

Hatch Systems and Process Control

Energy Monitoring in an Underground Mine



Josh Lilley, MBA, P.Eng
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Introduction

Josh Lilley

- Senior Electrical Engineer with Hatch Sudbury (8+yrs)
- Sudbury Systems & Process Control Discipline Lead
- Involved with Nickel Rim South Project for past 6 years

Overview

Presentation Overview

- Introduction
- About Hatch
- Hatch Systems & Process Control
- Nickel Rim South Project
- Conclusion
- Questions

About us

About Hatch

- Global company, headquartered in Canada
- Awarded one of Canada's 50 best managed private companies in 2007, 2008, 2009
- Employee owned
- Projects in more than 150 countries
- 8000 professionals worldwide
- US\$40 billion of projects under management
- EPCM, Integrated Teams, Project and Construction Management
- Consulting – process, systems and process control, technology and business
- Engineering services for operations support
- Serving mining & metals, energy and infrastructure for more than 50 years

Hatch Services & Sectors



Our Business Units

metals

- MINING & MINERAL PROCESSING
- IRON & STEEL
- LIGHT METALS
- INDUSTRIAL MINERALS
- NON-FERROUS
- IRON ORE

energy

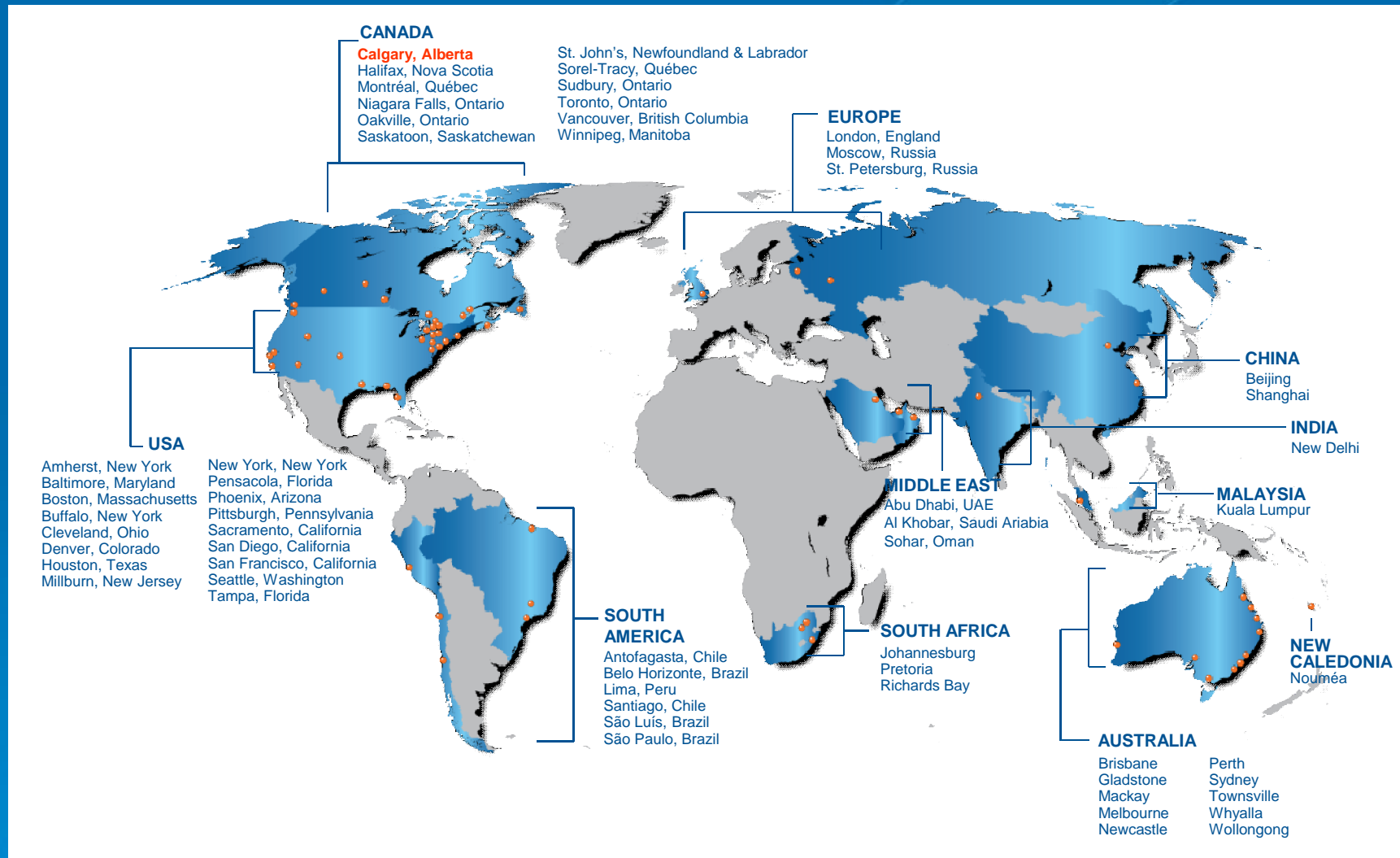
- OIL & GAS
- THERMAL/NUCLEAR
- TRANSMISSION & DISTRIBUTION
- RENEWABLE POWER

infrastructure

- TRANSPORT
- WATER
- INFRASTRUCTURE SERVICES
- INFRASTRUCTURE VENTURES

Global Operations

8000 staff – July 2010

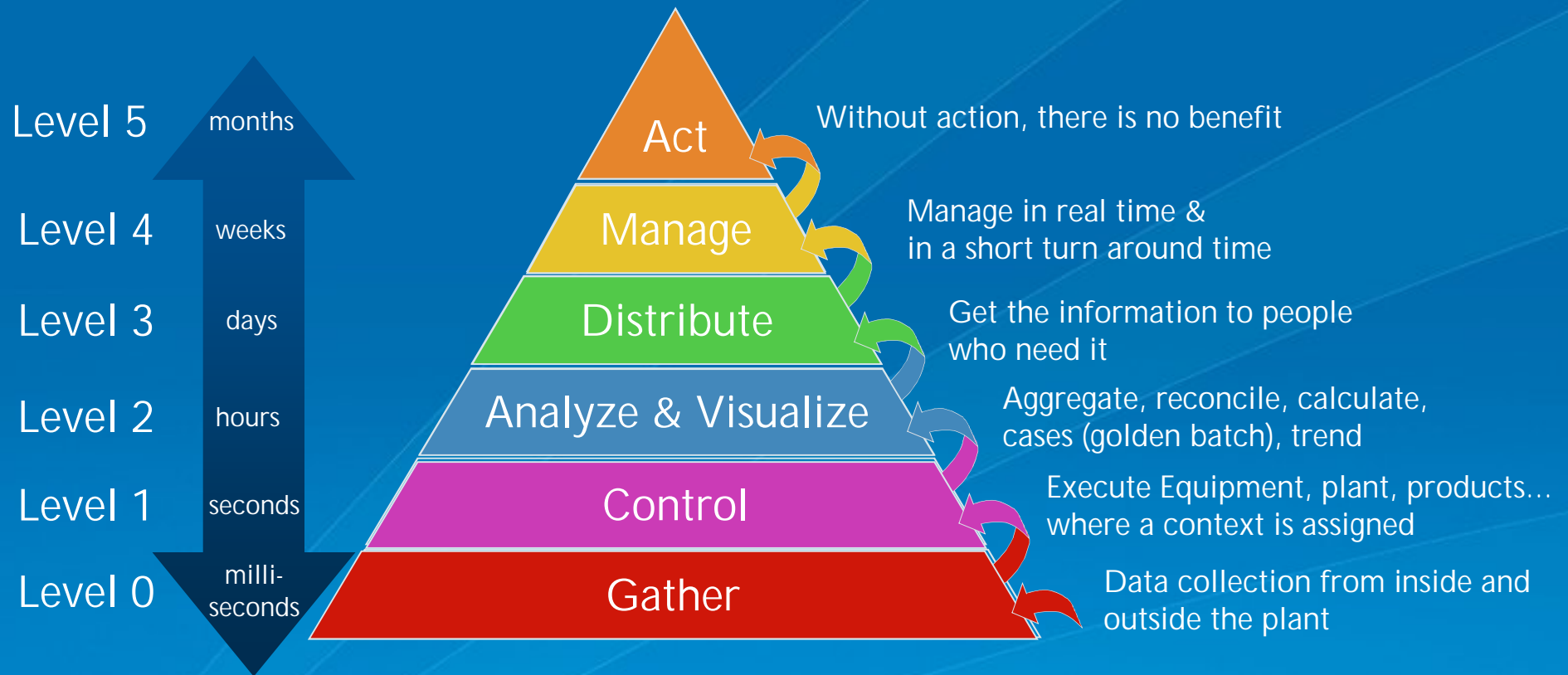


S&PC

About Hatch Systems & Process Control

- 450 professionals world wide
- Roots in mining, metallurgical and energy engineering
- Thorough understanding of Process Control, PIMS/MES and IT/Systems domains
- Use of sound engineering principles/ international standards
- Can draw on experience from around the world and across different industries
- Proven track record
- We believe in getting it right the first time

S&PC Scope - Purdue Model



Nickel Rim South Project

- Client: Xstrata Nickel
- Facility: Nickel & Copper Mine
- Start Date: March 8, 2004
- Completion: April 1, 2010
- Capital Cost: approx. \$920M

Nickel Rim South Project

- Two Shafts Sunk – 50m apart
- Main Shaft Sunk to depth of 1735m
- Vent Shaft Sunk to depth of 1685 m
- Lateral Development: 21.6 km

Nickel Rim South Power System

- 115kV power line to site
- Two 15/20/25 MVA Transformers step down voltage from 115kV to 13.8kV
- Site distribution is at 13.8kV & 600V
- One 2 MW diesel generator used for emergency backup

Nickel Rim South Project



Overall Site - 2004

Nickel Rim South Project



Overall Site - 2010

Scope & Design Basis

Project mandate was to establish the provisions to monitor all permanent infrastructure to enable collection of base line measurements for future energy “management”

- Allow users to make economic decisions in a real time environment;
- Monitor Mine Commodities;
 - Electricity
 - Water – process & potable
 - Diesel Fuel
 - Natural Gas

Why ION Enterprise?

- Proven success within the Sudbury Business Unit
- Maintain standardization of energy management product deployments within Sudbury
- Capable of being integrated with a deregulated market

