSSES THRU FEEDER:    0.1 KW    0.1 KVAR    0.1 KVA
```

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

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*****
```

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

```
LOAD TO: BUS-0145      VFD-0019      FEEDER AMPS:  84.6 VOLTAGE DROP:  0. %VD:  0.00
PROJECTED POWER FLOW:  51.0 KW    31.6 KVAR    60.0 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER:    0.0 KW    0.0 KVAR    0.0 KVA

LOAD TO: BUS-0146      VFD-0020      FEEDER AMPS:  18.2 VOLTAGE DROP:  0. %VD:  0.00
PROJECTED POWER FLOW: 11.0 KW    6.8 KVAR    12.9 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER:    0.0 KW    0.0 KVAR    0.0 KVA
```

```
==== BUS: BUS 2      DESIGN VOLTS: 11000 BUS VOLTS: 10979 %VD:  0.19
===== PU BUS VOLTAGE: 0.998      ANGLE: -0.9 DEGREES
NET BRANCH DIVERSITY LOAD: -41.4 KW    -31.1 KVAR
```

```
LOAD TO: BUS-0004      HV-CBL-FDR2    FEEDER AMPS: 47.0 VOLTAGE DROP: 1. %VD:  0.01
PROJECTED POWER FLOW: 745.6 KW    494.3 KVAR    894.5 KVA PF:0.83 LAGGING
LOSSES THRU FEEDER:  0.1 KW    0.0 KVAR    0.1 KVA
```

```
LOAD TO: BUS-0006      CABLE2       FEEDER AMPS: 16.6 VOLTAGE DROP: 0. %VD:  0.00
PROJECTED POWER FLOW: 266.7 KW    170.6 KVAR    316.6 KVA PF:0.84 LAGGING
LOSSES THRU FEEDER:  0.0 KW    0.0 KVAR    0.0 KVA
```

```
LOAD TO: BUS-0025      CABLE15      FEEDER AMPS: 15.7 VOLTAGE DROP: 0. %VD:  0.00
PROJECTED POWER FLOW: 252.8 KW    159.9 KVAR    299.1 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER:  0.0 KW    0.0 KVAR    0.0 KVA
```

```
LOAD FROM: BUS-0071     FDR8        FEEDER AMPS: 155.4 VOLTAGE DROP: 5. %VD:  0.05
PROJECTED POWER FLOW: 2475.3 KW   1616.0 KVAR   2956.1 KVA PF:0.84 LAGGING
LOSSES THRU FEEDER:  1.2 KW    0.8 KVAR    1.4 KVA
```

```
LOAD TO: BUS-0007      HV CABLE -FDR1    FEEDER AMPS: 14.6 VOLTAGE DROP: 3. %VD:  0.03
PROJECTED POWER FLOW: 234.1 KW    151.7 KVAR    279.0 KVA PF:0.84 LAGGING
LOSSES THRU FEEDER:  0.1 KW    0.0 KVAR    0.1 KVA
```

```
LOAD TO: BUS-0009      CABLE21      FEEDER AMPS: 25.5 VOLTAGE DROP: 3. %VD:  0.03
PROJECTED POWER FLOW: 408.8 KW    261.5 KVAR    485.3 KVA PF:0.84 LAGGING
LOSSES THRU FEEDER:  0.1 KW    0.0 KVAR    0.2 KVA
```

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LOAD TO: BUS-0010 CABLE6 FEEDER AMPS: 32.5 VOLTAGE DROP: 4. %VD: 0.04
PROJECTED POWER FLOW: 514.1 KW 344.9 KVAR 619.1 KVA PF:0.83 LAGGING
LOSSES THRU FEEDER: 0.2 KW 0.0 KVAR 0.2 KVA

LOAD TO: BUS-0011 FEEDER 10 FEEDER AMPS: 6.0 VOLTAGE DROP: 1. %VD: 0.01
PROJECTED POWER FLOW: 94.6 KW 64.1 KVAR 114.2 KVA PF:0.83 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

===== BUS: BUS12 DESIGN VOLTS: 415 BUS VOLTS: 398 %VD: 4.11
===== PU BUS VOLTAGE: 0.959 ANGLE: -2.4 DEGREES

LOAD FROM: BUS-0005 FDR2-MBSB FEEDER AMPS: 1246.8 VOLTAGE DROP: 1. %VD: 0.18
PROJECTED POWER FLOW: 728.8 KW 455.4 KVAR 859.4 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 1.2 KW 1.1 KVAR 1.7 KVA

LOAD TO: BUS-0103 BLW4-CBL FEEDER AMPS: 772.6 VOLTAGE DROP: 2. %VD: 0.57
PROJECTED POWER FLOW: 452.5 KW 280.9 KVAR 532.6 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 2.5 KW 2.0 KVAR 3.2 KVA

LOAD TO: BUS-0104 BLW1-CBL FEEDER AMPS: 427.8 VOLTAGE DROP: 1. %VD: 0.26
PROJECTED POWER FLOW: 250.7 KW 155.3 KVAR 294.9 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.7 KW 0.4 KVAR 0.8 KVA

LOAD TO: ASB1-BUS1 ASB1 FEEDER 1 FEEDER AMPS: 20.3 VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 11.2 KW 8.4 KVAR 14.0 KVA PF:0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: ASB3 - BUS1 ASB3-FDR1 FEEDER AMPS: 26.1 VOLTAGE DROP: 0. %VD: 0.04
PROJECTED POWER FLOW: 14.4 KW 10.8 KVAR 18.0 KVA PF:0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

===== BUS: BUS22 DESIGN VOLTS: 415 BUS VOLTS: 408 %VD: 1.57
===== PU BUS VOLTAGE: 0.984 ANGLE: -1.4 DEGREES

LOAD FROM: BUS-0012 FDR5-MBSB FEEDER AMPS: 441.2 VOLTAGE DROP: 0. %VD: 0.06
PROJECTED POWER FLOW: 264.6 KW 165.7 KVAR 312.2 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.1 KW 0.1 KVAR 0.2 KVA

LOAD TO: BUS-0106 BLW2-CBL FEEDER AMPS: 417.0 VOLTAGE DROP: 1. %VD: 0.32
PROJECTED POWER FLOW: 250.8 KW 155.4 KVAR 295.1 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.8 KW 0.5 KVAR 0.9 KVA

LOAD TO: ASB1 - BUS2 ASB1 FEEDER 2 FEEDER AMPS: 14.1 VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 8.0 KW 6.0 KVAR 10.0 KVA PF:0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

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BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

LOAD TO: ASB3- BUS2 FEEDER AMPS: 10.1 VOLTAGE DROP: 0. %VD: 0.01
PROJECTED POWER FLOW: 5.8 KW 4.3 KVAR 7.2 KVA PF:0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: BUS32 DESIGN VOLTS: 415 BUS VOLTS: 409 %VD: 1.49
===== PU BUS VOLTAGE: 0.985 ANGLE: -1.4 DEGREES

LOAD FROM: BUS-0026 CABLE14 FEEDER AMPS: 416.9 VOLTAGE DROP: 0. %VD: 0.06
PROJECTED POWER FLOW: 251.0 KW 155.5 KVAR 295.3 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.1 KW 0.1 KVAR 0.2 KVA

LOAD TO: BUS-0069 CABLE17 FEEDER AMPS: 416.9 VOLTAGE DROP: 2. %VD: 0.38
PROJECTED POWER FLOW: 251.0 KW 155.5 KVAR 295.3 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 1.0 KW 0.6 KVAR 1.1 KVA

==== BUS: BUS48 DESIGN VOLTS: 415 BUS VOLTS: 405 %VD: 2.47
===== PU BUS VOLTAGE: 0.975 ANGLE: -1.7 DEGREES

LOAD FROM: MPSB BUS1 PUMP1-FDR FEEDER AMPS: 676.4 VOLTAGE DROP: 1. %VD: 0.20
PROJECTED POWER FLOW: 403.1 KW 249.8 KVAR 474.2 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.9 KW 0.5 KVAR 1.0 KVA

LOAD TO: BUS-0107 PUMP1-DOL CBL FEEDER AMPS: 676.4 VOLTAGE DROP: 3. %VD: 0.75
PROJECTED POWER FLOW: 403.1 KW 249.8 KVAR 474.2 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 3.1 KW 1.9 KVAR 3.6 KVA

LOAD FROM: BUS-0125 VFD-0016 FEEDER AMPS: VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 0.0 KW 0.0 KVAR 0.0 KVA PF:0.00 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: BUS52 DESIGN VOLTS: 415 BUS VOLTS: 403 %VD: 2.92
===== PU BUS VOLTAGE: 0.971 ANGLE: -1.9 DEGREES
NET BRANCH DIVERSITY LOAD: -1.2 KW -0.9 KVAR

LOAD TO: BUS-0115 ODSB FDR FEEDER AMPS: 14.3 VOLTAGE DROP: 0. %VD: 0.05
PROJECTED POWER FLOW: 8.0 KW 6.0 KVAR 10.0 KVA PF:0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

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QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

LOAD FROM: MPSB BUS2 ASB2-FEEDER2 FEEDER AMPS: 185.0 VOLTAGE DROP: 0. %VD: 0.05
PROJECTED POWER FLOW: 103.3 KW 77.5 KVAR 129.2 KVA PF:0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.1 KVA

LOAD FROM: BUS-0159 CABLE 29 FEEDER AMPS: VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 0.0 KW 0.0 KVAR 0.0 KVA PF:0.00 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: BUS-0114 ESB3 FDR FEEDER AMPS: 14.3 VOLTAGE DROP: 0. %VD: 0.06
PROJECTED POWER FLOW: 8.0 KW 6.0 KVAR 10.0 KVA PF:0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: ESB1 ESB1 FEEDR FEEDER AMPS: 14.3 VOLTAGE DROP: 0. %VD: 0.04
PROJECTED POWER FLOW: 8.0 KW 6.0 KVAR 10.0 KVA PF:0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: BUS-0173 ESB4 FDR FEEDER AMPS: 144.2 VOLTAGE DROP: 1. %VD: 0.13
PROJECTED POWER FLOW: 80.5 KW 60.4 KVAR 100.6 KVA PF:0.80 LAGGING
LOSSES THRU FEEDER: 0.1 KW 0.1 KVAR 0.1 KVA

==== BUS: BUS67 DESIGN VOLTS: 415 BUS VOLTS: 403 %VD: 2.98
===== PU BUS VOLTAGE: 0.970 ANGLE: -1.9 DEGREES

LOAD FROM: MPSB BUS2 BUSBAR67 FEEDER AMPS: 339.2 VOLTAGE DROP: 0. %VD: 0.10
PROJECTED POWER FLOW: 201.2 KW 124.4 KVAR 236.6 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.2 KW 0.1 KVAR 0.2 KVA

LOAD FROM: BUS-0112 CABLE -34 FEEDER AMPS: VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 0.0 KW 0.0 KVAR 0.0 KVA PF:0.00 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: BUS-0143 VFD-0017 FEEDER AMPS: 339.2 VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 201.2 KW 124.4 KVAR 236.6 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

WATER SERVICES ENGINEERING (WSE) PTY. LTD.

POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

==== BUS: BUS7 DESIGN VOLTS: 415 BUS VOLTS: 405 %VD: 2.29
===== PU BUS VOLTAGE: 0.977 ANGLE: -1.8 DEGREES

LOAD FROM: RASB1 RAS PUMPS CABL FEEDER AMPS: 368.5 VOLTAGE DROP: 0. %VD: 0.11
PROJECTED POWER FLOW: 220.0 KW 136.3 KVAR 258.8 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.2 KW 0.2 KVAR 0.3 KVA

LOAD TO: BUS-0101 VFD-0008 FEEDER AMPS: 184.2 VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 110.0 KW 68.2 KVAR 129.4 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: BUS-0102 VFD-0010 FEEDER AMPS: 184.2 VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 110.0 KW 68.2 KVAR 129.4 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD FROM: BUS-0105 VFD-0011 FEEDER AMPS: VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 0.0 KW 0.0 KVAR 0.0 KVA PF:0.00 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: BUS75 DESIGN VOLTS: 415 BUS VOLTS: 403 %VD: 2.98
===== PU BUS VOLTAGE: 0.970 ANGLE: -1.9 DEGREES

LOAD FROM: MPSB BUS2 BUSBAR68 FEEDER AMPS: 339.2 VOLTAGE DROP: 0. %VD: 0.10
PROJECTED POWER FLOW: 201.2 KW 124.4 KVAR 236.6 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.2 KW 0.1 KVAR 0.2 KVA

LOAD FROM: BUS-0116 CABLE -38 FEEDER AMPS: VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 0.0 KW 0.0 KVAR 0.0 KVA PF:0.00 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

LOAD TO: BUS-0144 VFD-0018 FEEDER AMPS: 339.2 VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 201.2 KW 124.4 KVAR 236.6 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: ESB1 DESIGN VOLTS: 415 BUS VOLTS: 403 %VD: 2.97
===== PU BUS VOLTAGE: 0.970 ANGLE: -1.9 DEGREES
NET BRANCH DIVERSITY LOAD: 8.0 KW 6.0 KVAR

LOAD FROM: BUS52 ESB1 FEEDR FEEDER AMPS: 14.3 VOLTAGE DROP: 0. %VD: 0.04
PROJECTED POWER FLOW: 8.0 KW 6.0 KVAR 10.0 KVA PF:0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

WATER SERVICES ENGINEERING (WSE) PTY. LTD.

POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

LOAD FROM: ESB2 CABLE 33 FEEDER AMPS: 0.0 VOLTAGE DROP: 0. %VD: 0.00
PROJECTED POWER FLOW: 0.0 KW 0.0 KVAR 0.0 KVA PF:0.00 LEADING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.0 KVA

==== BUS: ESB2 DESIGN VOLTS: 415 BUS VOLTS: 403 %VD: 2.97
===== PU BUS VOLTAGE: 0.970 ANGLE: -1.9 DEGREES
**** NO LOAD SPECIFIED ****

==== BUS: MPSB BUS1 DESIGN VOLTS: 415 BUS VOLTS: 406 %VD: 2.27
===== PU BUS VOLTAGE: 0.977 ANGLE: -1.7 DEGREES

LOAD FROM: BUS-0013 BUSBAR FEEDER AMPS: 676.4 VOLTAGE DROP: 0. %VD: 0.04
PROJECTED POWER FLOW: 404.0 KW 250.3 KVAR 475.2 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.2 KW 0.1 KVAR 0.2 KVA

LOAD TO: BUS48 PUMP1-FDR FEEDER AMPS: 676.4 VOLTAGE DROP: 1. %VD: 0.20
PROJECTED POWER FLOW: 404.0 KW 250.3 KVAR 475.2 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.9 KW 0.5 KVAR 1.0 KVA

==== BUS: MPSB BUS2 DESIGN VOLTS: 415 BUS VOLTS: 403 %VD: 2.88
===== PU BUS VOLTAGE: 0.971 ANGLE: -1.9 DEGREES

LOAD TO: BUS52 ASB2-FEEDER2 FEEDER AMPS: 185.0 VOLTAGE DROP: 0. %VD: 0.05
PROJECTED POWER FLOW: 103.4 KW 77.5 KVAR 129.2 KVA PF:0.80 LAGGING
LOSSES THRU FEEDER: 0.0 KW 0.0 KVAR 0.1 KVA

LOAD FROM: BUS-0014 BUSBAR5 FEEDER AMPS: 862.9 VOLTAGE DROP: 0. %VD: 0.05
PROJECTED POWER FLOW: 506.2 KW 326.6 KVAR 602.4 KVA PF:0.84 LAGGING
LOSSES THRU FEEDER: 0.2 KW 0.2 KVAR 0.3 KVA

LOAD TO: BUS67 BUSBAR67 FEEDER AMPS: 339.2 VOLTAGE DROP: 0. %VD: 0.10
PROJECTED POWER FLOW: 201.4 KW 124.6 KVAR 236.8 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.2 KW 0.1 KVAR 0.2 KVA

LOAD TO: BUS75 BUSBAR68 FEEDER AMPS: 339.2 VOLTAGE DROP: 0. %VD: 0.10
PROJECTED POWER FLOW: 201.4 KW 124.6 KVAR 236.8 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.2 KW 0.1 KVAR 0.2 KVA

WATER SERVICES ENGINEERING (WSE) PTY. LTD.

POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

BALANCED VOLTAGE DROP AND LOAD FLOW ANALYSIS

VOLTAGE EFFECT ON LOADS MODELED

VOLTAGE DROP CRITERIA: BRANCH = 3.00 % BUS = 5.00

==== BUS: POLE P63460E DESIGN VOLTS: 11000 BUS VOLTS: 11110 %VD: -1.00
===== PU BUS VOLTAGE: 1.010 ANGLE: 0.0 DEGREES
*** SWING GENERATOR: POLE P63460E 2479.8 KW 1672.8 KVAR

LOAD TO: BUS-0071 FEEDER AMPS: 155.4 VOLTAGE DROP: 125. %VD: 1.14
PROJECTED POWER FLOW: 2479.8 KW 1672.8 KVAR 2991.3 KVA PF:0.83 LAGGING
LOSSES THRU FEEDER: 3.3 KW 56.1 KVAR 56.2 KVA

==== BUS: RASB1 DESIGN VOLTS: 415 BUS VOLTS: 406 %VD: 2.18
===== PU BUS VOLTAGE: 0.978 ANGLE: -1.7 DEGREES
NET BRANCH DIVERSITY LOAD: 11.5 KW 8.6 KVAR

LOAD FROM: BUS-0008 FDR1-RASB1 FEEDER AMPS: 388.8 VOLTAGE DROP: 0. %VD: 0.03
PROJECTED POWER FLOW: 231.7 KW 145.2 KVAR 273.4 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.1 KW 0.1 KVAR 0.1 KVA

LOAD TO: BUS7 RAS PUMPS CABL FEEDER AMPS: 368.5 VOLTAGE DROP: 0. %VD: 0.11
PROJECTED POWER FLOW: 220.2 KW 136.5 KVAR 259.1 KVA PF:0.85 LAGGING
LOSSES THRU FEEDER: 0.2 KW 0.2 KVAR 0.3 KVA

BALANCED VOLTAGE DROP AND LOAD FLOW BUS DATA SUMMARY

BUS NAME	BASE VOLT	PU VOLT	BUS NAME	BASE VOLT	PU VOLT
ASB1 - BUS2	415.00	0.9843	ASB1-BUS1	415.00	0.9589
ASB3 - BUS1	415.00	0.9586	ASB3- BUS2	415.00	0.9842
EFP MCC	415.00	0.9859	BUS 2	11000.00	0.9981
BUS-0004	11000.00	0.9981	BUS-0005	415.00	0.9607
BUS-0006	11000.00	0.9981	BUS-0007	11000.00	0.9979
BUS-0008	415.00	0.9785	BUS-0009	11000.00	0.9978
BUS-0010	11000.00	0.9978	BUS-0011	11000.00	0.9980
BUS-0012	415.00	0.9850	BUS-0013	415.00	0.9777
BUS-0014	415.00	0.9717	BUS-0015	415.00	0.9866
BUS-0025	11000.00	0.9981	BUS-0026	415.00	0.9857
BUS-0069	415.00	0.9813	BUS-0071	11000.00	0.9986
BUS-0101	415.00	0.9771	BUS-0102	415.00	0.9771
BUS-0103	415.00	0.9532	BUS-0104	415.00	0.9563
BUS-0105	415.00	0.9771	BUS-0106	415.00	0.9812
BUS-0107	415.00	0.9678	BUS-0112	415.00	0.9702
BUS-0114	415.00	0.9701	BUS-0115	415.00	0.9703
BUS-0116	415.00	0.9702	BUS-0125	400.00	0.9753
BUS-0126	400.00	0.9753	BUS-0143	415.00	0.9702

WATER SERVICES ENGINEERING (WSE) PTY. LTD.

POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

BUS-0144	415.00	0.9702	BUS-0145	415.00	0.9859
BUS-0146	415.00	0.9859	BUS-0159	415.00	0.9708
BUS-0171	415.00	0.9650	BUS-0172	415.00	0.9650
BUS-0173	415.00	0.9694	BUS12	415.00	0.9589
BUS22	415.00	0.9843	BUS32	415.00	0.9851
BUS48	415.00	0.9753	BUS52	415.00	0.9708
BUS67	415.00	0.9702	BUS7	415.00	0.9771
BUS75	415.00	0.9702	ESB1	415.00	0.9703
ESB2	415.00	0.9703	MPSB BUS1	415.00	0.9773
RASB1	415.00	0.9782			