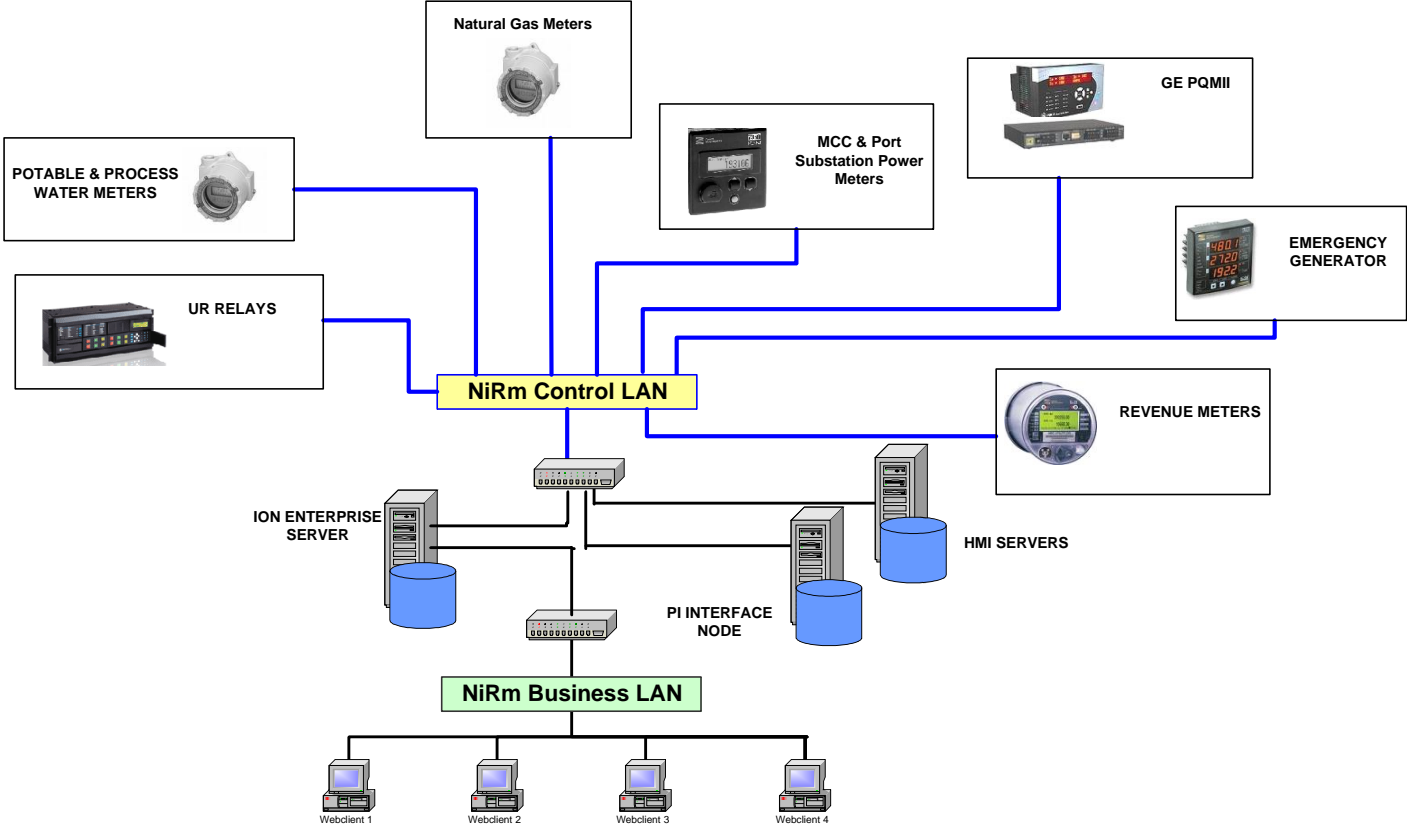
System Statistics

<u>Device</u>	<u>Function</u>	<u>Quantity</u>
ION 7350	600V Bus Monitoring/Nat. Gas	108
ION 8500	Revenue Meters	4
ION 6200	2MW Generator	3