BALANCED VOLTAGE DROP AND LOAD FLOW BRANCH DATA SUMMARY

FROM	NAME	TO	NAME	TYPE	VD%	AMPS	KVA	RATING%
BFP	MCC	BUS-0145		FDR	0.00	84.66	60.00	91.29
BFP	MCC	BUS-0146		FDR	0.00	18.26	12.94	107.39
BUS-0004	BUS-0005			TX2	3.73	47.04	894.48	59.63
BUS-0005	BUS12			FDR	0.18	1246.81	861.01	46.18
BUS-0006	BUS-0012			TX2	1.31	16.65	316.56	21.10
BUS-0007	BUS-0008			TX2	1.94	14.67	278.93	55.79
BUS-0008	RASB1			FDR	0.03	388.89	273.53	33.24
BUS-0009	BUS-0013			TX2	2.01	25.52	485.21	32.35
BUS-0010	BUS-0014			TX2	2.60	32.56	618.88	41.26
BUS-0011	BUS-0015			TX2	1.14	6.01	114.23	36.26
BUS-0012	BUS22			FDR	0.06	441.23	312.39	16.34
BUS-0013	MPSB BUS1			FDR	0.04	676.49	475.43	28.19
BUS-0014	MPSB BUS2			FDR	0.05	862.92	602.74	35.96
BUS-0015	BFP MCC			FDR	0.07	159.23	112.92	35.38
BUS-0025	BUS-0026			TX2	1.24	15.73	299.14	19.94
BUS-0026	BUS32			FDR	0.06	416.96	295.43	15.44
BUS-0071	BUS 2			FDR	0.05	155.45	2957.55	79.72
BUS-0125	BUS-0126			FDR	0.00	0.00	0.00	0.00
BUS-0143	BUS-0171			FDR	0.52	339.21	236.55	45.23
BUS-0144	BUS-0172			FDR	0.52	339.21	236.55	45.23
BUS-0159	BUS52			FDR	0.00	0.00	0.00	0.00
BUS12	BUS-0103			FDR	0.57	772.69	532.60	99.06
BUS12	BUS-0104			FDR	0.26	427.86	294.91	64.83
BUS12	ASB1-BUS1			FDR	0.00	20.31	14.00	1.74
BUS12	ASB3 - BUS1			FDR	0.04	26.12	18.01	3.96
BUS22	BUS-0106			FDR	0.32	417.03	295.06	63.19
BUS22	ASB1 - BUS2			FDR	0.00	14.13	10.00	1.21
BUS22	ASB3- BUS2			FDR	0.01	10.16	7.19	1.54
BUS32	BUS-0069			FDR	0.38	416.96	295.25	63.18
BUS48	BUS-0107			FDR	0.75	676.49	474.23	68.33
BUS48	BUS-0125			FDR	0.00	0.00	0.00	0.00
BUS52	BUS-0115			FDR	0.05	14.34	10.00	2.52
BUS52	BUS-0114			FDR	0.06	14.34	10.01	4.35
BUS52	ESB1			FDR	0.04	14.34	10.00	2.17
BUS52	BUS-0173			FDR	0.13	144.22	100.63	43.70
BUS67	BUS-0112			FDR	0.00	0.00	0.00	0.00

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QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

BUS67	BUS-0143	FDR	0.00	339.21	236.55	87.78
BUS7	BUS-0101	FDR	0.00	184.26	129.41	108.37
BUS7	BUS-0102	FDR	0.00	184.26	129.41	108.37
BUS7	BUS-0105	FDR	0.00	0.00	0.00	0.00
BUS75	BUS-0116	FDR	0.00	0.00	0.00	0.00
BUS75	BUS-0144	FDR	0.00	339.21	236.55	87.78
ESB1	ESB2	FDR	0.00	0.00	0.00	0.00
MPSB BUS1	BUS48	FDR	0.20	676.49	475.23	68.33
MPSB BUS2	BUS52	FDR	0.05	185.09	129.21	15.82
MPSB BUS2	BUS67	FDR	0.10	339.21	236.80	34.26
MPSB BUS2	BUS75	FDR	0.10	339.21	236.80	34.26
RASB1	BUS7	FDR	0.11	368.52	259.11	94.49

NOTE: FDR RATING% = % AMPS RATING BASED ON LIBRARY FLA OR BRANCH INPUT FLA

TX2 RATING% = % KVA RATING BASED ON TRANSFORMER FL KVA

57 BUSES

*** T O T A L S Y S T E M L O S S E S ***
50. KW 94. KVAR

WATER SERVICES ENGINEERING (WSE) PTY. LTD.

POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

13 APPENDIX C: FAULT STUDY REPORT

15 Apr 2012 07:39:43

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED ENGINEER ONLY
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SKM POWER*TOOLS FOR WINDOWS
SHORT CIRCUIT ANALYSIS REPORT
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ALL PU VALUES ARE EXPRESSED ON A 100 MVA BASE

SWING GENERATORS
SOURCE NAME VOLTAGE ANGLE
=====

POLE P63460E	1.01	0.00
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***** P R E - F A U L T V O L T A G E P R O F I L E *****

BUS#	NAME	BASE VOLTS	PU VOLTS	ANGLE (D)
ASB1 - BUS2		415.00	1.0000	-30.
ASB1-BUS1		415.00	1.0000	-30.
ASB3 - BUS1		415.00	1.0000	-30.
ASB3- BUS2		415.00	1.0000	-30.
BFP MCC		415.00	1.0000	-30.
BUS 2		11000.00	1.0000	0.
BUS-0004		11000.00	1.0000	0.
BUS-0005		415.00	1.0000	-30.
BUS-0006		11000.00	1.0000	0.
BUS-0007		11000.00	1.0000	0.
BUS-0008		415.00	1.0000	-30.
BUS-0009		11000.00	1.0000	0.
BUS-0010		11000.00	1.0000	0.
BUS-0011		11000.00	1.0000	0.
BUS-0012		415.00	1.0000	-30.
BUS-0013		415.00	1.0000	-30.
BUS-0014		415.00	1.0000	-30.
BUS-0015		415.00	1.0000	-30.
BUS-0025		11000.00	1.0000	0.
BUS-0026		415.00	1.0000	-30.

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QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

BUS-0069	415.00	1.0000	-30.
BUS-0071	11000.00	1.0000	0.
BUS-0101	415.00	1.0000	-75.
BUS-0102	415.00	1.0000	-75.
BUS-0103	415.00	1.0000	-30.
BUS-0104	415.00	1.0000	-30.
BUS-0105	415.00	1.0000	-75.
BUS-0106	415.00	1.0000	-30.
BUS-0107	415.00	1.0000	-30.
BUS-0112	415.00	1.0000	-30.
BUS-0114	415.00	1.0000	-30.
BUS-0115	415.00	1.0000	-30.
BUS-0116	415.00	1.0000	-30.
BUS-0125	400.00	1.0000	-75.
BUS-0126	400.00	1.0000	-75.
BUS-0143	415.00	1.0000	-75.
BUS-0144	415.00	1.0000	-75.
BUS-0145	415.00	1.0000	-75.
BUS-0146	415.00	1.0000	-75.
BUS-0159	415.00	1.0000	-30.
BUS-0171	415.00	1.0000	-75.
BUS-0172	415.00	1.0000	-75.
BUS-0173	415.00	1.0000	-30.
BUS12	415.00	1.0000	-30.
BUS22	415.00	1.0000	-30.
BUS32	415.00	1.0000	-30.
BUS48	415.00	1.0000	-30.
BUS52	415.00	1.0000	-30.
BUS67	415.00	1.0000	-30.
BUS7	415.00	1.0000	-30.
BUS75	415.00	1.0000	-30.
ESB1	415.00	1.0000	-30.
ESB2	415.00	1.0000	-30.
MPSB BUS1	415.00	1.0000	-30.
MPSB BUS2	415.00	1.0000	-30.
RASB1	415.00	1.0000	-30.

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POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

***** F A U L T A N A L Y S I S R E P O R T *****

FAULT TYPE: 3PH
MODEL INDUCTION MOTOR CONTRIBUTION: YES
MODEL TRANSFORMER TAPS: YES
MODEL TRANSFORMER PHASE SHIFT: YES

ASB1 - BUS2 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 24222.4 / -98. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 2.125 +j 5.336 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.511

ASYM	RMS	INTERRUPTING AMPS			
1/2 CYCLES	2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
26130.3	24223.5	24222.4	24222.4	24222.4	

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
24222.4 / -98.3 24222.4 / 141.7 24222.4 / 21.7

ASB1 - BUS2 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) =====
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
BUS22 415.0 0.0402 / -60. 0.0402 / -180. 0.0402 / 60.
ASB1 - BUS2 ====== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======
 FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
 BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS22 ASB1 - BUS2 MBSB-ASB1-2 415. 24222.4/ -98. 24222.4/ 142. 24222.4/ 22.

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ASB1-BUS1 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 26513.8 / -99. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 1.844 +j 4.913 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.665

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
28913.5 26515.9 26513.8 26513.8 26513.8

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
26513.8 / -99.4 26513.8 / 140.6 26513.8 / 20.6

ASB1-BUS1 ====== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) ======
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
BUS12 415.0 0.0440 / -61. 0.0440 / 179. 0.0440 / 59.
ASB1-BUS1 ====== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS12 ASB1-BUS1 ASB1 FEEDER 1 415. 26513.8/-99. 26513.8/141. 26513.8/21.

ASB3 - BUS1 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 21021.8 / -90. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 3.283 +j 5.746 (PU)
THEVENIN IMPEDANCE X/R RATIO: 1.750

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
21594.4 21021.8 21021.8 21021.8 21021.8

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---

WATER SERVICES ENGINEERING (WSE) PTY. LTD.

POWER SYSTEM ANALYSIS AND PROTECTION COORDINATION REPORT FOR:

QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

21021.8 / -90.3 21021.8 / 149.7 21021.8 / 29.7

ASB3 - BUS1 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) =====
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
BUS12 415.0 0.2859 / -59. 0.2859 /-179. 0.2859 / 61.
ASB3 - BUS1 ====== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS12 ASB3 - BUS1 MBSB-ASB3 415. 21021.8/-90. 21021.8/ 150. 21021.8/ 30.

ASB3- BUS2 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 19525.1 / -90. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 3.565 +j 6.170 (PU)
THEVENIN IMPEDANCE X/R RATIO: 1.731

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
20036.1 19525.1 19525.1 19525.1 19525.1

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
19525.1 / -90.0 19525.1 / 150.0 19525.1 / 30.0

ASB3- BUS2 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) =====
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
BUS22 415.0 0.2655 / -59. 0.2655 /-179. 0.2655 / 61.
ASB3- BUS2 ====== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS22 ASB3- BUS2 MBSB-ASB3-2 415. 19525.1/-90. 19525.1/ 150. 19525.1/ 30.

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BFP MCC VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 10019.0 / -101. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 4.497 +j 13.137 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.922

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
11124.3 10020.8 10019.0 10019.0 10019.0

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
10019.0 /-101.1 10019.0 / 138.9 10019.0 / 18.9

BFP MCC ====== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) ======
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
BUS-0015 415.0 0.0444 / -57. 0.0444 /-177. 0.0444 / 63.
BUS-0145 415.0 0.0707 / -75. 0.0707 / 165. 0.0707 / 45.
BUS-0146 415.0 0.0707 / -75. 0.0707 / 165. 0.0707 / 45.

BFP MCC ====== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BFP MCC CABLE 42 415. 10019.0/-101. 10019.0/ 139. 10019.0/ 19.
BFP MCC VFD-0019 415. 0.0/ 0. 0.0/ 0. 0.0/ 0.
BFP MCC VFD-0020 415. 0.0/ 0. 0.0/ 0. 0.0/ 0.

BUS 2 VOLTAGE BASE LL: 11000.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 8420.6 / -85. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 0.051 +j 0.621 (PU)
THEVENIN IMPEDANCE X/R RATIO: 12.251

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
12482.8 9441.2 8800.1 8470.3 8422.9

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

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INI.      RMS   FAULTED CURRENT ( AMPS / DEG )
          AT TIME =      0.5 CYCLES
---PHASE A---      ---PHASE B---      ---PHASE C---
8420.6 / -85.3    8420.6 / 154.7    8420.6 /  34.7

BUS 2      ====== INI.  SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ======
          FIRST BUS FROM FAULT      AT TIME =      0.5 CYCLES
          ---PHASE A---      ---PHASE B---      ---PHASE C---
BUS-0004    11000.0  0.0002 / -71.  0.0002 / 169.  0.0002 /  49.
BUS-0006    11000.0  0.0001 / -73.  0.0001 / 167.  0.0001 /  47.
BUS-0025    11000.0  0.0001 / -73.  0.0001 / 167.  0.0001 /  47.
BUS-0071    11000.0  0.0252 / -54.  0.0252 /-174.  0.0252 /  66.
BUS-0007    11000.0  0.0000 /  0.  0.0000 /  0.  0.0000 /  0.
BUS-0009    11000.0  0.0014 / -70.  0.0014 / 170.  0.0014 /  50.
BUS-0010    11000.0  0.0000 /  0.  0.0000 /  0.  0.0000 /  0.
BUS-0011    11000.0  0.0000 /  0.  0.0000 /  0.  0.0000 /  0.

BUS 2      ====== INI.  RMS   SYSTEM BRANCH FLOWS ( AMPS ) ======
          FIRST BRANCH FROM FAULT AT TIME =      0.5 CYCLES
          BRANCH NAME  VBASE LL  -PHASE A-  -PHASE B-  -PHASE C-
BUS 2      BUS-0004  HV-CBL-FDR2  11000.  130.8/  99.  130.8/ -21.  130.8/-141.
BUS 2      BUS-0006  CABLE2     11000.  51.0/  97.  51.0/ -23.  51.0/-143.
BUS 2      BUS-0025  CABLE15    11000.  51.0/  97.  51.0/ -23.  51.0/-143.
BUS-0071    BUS 2      FDR8      11000.  8070.3/ -86.  8070.3/ 154.  8070.3/  34.
BUS 2      BUS-0007  HV CABLE -FDR1 11000.  0.0/  0.  0.0/  0.  0.0/  0.

BUS 2      ====== FIRST BRANCH SYSTEM BRANCH FLOWS ( AMPS ) ======
BUS 2      BUS-0009  CABLE21    11000.  118.4/ 100.  118.4/ -20.  118.4/-140.
BUS 2      BUS-0010  CABLE6     11000.  0.0/  0.  0.0/  0.  0.0/  0.
BUS 2      BUS-0011  CABLE41    11000.  0.0/  0.  0.0/  0.  0.0/  0.
-----
```

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BUS12      VOLTAGE BASE LL:           415.0 (VOLTS)
INI.  SYM. RMS FAULT CURRENT: 27545.6 / -101. ( AMPS/DEG )
THEVENIN EQUIVALENT IMPEDANCE: 1.663 +j 4.769 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.868

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ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES
30471.2	27549.9	27545.7	27545.6	27545.6

```

INI.  SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
          AT TIME =      0.5 CYCLES
---PHASE A---      ---PHASE B---      ---PHASE C---
0.0000 /  0.0    0.0000 /  0.0    0.0000 /  0.0

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INI.      RMS   FAULTED CURRENT ( AMPS / DEG )
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AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 27545.6 /-100.8 27545.6 / 139.2 27545.6 / 19.2

BUS12 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) ======
 FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 BUS-0005 415.0 0.0350 / -55. 0.0350 /-175. 0.0350 / 65.
 BUS-0103 415.0 0.0190 / -75. 0.0190 / 165. 0.0190 / 45.
 BUS-0104 415.0 0.0086 / -83. 0.0086 / 157. 0.0086 / 37.
 ASB1-BUS1 415.0 0.0000 / 0. 0.0000 / 0. 0.0000 / 0.
 ASB3 - BUS1 415.0 0.0000 / 0. 0.0000 / 0. 0.0000 / 0.
 BUS12 ====== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======
 FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
 BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
 BUS-0005 BUS12 FDR2-MBSB 415. 23693.6/ -99. 23693.6/ 141. 23693.6/ 21.
 BUS12 BUS-0103 BLW4-CBL 415. 2543.5/ 66. 2543.5/ -54. 2543.5/-174.
 BUS12 BUS-0104 BLW1-CBL 415. 1424.7/ 66. 1424.7/ -54. 1424.7/-174.
 BUS12 ASB1-BUS1 ASB1 FEEDER 1 415. 0.0/ 0. 0.0/ 0. 0.0/ 0.
 BUS12 ASB3 - BUS1 MBSB-ASB3 415. 0.0/ 0. 0.0/ 0. 0.0/ 0.

BUS22 VOLTAGE BASE LL: 415.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 25092.2 / -99. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 1.944 +j 5.192 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.670

ASYM RMS INTERRUPTING AMPS
 1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
 27374.6 25094.3 25092.2 25092.2 25092.2

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 25092.2 / -99.5 25092.2 / 140.5 25092.2 / 20.5

BUS22 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) ======
 FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 BUS-0012 415.0 0.0351 / -55. 0.0351 /-175. 0.0351 / 65.
 BUS-0106 415.0 0.0108 / -83. 0.0108 / 157. 0.0108 / 37.
 ASB1 - BUS2 415.0 0.0000 / 0. 0.0000 / 0. 0.0000 / 0.

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ASB3- BUS2      415.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
BUS22      ====== INI. RMS SYSTEM BRANCH FLOWS ( AMPS ) ======
          FIRST BRANCH FROM FAULT AT TIME =    0.5 CYCLES
          BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS-0012     BUS22 FDR5-MBSB   415. 23716.3/ -99. 23716.2/ 141. 23716.2/ 21.
BUS22     BUS-0106 BLW2-CBL    415. 1422.8/ 66. 1422.8/ -54. 1422.8/-174.
BUS22     ASB1 - BUS2 MBSB-ASB1-2  415. 0.0/ 0. 0.0/ 0. 0.0/ 0.
BUS22     ASB3- BUS2 MBSB-ASB3-2  415. 0.0/ 0. 0.0/ 0. 0.0/ 0.

-----
BUS32      VOLTAGE BASE LL:           415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 25091.1 / -99. ( AMPS/DEG )
THEVENIN EQUIVALENT IMPEDANCE: 1.945 +j 5.192 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.670

          ASYM RMS INTERRUPTING AMPS
          1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
          27371.6 25093.1 25091.1 25091.1 25091.1

          INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
          AT TIME = 0.5 CYCLES
          ---PHASE A--- ---PHASE B--- ---PHASE C---
          0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

          INI. RMS FAULTED CURRENT ( AMPS / DEG )
          AT TIME = 0.5 CYCLES
          ---PHASE A--- ---PHASE B--- ---PHASE C---
          25091.1 / -99.5 25091.0 / 140.5 25091.0 / 20.5

BUS32      === INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ====
          FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
          ---PHASE A--- ---PHASE B--- ---PHASE C---
BUS-0026     415.0 0.0351 / -55. 0.0351 /-175. 0.0351 / 65.
BUS-0069     415.0 0.0129 / -83. 0.0129 / 157. 0.0129 / 37.
BUS32      ====== INI. RMS SYSTEM BRANCH FLOWS ( AMPS ) ======
          FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
          BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS-0026     BUS32 CABLE14    415. 23716.3/ -99. 23716.3/ 141. 23716.3/ 21.
BUS32     BUS-0069 CABLE17    415. 1421.0/ 66. 1421.0/ -54. 1421.0/-174.

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BUS48      VOLTAGE BASE LL:           415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 26140.2 / -98. ( AMPS/DEG )
THEVENIN EQUIVALENT IMPEDANCE: 1.959 +j 4.948 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.526

          ASYM RMS INTERRUPTING AMPS

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1/2 CYCLES	2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES
28228.7	26141.5	26140.2	26140.2	26140.2

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
26140.2 / -98.4 26140.2 / 141.6 26140.2 / 21.6

BUS48 ====== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) ======
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES

---PHASE A--- ---PHASE B--- ---PHASE C---
MPSB BUS1 415.0 0.0686 / -65. 0.0686 / 175. 0.0686 / 55.
BUS-0107 415.0 0.0395 / -81. 0.0395 / 159. 0.0395 / 39.
BUS-0125 400.0 0.0000 / 0. 0.0000 / 0. 0.0000 / 0.

BUS48 ====== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
MPSB BUS1 BUS48 CBL-33 415. 22701.8/ -96. 22701.7/ 144. 22701.8/ 24.
BUS48 BUS-0107 CABLE 23 415. 3562.0/ 68. 3562.0/ -52. 3562.0/-172.
BUS48 BUS-0125 VFD-0016 415. 0.0/ 0. 0.0/ 0. 0.0/ 0.

BUS52 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 22870.0 / -97. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 2.383 +j 5.597 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.348

ASYM	RMS	INTERRUPTING AMPS			
1/2 CYCLES	2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
24394.0	22870.5	22870.0	22870.0	22870.0	

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
22870.0 / -96.9 22870.0 / 143.1 22870.0 / 23.1

BUS52 ====== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) ======

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FIRST BUS FROM FAULT      AT TIME =      0.5 CYCLES
    ---PHASE A---      ---PHASE B---      ---PHASE C---
BUS-0115      415.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
MPSB BUS2      415.0  0.0570 / -59.  0.0570 / -179.  0.0570 /   61.
BUS-0159      415.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
BUS-0114      415.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
ESB1          415.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
BUS-0173      415.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
BUS52          ====== INI. RMS SYSTEM BRANCH FLOWS ( AMPS ) ======
                  FIRST BRANCH FROM FAULT AT TIME =      0.5 CYCLES
                  BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS52          BUS-0115  CABLE 26      415.  0.0/   0.  0.0/   0.  0.0/   0.
MPSB BUS2      BUS52     CABLE 25      415.  22870.0/ -97.  22870.0/ 143.  22870.0/ 23.
BUS-0159      BUS52     CABLE 29      415.  0.0/   0.  0.0/   0.  0.0/   0.
BUS52          BUS-0114  CABLE 30      415.  0.0/   0.  0.0/   0.  0.0/   0.
BUS52          ESB1      CABLE 28      415.  0.0/   0.  0.0/   0.  0.0/   0.
BUS52          BUS-0173  CABLE 27      415.  0.0/   0.  0.0/   0.  0.0/   0.

-----
BUS67          VOLTAGE BASE LL:      415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 22731.8 / -96. ( AMPS/DEG )
THEVENIN EQUIVALENT IMPEDANCE: 2.472 +j 5.599 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.265

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES   2 CYCLES   3 CYCLES   5 CYCLES   8 CYCLES
24108.5     22732.1    22731.8    22731.8    22731.8

INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
AT TIME =      0.5 CYCLES
    ---PHASE A---      ---PHASE B---      ---PHASE C---
0.0000 /   0.0  0.0000 /   0.0  0.0000 /   0.0

INI. RMS FAULTED CURRENT ( AMPS / DEG )
AT TIME =      0.5 CYCLES
    ---PHASE A---      ---PHASE B---      ---PHASE C---
22731.8 / -96.2  22731.8 / 143.8  22731.8 / 23.8

BUS67          ===== INI. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =====
FIRST BUS FROM FAULT      AT TIME =      0.5 CYCLES
    ---PHASE A---      ---PHASE B---      ---PHASE C---
MPSB BUS2      415.0  0.0687 / -65.  0.0687 / 175.  0.0687 / 55.
BUS-0112      415.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
BUS-0143      415.0  0.0707 / -75.  0.0707 / 165.  0.0707 / 45.
BUS67          ====== INI. RMS SYSTEM BRANCH FLOWS ( AMPS ) ======
                  FIRST BRANCH FROM FAULT AT TIME =      0.5 CYCLES
                  BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
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MPSB BUS2	BUS67	BUSBAR67	415. 22731.8/ -96. 22731.8/ 144. 22731.8/ 24.
BUS67	BUS-0112	CABLE -34	415. 0.0/ 0. 0.0/ 0. 0.0/ 0.
BUS67	BUS-0143	VFD-0017	415. 0.0/ 0. 0.0/ 0. 0.0/ 0.