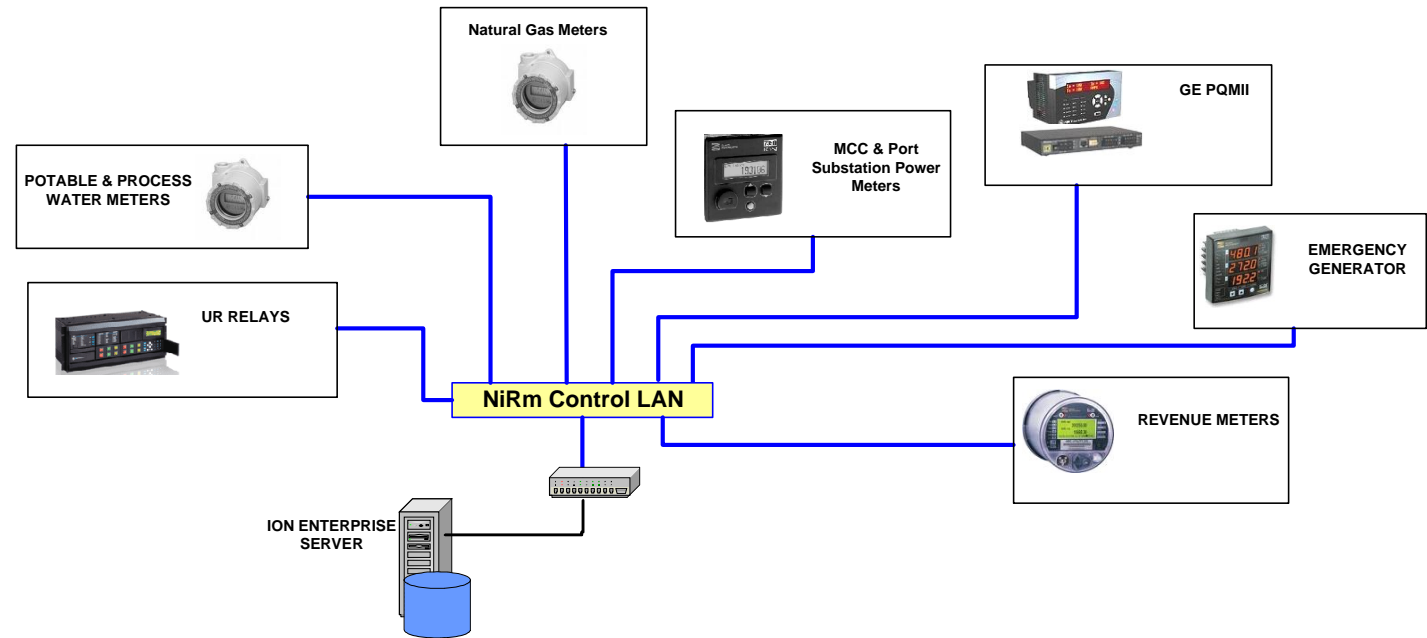
System Statistics

<u>Device</u>	<u>Function</u>	<u>Quantity</u>
T60 UR Relay	Main 115/13.8kV Tx Protection	2
PQMII AM0D50	13.8/0.6kV Substation	2
Startco SE-330 Ground Fault Relay	600V Ground Fault Monitoring	28
F35 UR Relay	13.8kV Breaker Protection	12