BUS7 VOLTAGE BASE LL: 415.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 14016.4 / -100. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 3.470 +j 9.299 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.680

ASYM	RMS	INTERRUPTING AMPS			
1/2 CYCLES	2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
15301.3	14017.6	14016.4	14016.4	14016.4	

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 14016.4 / -99.5 14016.4 / 140.5 14016.4 / 20.5

BUS7 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) ======
 FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 RASB1 415.0 0.0419 / -61. 0.0419 / 179. 0.0419 / 59.
 BUS-0101 415.0 0.0707 / -75. 0.0707 / 165. 0.0707 / 45.
 BUS-0102 415.0 0.0707 / -75. 0.0707 / 165. 0.0707 / 45.
 BUS-0105 415.0 0.0000 / 0. 0.0000 / 0. 0.0000 / 0.
 BUS7 ====== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======
 FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
 BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
 RASB1 BUS7 RAS PUMPS CABL 415. 14016.4/-100. 14016.4/ 140. 14016.4/ 20.
 BUS7 BUS-0101 VFD-0008 415. 0.0/ 0. 0.0/ 0. 0.0/ 0.
 BUS7 BUS-0102 VFD-0010 415. 0.0/ 0. 0.0/ 0. 0.0/ 0.
 BUS7 BUS-0105 VFD-0011 415. 0.0/ 0. 0.0/ 0. 0.0/ 0.

BUS75 VOLTAGE BASE LL: 415.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 22731.8 / -96. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 2.472 +j 5.599 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 2.265

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ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
24108.5 22732.1 22731.8 22731.8 22731.8

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
22731.8 / -96.2 22731.8 / 143.8 22731.8 / 23.8

BUS75 ====== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) ======
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES

---PHASE A--- ---PHASE B--- ---PHASE C---
MPSB BUS2 415.0 0.0687 / -65. 0.0687 / 175. 0.0687 / 55.
BUS-0116 415.0 0.0000 / 0. 0.0000 / 0. 0.0000 / 0.
BUS-0144 415.0 0.0707 / -75. 0.0707 / 165. 0.0707 / 45.

BUS75 ====== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
MPSB BUS2 BUS75 BUSBAR68 415. 22731.8 / -96. 22731.8 / 144. 22731.8 / 24.
BUS75 BUS-0116 CABLE -38 415. 0.0 / 0. 0.0 / 0. 0.0 / 0.
BUS75 BUS-0144 VFD-0018 415. 0.0 / 0. 0.0 / 0. 0.0 / 0.

ESB1 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 14187.6 / -82. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 5.984 +j 7.768 (PU)
THEVENIN IMPEDANCE X/R RATIO: 1.298

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
14299.3 14187.6 14187.6 14187.6 14187.6

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
14187.6 / -82.4 14187.6 / 157.6 14187.6 / 37.6

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ESB1      ===== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ======
          FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
          ---PHASE A---  ---PHASE B---  ---PHASE C---
          415.0  0.4288 / -51.  0.4288 / -171.  0.4288 /   69.
ESB2      415.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
ESB1      ===== INI. RMS SYSTEM BRANCH FLOWS ( AMPS ) ======
          FIRST BRANCH FROM FAULT AT TIME =      0.5 CYCLES
          BRANCH NAME   VBASE LL  -PHASE A-  -PHASE B-  -PHASE C-
BUS52    ESB1      CABLE 28        415.  14187.6/ -82.  14187.6/ 158.  14187.6/  38.
ESB1      ESB2      CABLE 33        415.      0.0/   0.      0.0/   0.      0.0/   0.

-----
ESB2      VOLTAGE BASE LL:           415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 14129.1 / -82. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 6.031 +j 7.783 (PU)
THEVENIN IMPEDANCE X/R RATIO: 1.291

      ASYM   RMS   INTERRUPTING AMPS
1/2 CYCLES   2 CYCLES   3 CYCLES   5 CYCLES   8 CYCLES
          14237.3   14129.1   14129.1   14129.1   14129.1

INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
          AT TIME =      0.5 CYCLES
          ---PHASE A---  ---PHASE B---  ---PHASE C---
          0.0000 /   0.0  0.0000 /   0.0  0.0000 /   0.0

INI. RMS FAULTED CURRENT ( AMPS / DEG )
          AT TIME =      0.5 CYCLES
          ---PHASE A---  ---PHASE B---  ---PHASE C---
          14129.1 / -82.2  14129.1 / 157.8  14129.1 /  37.8

ESB2      ===== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =====
          FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
          ---PHASE A---  ---PHASE B---  ---PHASE C---
          415.0  0.0050 / -65.  0.0050 / 175.  0.0050 /   55.
ESB1      ESB2      ===== INI. RMS SYSTEM BRANCH FLOWS ( AMPS ) =====
          FIRST BRANCH FROM FAULT AT TIME =      0.5 CYCLES
          BRANCH NAME   VBASE LL  -PHASE A-  -PHASE B-  -PHASE C-
ESB1      ESB2      CABLE 33        415.  14129.1/ -82.  14129.1/ 158.  14129.1/  38.

-----
MPSB BUS1 VOLTAGE BASE LL:           415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 27484.8 / -100. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 1.705 +j 4.766 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.795

      ASYM   RMS   INTERRUPTING AMPS
1/2 CYCLES   2 CYCLES   3 CYCLES   5 CYCLES   8 CYCLES
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30248.7 27488.2 27484.8 27484.8 27484.8

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)

AT TIME = 0.5 CYCLES

---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)

AT TIME = 0.5 CYCLES

---PHASE A--- ---PHASE B--- ---PHASE C---
27484.8 /-100.3 27484.7 / 139.7 27484.7 / 19.7

MPSB BUS1 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) =====

FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES

---PHASE A--- ---PHASE B--- ---PHASE C---

BUS-0013 415.0 0.0147 / -58. 0.0147 /-178. 0.0147 / 62.
BUS48 415.0 0.0107 / -81. 0.0107 / 159. 0.0107 / 39.

MPSB BUS1 ===== INI. RMS SYSTEM BRANCH FLOWS (AMPS) =====

FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES

BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-

BUS-0013 MPSB BUS1 BUSBAR 415. 24030.7/ -99. 24030.6/ 141. 24030.7/ 21.
MPSB BUS1 BUS48 CBL-33 415. 3538.1/ 68. 3538.1/ -52. 3538.1/-172.

MPSB BUS2 VOLTAGE BASE LL: 415.0 (VOLTS)

INI. SYM. RMS FAULT CURRENT: 24064.9 / -99. (AMPS/DEG)

THEVENIN EQUIVALENT IMPEDANCE: 2.112 +j 5.381 (PU)

THEVENIN IMPEDANCE X/R RATIO: 2.548

ASYM RMS INTERRUPTING AMPS

1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
26028.9 24066.2 24064.9 24064.9 24064.9

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)

AT TIME = 0.5 CYCLES

---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 0.0000 / 0.0 0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)

AT TIME = 0.5 CYCLES

---PHASE A--- ---PHASE B--- ---PHASE C---
24064.9 / -98.6 24064.9 / 141.4 24064.9 / 21.4

MPSB BUS2 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) =====

FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES

---PHASE A--- ---PHASE B--- ---PHASE C---

BUS52 415.0 0.0000 / 0. 0.0000 / 0. 0.0000 / 0.
BUS-0014 415.0 0.0148 / -58. 0.0148 /-178. 0.0148 / 62.

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BUS67      415.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.  
BUS75      415.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.  
MPSB BUS2 ====== INI. RMS SYSTEM BRANCH FLOWS ( AMPS ) ======  
                      FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES  
                      BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-  
MPSB BUS2  BUS52      CABLE 25      415.    0.0/ 0.    0.0/ 0.    0.0/ 0.  
BUS-0014  MPSB BUS2  BUSBAR5      415.  24064.9/-99.  24064.9/ 141.  24064.9/ 21.  
MPSB BUS2  BUS67      BUSBAR67     415.    0.0/ 0.    0.0/ 0.    0.0/ 0.  
MPSB BUS2  BUS75      BUSBAR68     415.    0.0/ 0.    0.0/ 0.    0.0/ 0.  
  
-----  
RASB1      VOLTAGE BASE LL:          415.0 (VOLTS)  
INI. SYM. RMS FAULT CURRENT: 14534.0 / -101. ( AMPS/DEG )  
THEVENIN EQUIVALENT IMPEDANCE: 3.144 +j 9.041 (PU)  
THEVENIN IMPEDANCE X/R RATIO: 2.875  
  
ASYM RMS INTERRUPTING AMPS  
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES  
16085.5   14536.4   14534.1   14534.0   14534.0  
  
INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )  
AT TIME = 0.5 CYCLES  
---PHASE A--- ---PHASE B--- ---PHASE C---  
0.0000 / 0.0    0.0000 / 0.0    0.0000 / 0.0  
  
INI. RMS FAULTED CURRENT ( AMPS / DEG )  
AT TIME = 0.5 CYCLES  
---PHASE A--- ---PHASE B--- ---PHASE C---  
14534.0 /-100.8 14534.0 / 139.2 14534.0 / 19.2  
  
RASB1      ===== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =====  
                      FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES  
                      ---PHASE A--- ---PHASE B--- ---PHASE C---  
BUS-0008  415.0  0.0121 / -62.  0.0121 / 178.  0.0121 / 58.  
BUS7      415.0  0.0000 / 0.  0.0000 / 0.  0.0000 / 0.  
RASB1      ====== INI. RMS SYSTEM BRANCH FLOWS ( AMPS ) ======  
                      FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES  
                      BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-  
BUS-0008  RASB1      FDR1=RASB1    415.  14534.0/-101.  14534.0/ 139.  14534.0/ 19.  
RASB1      BUS7      RAS PUMPS CABL  415.    0.0/ 0.    0.0/ 0.    0.0/ 0.  
  
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***** F A U L T A N A L Y S I S R E P O R T *****

FAULT TYPE: SLG
MODEL INDUCTION MOTOR CONTRIBUTION: YES
MODEL TRANSFORMER TAPS: YES
MODEL TRANSFORMER PHASE SHIFT: YES

ASB1 - BUS2 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 11221.3 / -56. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 33.532 +j 16.093 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.480
SEQUENCE EQUIVALENT IMPEDANCE Z1: 2.125 +j 5.336 (PU)
 Z2: 2.125 +j 5.336 (PU)
 Z0: 29.281 +j 5.422 (PU)

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
11221.3 11221.3 11221.3 11221.3 11221.3

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 1.2840 / 175.5 1.6541 / 104.5

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
11221.3 / -55.6 0.0 / 0.0 0.0 / 0.0

ASB1 - BUS2 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) =====
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
BUS22 415.0 0.0247 / -11. 1.2776 / 175. 1.6534 / 104.
ASB1 - BUS2 ====== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS22 ASB1 - BUS2 MBSB-ASB1-2 415. 11221.3/-56. 0.0/-56. 0.0/-56.

ASB1-BUS1 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 11490.1 / -55. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 32.969 +j 15.247 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.462
SEQUENCE EQUIVALENT IMPEDANCE Z1: 1.844 +j 4.913 (PU)

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Z2: 1.844 +j 4.913 (PU)
Z0: 29.281 +j 5.422 (PU)

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
11490.2 11490.1 11490.1 11490.1 11490.1

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 1.3172 / 175.2 1.6702 / 105.5

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
11490.1 / -54.8 0.0 / 0.0 0.0 / 0.0

ASB1-BUS1 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) =====
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
BUS12 415.0 0.0253 / -10. 1.3107 / 175. 1.6695 / 105.
ASB1-BUS1 ===== INI. RMS SYSTEM BRANCH FLOWS (AMPS) =====
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS12 ASB1-BUS1 ASB1 FEEDER 1 415. 11490.1/ -55. 0.0/ -55. 0.0/ -55.

ASB3 - BUS1 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 9793.0 / -57. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 38.131 +j 19.035 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.499
SEQUENCE EQUIVALENT IMPEDANCE Z1: 3.283 +j 5.746 (PU)
Z2: 3.283 +j 5.746 (PU)
Z0: 31.565 +j 7.543 (PU)

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
9793.1 9793.0 9793.0 9793.0 9793.0

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 1.2675 / 178.6 1.5820 / 104.7

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---

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9793.0 / -56.5 0.0 / 0.0 0.0 / 0.0

ASB3 - BUS1 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) =====
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
BUS12 415.0 0.1716 / -19. 1.2257 / 179. 1.5728 / 103.
ASB3 - BUS1 ===== INI. RMS SYSTEM BRANCH FLOWS (AMPS) =====
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS12 ASB3 - BUS1 MBSB-ASB3 415. 9793.0/ -57. 0.0/ -57. 0.0/ -57.

ASB3- BUS2 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 9593.8 / -57. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 38.694 +j 19.882 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.514
SEQUENCE EQUIVALENT IMPEDANCE Z1: 3.565 +j 6.170 (PU)
Z2: 3.565 +j 6.170 (PU)
Z0: 31.565 +j 7.543 (PU)

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
9593.8 9593.8 9593.8 9593.8 9593.8

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 1.2415 / 178.9 1.5694 / 103.8

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
9593.8 / -57.2 0.0 / 0.0 0.0 / 0.0

ASB3- BUS2 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) =====
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
BUS22 415.0 0.1681 / -20. 1.2005 / 179. 1.5605 / 102.
ASB3- BUS2 ===== INI. RMS SYSTEM BRANCH FLOWS (AMPS) =====
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS22 ASB3- BUS2 MBSB-ASB3-2 415. 9593.8/ -57. 0.0/ -57. 0.0/ -57.

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BFP MCC VOLTAGE BASE LL: 415.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 7387.2 / -74. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 40.454 +j 39.439 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 0.975
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 4.497 +j 13.137 (PU)
 Z2: 4.497 +j 13.137 (PU)
 Z0: 31.461 +j 13.165 (PU)

ASYM	RMS	INTERRUPTING AMPS			
1/2 CYCLES	2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES	
7398.9	7387.2	7387.2	7387.2	7387.2	

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 0.0000 / 0.0 0.9967 / -177.7 1.4650 / 95.1

INI. RMS FAULTED CURRENT (AMPS / DEG)
 AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 7387.2 / -74.3 0.0 / 0.0 0.0 / 0.0

BFP MCC ====== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) ======
 FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
 ---PHASE A--- ---PHASE B--- ---PHASE C---
 BUS-0015 415.0 0.0445 / -24. 0.9842 /-178. 1.4627 / 95.
 BUS-0145 415.0 0.0458 / -89. 0.0953 / 155. 0.0793 / 66.
 BUS-0146 415.0 0.0458 / -89. 0.0953 / 155. 0.0793 / 66.
 BFP MCC ====== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======
 FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES

BRANCH NAME	VBASE LL	-PHASE A-	-PHASE B-	-PHASE C-
BUS-0015 BFP MCC	CABLE 42	415.	7387.2 / -74.	0.0 / -74.
BFP MCC BUS-0145	VFD-0019	415.	0.0 / 0.	0.0 / 0.
BFP MCC BUS-0146	VFD-0020	415.	0.0 / 0.	0.0 / 0.

 BUS 2 VOLTAGE BASE LL: 11000.0 (VOLTS)
 INI. SYM. RMS FAULT CURRENT: 1695.1 / -80. (AMPS/DEG)
 THEVENIN EQUIVALENT IMPEDANCE: 1.608 +j 9.149 (PU)
 THEVENIN IMPEDANCE X/R RATIO: 5.689
 SEQUENCE EQUIVALENT IMPEDANCE Z1: 0.051 +j 0.621 (PU)
 Z2: 0.051 +j 0.621 (PU)
 Z0: 1.507 +j 7.906 (PU)

 ASYM RMS INTERRUPTING AMPS
 1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
 2185.9 1715.5 1697.4 1695.2 1695.1

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INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 1.5514 / -146.9 1.5721 / 145.8

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
1695.1 / -80.0 0.0 / 0.0 0.0 / 0.0

BUS 2 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) ======
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---

BUS-0004 11000.0 0.0000 / -66. 1.5514 /-147. 1.5721 / 146.
BUS-0006 11000.0 0.0000 / -68. 1.5514 /-147. 1.5721 / 146.
BUS-0025 11000.0 0.0000 / -68. 1.5514 /-147. 1.5721 / 146.
BUS-0071 11000.0 0.0067 / -42. 1.5504 /-147. 1.5704 / 146.
BUS-0007 11000.0 0.0000 / 0. 1.5514 /-147. 1.5721 / 146.
BUS-0009 11000.0 0.0002 / -65. 1.5514 /-147. 1.5722 / 146.
BUS-0010 11000.0 0.0000 / 0. 1.5514 /-147. 1.5721 / 146.
BUS-0011 11000.0 0.0000 / 0. 1.5514 /-147. 1.5721 / 146.

BUS 2 ====== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS 2 BUS-0004 HV-CBL-FDR2 11000. 17.6/ 104. 8.8/ -76. 8.8/ -76.
BUS 2 BUS-0006 CABLE2 11000. 6.9/ 102. 3.4/ -78. 3.4/ -78.
BUS 2 BUS-0025 CABLE15 11000. 6.8/ 102. 3.4/ -78. 3.4/ -78.
BUS-0071 BUS 2 FDR8 11000. 1648.1/ -80. 23.6/ -76. 23.6/ -76.
BUS 2 BUS-0007 HV CABLE -FDR1 11000. 0.0/ 0. 0.0/ 0. 0.0/ 0.
BUS 2 ====== FIRST BRANCH SYSTEM BRANCH FLOWS (AMPS) ======

BUS 2 BUS-0009 CABLE21 11000. 15.9/ 105. 7.9/ -75. 7.9/ -75.
BUS 2 BUS-0010 CABLE6 11000. 0.0/ 0. 0.0/ 0. 0.0/ 0.
BUS 2 BUS-0011 CABLE41 11000. 0.0/ 0. 0.0/ 0. 0.0/ 0.

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BUS12 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 11769.4 / -54. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 32.319 +j 14.595 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.452
SEQUENCE EQUIVALENT IMPEDANCE Z1: 1.663 +j 4.769 (PU)
Z2: 1.663 +j 4.769 (PU)
Z0: 28.994 +j 5.057 (PU)

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
11769.4 11769.4 11769.4 11769.4 11769.4

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 1.3279 / 174.8 1.6842 / 105.7

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
11769.4 / -54.3 0.0 / 0.0 0.0 / 0.0

BUS12 ====== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) ======
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES

---PHASE A--- ---PHASE B--- ---PHASE C---
BUS-0005 415.0 0.0221 / -2. 1.3208 / 175. 1.6835 / 105.
BUS-0103 415.0 0.0054 / -29. 1.3304 / 175. 1.6861 / 106.
BUS-0104 415.0 0.0025 / -36. 1.3289 / 175. 1.6851 / 106.
ASB1-BUS1 415.0 0.0000 / 0. 1.3279 / 175. 1.6842 / 106.
ASB3 - BUS1 415.0 0.0000 / 0. 1.3279 / 175. 1.6842 / 106.
BUS12 ====== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======

FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS-0005 BUS12 FDR2-MBSB 415. 10670.5/ -53. 565.2/ -67. 565.2/ -67.
BUS12 BUS-0103 BLW4-CBL 415. 724.5/ 113. 362.3/ -67. 362.3/ -67.
BUS12 BUS-0104 BLW1-CBL 415. 405.8/ 113. 202.9/ -67. 202.9/ -67.
BUS12 ASB1-BUS1 ASB1 FEEDER 1 415. 0.0/ 0. 0.0/ 0. 0.0/ 0.
BUS12 ASB3 - BUS1 MBSB-ASB3 415. 0.0/ 0. 0.0/ 0. 0.0/ 0.

BUS22 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 11488.9 / -55. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 32.882 +j 15.441 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.470
SEQUENCE EQUIVALENT IMPEDANCE Z1: 1.944 +j 5.192 (PU)

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Z2: 1.944 +j 5.192 (PU)
Z0: 28.994 +j 5.057 (PU)

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
11488.9 11488.9 11488.9 11488.9 11488.9

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 1.2934 / 175.0 1.6676 / 104.7

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
11488.9 / -55.2 0.0 / 0.0 0.0 / 0.0

BUS22 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) ======
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
BUS-0012 415.0 0.0225 / -4. 1.2869 / 175. 1.6672 / 104.
BUS-0106 415.0 0.0033 / -38. 1.2947 / 175. 1.6689 / 105.
ASB1 - BUS2 415.0 0.0000 / 0. 1.2934 / 175. 1.6676 / 105.
ASB3- BUS2 415.0 0.0000 / 0. 1.2934 / 175. 1.6676 / 105.
BUS22 ===== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS-0012 BUS22 FDR5-MBSB 415. 11068.6/ -55. 217.2/ -69. 217.2/ -69.
BUS22 BUS-0106 BLW2-CBL 415. 434.3/ 111. 217.2/ -69. 217.2/ -69.
BUS22 ASB1 - BUS2 MBSB-ASB1-2 415. 0.0/ 0. 0.0/ 0. 0.0/ 0.
BUS22 ASB3- BUS2 MBSB-ASB3-2 415. 0.0/ 0. 0.0/ 0. 0.0/ 0.

BUS32 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 11488.5 / -55. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 32.884 +j 15.441 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.470
SEQUENCE EQUIVALENT IMPEDANCE Z1: 1.945 +j 5.192 (PU)
Z2: 1.945 +j 5.192 (PU)
Z0: 28.994 +j 5.057 (PU)

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
11488.5 11488.5 11488.5 11488.5 11488.5

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES

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```
--PHASE A---      ---PHASE B---      ---PHASE C---
0.0000 /    0.0     1.2933 /   175.0     1.6676 /   104.7

INI.      RMS      FAULTED CURRENT ( AMPS / DEG )
          AT TIME =      0.5 CYCLES
--PHASE A---      ---PHASE B---      ---PHASE C---
11488.5 / -55.2     0.0 /    0.0     0.0 /    0.0

BUS32      ====== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ======
          FIRST BUS FROM FAULT      AT TIME =      0.5 CYCLES
          ---PHASE A---      ---PHASE B---      ---PHASE C---
          415.0  0.0225 / -4.  1.2869 / 175.  1.6672 / 104.
BUS-0026      415.0  0.0039 / -38. 1.2950 / 175.  1.6691 / 105.
BUS-0069      ====== INI. RMS      SYSTEM BRANCH FLOWS ( AMPS ) ======
          FIRST BRANCH FROM FAULT AT TIME =      0.5 CYCLES
          BRANCH NAME   VBASE LL -PHASE A-      -PHASE B-      -PHASE C-
          CABLE14        415.  11068.6 / -55.  216.9 / -69.  216.9 / -69.
BUS-0026      CABLE17        415.    433.8 / 111.  216.9 / -69.  216.9 / -69.
BUS32

-----
BUS48      VOLTAGE BASE LL:           415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 11277.5 / -55. ( AMPS/DEG )
THEVENIN EQUIVALENT IMPEDANCE: 33.633 +j 15.441 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.459
SEQUENCE EQUIVALENT IMPEDANCE Z1: 1.959 +j 4.948 (PU)
Z2: 1.959 +j 4.948 (PU)
Z0: 29.715 +j 5.544 (PU)

          ASYM      RMS      INTERRUPTING AMPS
          1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
          11277.5    11277.5    11277.5    11277.5    11277.5

INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
          AT TIME =      0.5 CYCLES
--PHASE A---      ---PHASE B---      ---PHASE C---
0.0000 /    0.0     1.3170 /   175.5     1.6636 /   105.6

INI.      RMS      FAULTED CURRENT ( AMPS / DEG )
          AT TIME =      0.5 CYCLES
--PHASE A---      ---PHASE B---      ---PHASE C---
11277.5 / -54.7     0.0 /    0.0     0.0 /    0.0

BUS48      ====== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ======
          FIRST BUS FROM FAULT      AT TIME =      0.5 CYCLES
          ---PHASE A---      ---PHASE B---      ---PHASE C---
          415.0  0.0410 / -16.  1.3050 / 176.  1.6601 / 105.
MPSB BUS1      415.0  0.0114 / -38. 1.3217 / 175.  1.6682 / 106.
BUS-0107      400.0  0.0000 /    0.  0.0931 / 131.  0.1176 /   61.
BUS-0125
```

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BUS48 ====== INI. RMS SYSTEM BRANCH FLOWS ( AMPS ) ======
          FIRST BRANCH FROM FAULT AT TIME =      0.5 CYCLES
          BRANCH NAME   VBASE LL -PHASE A- -PHASE B- -PHASE C-
MPSB BUS1    BUS48     CBL-33      415. 10286.8/ -53. 512.2/ -69. 512.2/ -69.
BUS48        BUS-0107   CABLE 23     415. 1024.5/ 111. 512.2/ -69. 512.2/ -69.
BUS48        BUS-0125   VFD-0016     415. 0.0/ 0. 0.0/ 0. 0.0/ 0.

-----
BUS52 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 10925.4 / -56. ( AMPS/DEG )
THEVENIN EQUIVALENT IMPEDANCE: 34.341 +j 16.733 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.487
SEQUENCE EQUIVALENT IMPEDANCE Z1: 2.383 +j 5.597 (PU)
Z2: 2.383 +j 5.597 (PU)
Z0: 29.575 +j 5.539 (PU)

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
10925.4 10925.4 10925.4 10925.4 10925.4

INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 1.2663 / 175.9 1.6396 / 104.0

INI. RMS FAULTED CURRENT ( AMPS / DEG )
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
10925.4 / -56.0 0.0 / 0.0 0.0 / 0.0

BUS52 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =====
          FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
          ---PHASE A--- ---PHASE B--- ---PHASE C---
BUS-0115 415.0 0.0000 / 0. 1.2663 / 176. 1.6396 / 104.
MPSB BUS2 415.0 0.0361 / -11. 1.2569 / 176. 1.6387 / 104.
BUS-0159 415.0 0.0000 / 0. 1.2663 / 176. 1.6396 / 104.
BUS-0114 415.0 0.0000 / 0. 1.2663 / 176. 1.6396 / 104.
ESB1      415.0 0.0000 / 0. 1.2663 / 176. 1.6396 / 104.
BUS-0173 415.0 0.0000 / 0. 1.2663 / 176. 1.6396 / 104.

BUS52 ====== INI. RMS SYSTEM BRANCH FLOWS ( AMPS ) ======
          FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
          BRANCH NAME   VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS52      BUS-0115   CABLE 26      415. 0.0/ 0. 0.0/ 0. 0.0/ 0.
MPSB BUS2  BUS52      CABLE 25      415. 10925.4/ -56. 0.0/ -56. 0.0/ -56.
BUS-0159   BUS52      CABLE 29      415. 0.0/ 0. 0.0/ 0. 0.0/ 0.
BUS52      BUS-0114   CABLE 30      415. 0.0/ 0. 0.0/ 0. 0.0/ 0.
BUS52      ESB1      CABLE 28      415. 0.0/ 0. 0.0/ 0. 0.0/ 0.

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BUS52	BUS-0173	CABLE 27	415.	0.0 / 0.	0.0 / 0.	0.0 / 0.
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BUS67	VOLTAGE BASE LL: 415.0 (VOLTS)
	INI. SYM. RMS FAULT CURRENT: 10843.3 / -56. (AMPS/DEG)
	THEVENIN EQUIVALENT IMPEDANCE: 34.659 +j 16.741 (PU)
	THEVENIN IMPEDANCE X/R RATIO: 0.483
	SEQUENCE EQUIVALENT IMPEDANCE Z1: 2.472 +j 5.599 (PU)
	Z2: 2.472 +j 5.599 (PU)
	Z0: 29.715 +j 5.544 (PU)

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
10843.3 10843.3 10843.3 10843.3 10843.3

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 1.2658 / 176.1 1.6350 / 104.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
10843.3 / -55.8 0.0 / 0.0 0.0 / 0.0

BUS67	===== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) =====
	FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
	---PHASE A--- ---PHASE B--- ---PHASE C---
MPSB BUS2	415.0 0.0422 / -18. 1.2556 / 176. 1.6328 / 104.
BUS-0112	415.0 0.0000 / 0. 1.2658 / 176. 1.6350 / 104.
BUS-0143	415.0 0.0425 / -101. 0.1047 / 155. 0.0801 / 73.
BUS67	===== INI. RMS SYSTEM BRANCH FLOWS (AMPS) =====
	FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
	BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
MPSB BUS2	BUS67 BUSBAR67 415. 10843.3 / -56. 0.0 / -56. 0.0 / -56.
BUS67	BUS-0112 CABLE -34 415. 0.0 / 0. 0.0 / 0. 0.0 / 0.
BUS67	BUS-0143 VFD-0017 415. 0.0 / 0. 0.0 / 0. 0.0 / 0.

BUS7	VOLTAGE BASE LL: 415.0 (VOLTS)
	INI. SYM. RMS FAULT CURRENT: 9156.6 / -67. (AMPS/DEG)
	THEVENIN EQUIVALENT IMPEDANCE: 36.627 +j 27.130 (PU)
	THEVENIN IMPEDANCE X/R RATIO: 0.741
	SEQUENCE EQUIVALENT IMPEDANCE Z1: 3.470 +j 9.299 (PU)
	Z2: 3.470 +j 9.299 (PU)
	Z0: 29.687 +j 8.531 (PU)

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ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES
9158.5	9156.6	9156.6	9156.6	9156.6

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 1.0802 / 178.2 1.5491 / 97.9

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
9156.6 / -66.5 0.0 / 0.0 0.0 / 0.0

BUS7 ====== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) ======
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---

RASB1	415.0	0.0363 / -21.	1.0705 / 178.	1.5474 / 98.
BUS-0101	415.0	0.0435 / -93.	0.0988 / 154.	0.0805 / 69.
BUS-0102	415.0	0.0435 / -93.	0.0988 / 154.	0.0805 / 69.
BUS-0105	415.0	0.0000 / 0.	0.0764 / 133.	0.1095 / 53.

BUS7 ====== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ======
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
BRANCH NAME VBASE LL -PHASE A- -PHASE B- -PHASE C-
RASB1 BUS7 RAS PUMPS CABL 415. 9156.6 / -67. 0.0 / -66. 0.0 / -66.
BUS7 BUS-0101 VFD-0008 415. 0.0 / 0. 0.0 / 0. 0.0 / 0.
BUS7 BUS-0102 VFD-0010 415. 0.0 / 0. 0.0 / 0. 0.0 / 0.
BUS7 BUS-0105 VFD-0011 415. 0.0 / 0. 0.0 / 0. 0.0 / 0.

BUS75 VOLTAGE BASE LL: 415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 10843.3 / -56. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 34.659 +j 16.741 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.483
SEQUENCE EQUIVALENT IMPEDANCE Z1: 2.472 +j 5.599 (PU)
Z2: 2.472 +j 5.599 (PU)
Z0: 29.715 +j 5.544 (PU)

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES
10843.3	10843.3	10843.3	10843.3	10843.3

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 1.2658 / 176.1 1.6350 / 104.0

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INI.      RMS      FAULTED CURRENT ( AMPS / DEG )
          AT TIME =      0.5 CYCLES
---PHASE A---      ---PHASE B---      ---PHASE C---
10843.3 / -55.8     0.0 /  0.0     0.0 /  0.0

BUS75      ===== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =====
          FIRST BUS FROM FAULT      AT TIME =      0.5 CYCLES
          ---PHASE A---      ---PHASE B---      ---PHASE C---
MPSB BUS2    415.0  0.0422 / -18.  1.2556 / 176.  1.6328 / 104.
BUS-0116     415.0  0.0000 /  0.  1.2658 / 176.  1.6350 / 104.
BUS-0144     415.0  0.0425 /-101. 0.1047 / 155.  0.0801 /  73.
BUS75      ====== INI. RMS      SYSTEM BRANCH FLOWS ( AMPS ) ======
          FIRST BRANCH FROM FAULT AT TIME =      0.5 CYCLES
          BRANCH NAME      VBASE LL      -PHASE A-      -PHASE B-      -PHASE C-
MPSB BUS2    BUS75      BUSBAR68      415.  10843.3/-56.     0.0/-56.     0.0/-56.
BUS75      BUS-0116     CABLE -38      415.     0.0/  0.     0.0/  0.     0.0/  0.
BUS75      BUS-0144     VFD-0018      415.     0.0/  0.     0.0/  0.     0.0/  0.

-----
ESB1      VOLTAGE BASE LL:      415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 7696.2 / -59. ( AMPS/DEG )
THEVENIN EQUIVALENT IMPEDANCE: 47.257 +j 26.601 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.563
SEQUENCE EQUIVALENT IMPEDANCE Z1: 5.984 +j 7.768 (PU)
Z2: 5.984 +j 7.768 (PU)
Z0: 35.290 +j 11.064 (PU)

ASYM      RMS      INTERRUPTING AMPS
1/2 CYCLES   2 CYCLES   3 CYCLES   5 CYCLES   8 CYCLES
    7696.3     7696.2     7696.2     7696.2     7696.2

INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
          AT TIME =      0.5 CYCLES
---PHASE A---      ---PHASE B---      ---PHASE C---
0.0000 /  0.0     1.1954 / -176.8     1.4710 / 102.9

INI.      RMS      FAULTED CURRENT ( AMPS / DEG )
          AT TIME =      0.5 CYCLES
---PHASE A---      ---PHASE B---      ---PHASE C---
7696.2 / -59.4     0.0 /  0.0     0.0 /  0.0

ESB1      ===== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =====
          FIRST BUS FROM FAULT      AT TIME =      0.5 CYCLES
          ---PHASE A---      ---PHASE B---      ---PHASE C---
BUS52      415.0  0.2997 / -22.  1.1226 /-177.  1.4545 / 100.
ESB2      415.0  0.0000 /  0.  1.1954 /-177.  1.4710 / 103.
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ESB1      ======INI. RMS SYSTEM BRANCH FLOWS ( AMPS ) ======
          FIRST BRANCH FROM FAULT AT TIME =      0.5 CYCLES
          BRANCH NAME   VBASE LL -PHASE A- -PHASE B- -PHASE C-
BUS52    ESB1      CABLE 28      415.  7696.2/ -59.      0.0/ -59.      0.0/ -59.
ESB1      ESB2      CABLE 33      415.      0.0/   0.      0.0/   0.      0.0/   0.

-----
ESB2      VOLTAGE BASE LL:           415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 7670.7 / -59. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 47.426 +j 26.668 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.562
SEQUENCE EQUIVALENT IMPEDANCE Z1: 6.031 +j 7.783 (PU)
Z2: 6.031 +j 7.783 (PU)
Z0: 35.364 +j 11.102 (PU)

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
7670.8     7670.7     7670.7     7670.7     7670.7

INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0     1.1952 / -176.8     1.4696 / 102.9

INI. RMS FAULTED CURRENT ( AMPS / DEG )
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
7670.7 / -59.3     0.0 / 0.0     0.0 / 0.0

ESB2      =====INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =====
          FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
          ---PHASE A--- ---PHASE B--- ---PHASE C---
ESB1      415.0 0.0033 / -37. 1.1946 / -177. 1.4693 / 103.
ESB2      ======INI. RMS SYSTEM BRANCH FLOWS ( AMPS ) =====
          FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES
          BRANCH NAME   VBASE LL -PHASE A- -PHASE B- -PHASE C-
ESB1      ESB2      CABLE 33      415.  7670.7/ -59.      0.0/ -59.      0.0/ -59.

-----
MPSB BUS1 VOLTAGE BASE LL:           415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 11708.4 / -54. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 32.553 +j 14.524 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.446
SEQUENCE EQUIVALENT IMPEDANCE Z1: 1.705 +j 4.766 (PU)
Z2: 1.705 +j 4.766 (PU)
Z0: 29.143 +j 4.992 (PU)

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ASYM      RMS      INTERRUPTING AMPS
1/2 CYCLES   2 CYCLES   3 CYCLES   5 CYCLES   8 CYCLES
           11708.4     11708.4     11708.4     11708.4     11708.4

INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
AT TIME =      0.5 CYCLES
---PHASE A---    ---PHASE B---    ---PHASE C---
0.0000 /     0.0     1.3285 /   174.8     1.6826 /   105.8

INI.      RMS      FAULTED CURRENT ( AMPS / DEG )
AT TIME =      0.5 CYCLES
---PHASE A---    ---PHASE B---    ---PHASE C---
11708.4 / -54.0     0.0 /     0.0     0.0 /     0.0

MPSB BUS1 ===== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ======
FIRST BUS FROM FAULT      AT TIME =      0.5 CYCLES
---PHASE A---    ---PHASE B---    ---PHASE C---
BUS-0013      415.0  0.0178 / -15.  1.3172 / 175.  1.6764 / 105.
BUS48         415.0  0.0030 / -35.  1.3298 / 175.  1.6838 / 106.
MPSB BUS1 ===== INI. RMS      SYSTEM BRANCH FLOWS ( AMPS ) ======
FIRST BRANCH FROM FAULT AT TIME =      0.5 CYCLES
BRANCH NAME   VBASE LL -PHASE A-    -PHASE B-    -PHASE C-
BUS-0013      MPSB BUS1      BUSBAR        415.  10726.4/ -53.  502.4/ -66.  502.4/ -66.
MPSB BUS1      BUS48         CBL-33         415.  1004.8/ 114.  502.4/ -66.  502.4/ -66.

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MPSB BUS2      VOLTAGE BASE LL:          415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 11310.8 / -55. ( AMPS/DEG )
THEVENIN EQUIVALENT IMPEDANCE: 33.367 +j 15.755 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.472
SEQUENCE EQUIVALENT IMPEDANCE Z1: 2.112 +j 5.381 (PU)
Z2: 2.112 +j 5.381 (PU)
Z0: 29.143 +j 4.992 (PU)

ASYM      RMS      INTERRUPTING AMPS
1/2 CYCLES   2 CYCLES   3 CYCLES   5 CYCLES   8 CYCLES
           11310.8     11310.8     11310.8     11310.8     11310.8

INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
AT TIME =      0.5 CYCLES
---PHASE A---    ---PHASE B---    ---PHASE C---
0.0000 /     0.0     1.2792 /   175.2     1.6592 /   104.3

INI.      RMS      FAULTED CURRENT ( AMPS / DEG )
AT TIME =      0.5 CYCLES
---PHASE A---    ---PHASE B---    ---PHASE C---
11310.8 / -55.3     0.0 /     0.0     0.0 /     0.0
```

WATER SERVICES ENGINEERING (WSE) PTY. LTD.

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QUEENSLAN URBAN UTILITIES - GIBSON ISLAND STP

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MPSB BUS2      ===== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =====
                FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                ---PHASE A---  ---PHASE B---  ---PHASE C---
                415.0  0.0000 /  0.  1.2792 / 175.  1.6592 / 104.
                415.0  0.0178 / -17. 1.2686 / 175.  1.6534 / 104.
                415.0  0.0000 /  0.  1.2792 / 175.  1.6592 / 104.
                415.0  0.0000 /  0.  1.2792 / 175.  1.6592 / 104.
MPSB BUS2      ===== INI. RMS SYSTEM BRANCH FLOWS ( AMPS ) =====
                FIRST BRANCH FROM FAULT AT TIME =      0.5 CYCLES
                BRANCH NAME   VBASE LL  -PHASE A-  -PHASE B-  -PHASE C-
MPSB BUS2      BUS52        CABLE 25     415.      0.0/  0.  0.0/  0.  0.0/  0.
BUS-0014      MPSB BUS2    BUSBAR5      415.  11310.8/ -55.  0.0/ -55.  0.0/ -55.
MPSB BUS2      BUS67        BUSBAR67    415.      0.0/  0.  0.0/  0.  0.0/  0.
MPSB BUS2      BUS75        BUSBAR68    415.      0.0/  0.  0.0/  0.  0.0/  0.

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RASB1          VOLTAGE BASE LL:           415.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 9497.8 / -66. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 35.458 +j 25.956 (PU)
THEVENIN IMPEDANCE X/R RATIO: 0.732
SEQUENCE EQUIVALENT IMPEDANCE Z1: 3.144 +j 9.041 (PU)
Z2: 3.144 +j 9.041 (PU)
Z0: 29.169 +j 7.874 (PU)

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES   2 CYCLES   3 CYCLES   5 CYCLES   8 CYCLES
         9499.6     9497.8     9497.8     9497.8     9497.8

INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
AT TIME =      0.5 CYCLES
---PHASE A---  ---PHASE B---  ---PHASE C---
0.0000 /  0.0  1.0820 / 177.2  1.5674 /  97.9

INI. RMS FAULTED CURRENT ( AMPS / DEG )
AT TIME =      0.5 CYCLES
---PHASE A---  ---PHASE B---  ---PHASE C---
9497.8 / -66.2  0.0 /  0.0  0.0 /  0.0

RASB1          ===== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =====
                FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                ---PHASE A---  ---PHASE B---  ---PHASE C---
                415.0  0.0105 / -21.  1.0792 / 177.  1.5669 /  98.
                415.0  0.0000 /  0.  1.0820 / 177.  1.5674 /  98.
RASB1          ===== INI. RMS SYSTEM BRANCH FLOWS ( AMPS ) =====
                FIRST BRANCH FROM FAULT AT TIME =      0.5 CYCLES
                BRANCH NAME   VBASE LL  -PHASE A-  -PHASE B-  -PHASE C-
BUS-0008      RASB1        FDR1-RASB1  415.  9497.8/ -66.  0.0/ -66.  0.0/ -66.
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RASB1	BUS7	RAS PUMPS CABL	415.	0.0/	0.	0.0/	0.	0.0/	0.
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***** F A U L T A N A L Y S I S S U M M A R Y *****

BUS NAME	VOLTAGE	AVAILABLE FAULT CURRENT			
		L-L	3 PHASE	X/R LINE/GRND	X/R
ASB1 - BUS2	415.	24222.4	2.5	11221.26	0.5
ASB1-BUS1	415.	26513.8	2.7	11490.15	0.5
ASB3 - BUS1	415.	21021.8	1.8	9793.03	0.5
ASB3- BUS2	415.	19525.1	1.7	9593.80	0.5
BFP MCC	415.	10019.0	2.9	7387.22	1.0
BUS 2	11000.	8420.6	12.3	1695.15	5.7
BUS12	415.	27545.6	2.9	11769.42	0.5
BUS22	415.	25092.2	2.7	11488.92	0.5
BUS32	415.	25091.1	2.7	11488.53	0.5
BUS48	415.	26140.2	2.5	11277.51	0.5
BUS52	415.	22870.0	2.3	10925.38	0.5
BUS67	415.	22731.8	2.3	10843.32	0.5
BUS7	415.	14016.4	2.7	9156.58	0.7
BUS75	415.	22731.8	2.3	10843.32	0.5
ESB1	415.	14187.6	1.3	7696.22	0.6
ESB2	415.	14129.1	1.3	7670.69	0.6
MPSB BUS1	415.	27484.8	2.8	11708.43	0.4
MPSB BUS2	415.	24064.9	2.5	11310.78	0.5
RASB1	415.	14534.0	2.9	9497.81	0.7

***** FAULT ANALYSIS REPORT COMPLETED *****