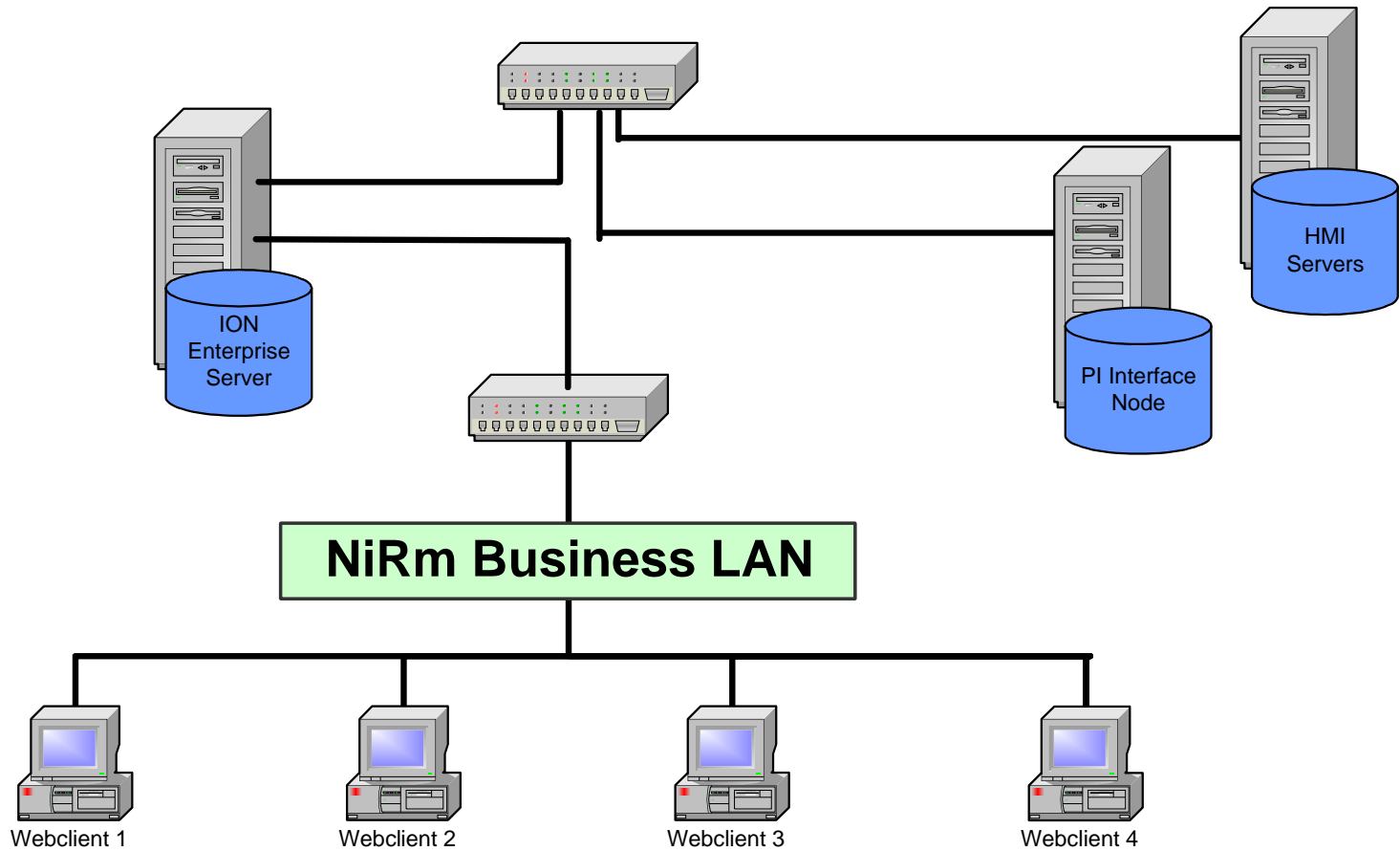
System Architecture



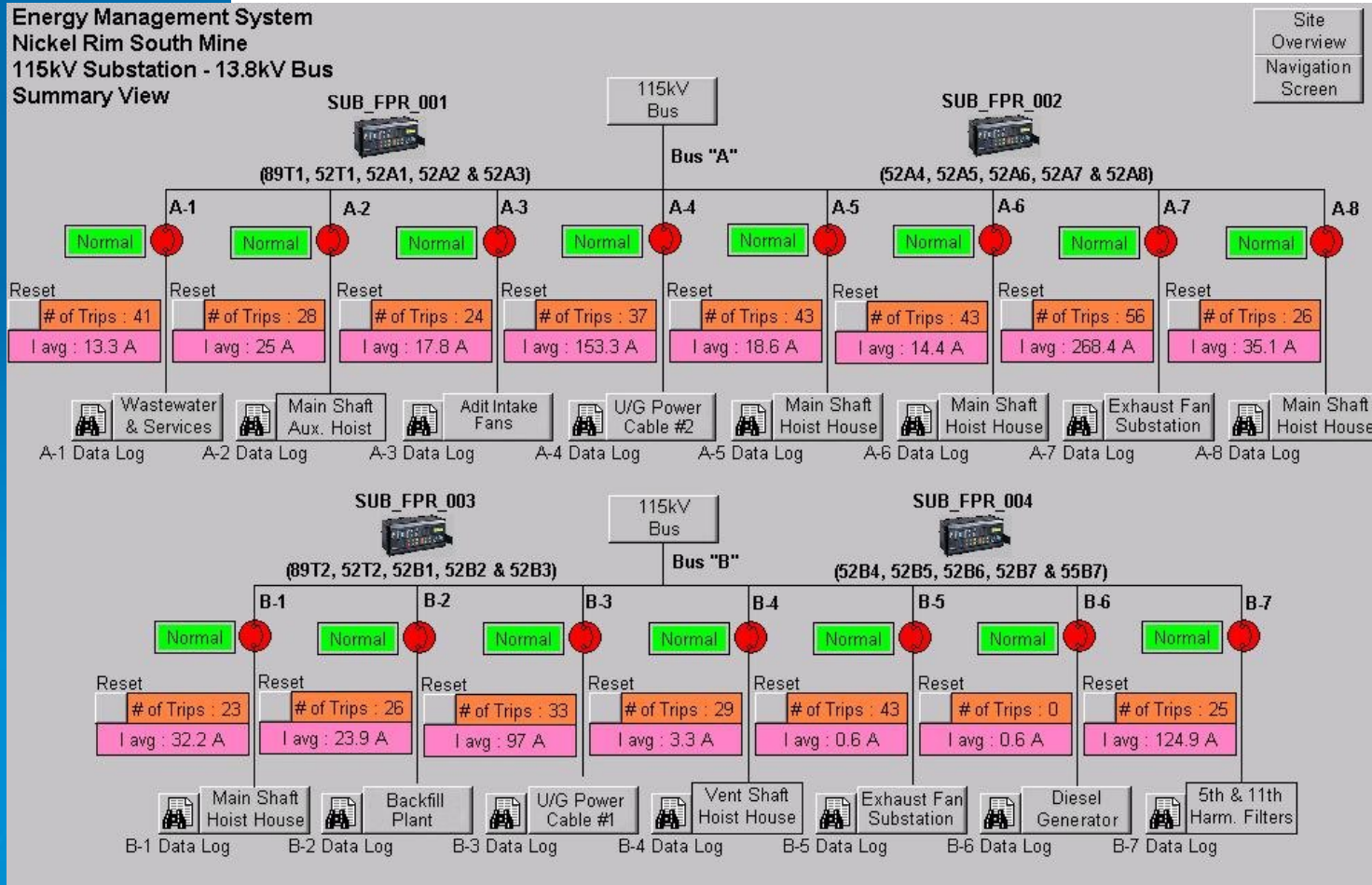
System Architecture – Field Devices



System Architecture



13.8kV Distribution Summary



UR Relay Detail Screen

Energy Management System
 Nickel Rim South Mine
 GE Multilin F35-1 Protection Relay
 Detailed Meter Data - PAGE 1



Meter Title: 118968123
 Page 1 Page 2

Site Overview
 Navigation Screen

SUB_FPR_001

Source 1: T1 PRI	Source 4: 52A1	Line	Power	Real	Reactive	Apparent	Energy
Current	Current						
Ia : 53.6A	Ia : 13.6A	Vab : 13 914V	PF p1A : -99.4%	kW p1A : 108kW	kvar p1A : -13 kvar	KVA p1A : 109KVA	MWh Pos : 2118.527 MWh
Ib : 49.8A	Ib : 13.2A	Vbc : 13 736V	PF p1B : -99 %	kW p1B : 102kW	kvar p1B : -15 kvar	KVA p1B : 105KVA	MWh Neg : 0.23MWh
Ic : 50.3A	Ic : 13.7A	Vca : 13 837V	PF p1C : -98.7%	kW p1C : 105kW	kvar p1C : -18 kvar	KVA p1C : 107KVA	MWh Pos : 739.284 MWh
Iground : 0A	Iground : 0.1 A	Phase	PF tot : -99%	kW tot : 316kW	kvar tot : -46 kvar	KVA tot : 324KVA	MWh Neg : 313.943 MWh
Frequency	Frequency	Vag : 8034V					
Freq : 60 Hz	Freq : 60 Hz	Vbg : 7976V					
		Vcg : 7944V					
Source 2: 52T1	Source 5: 52A2	Line	Power	Real	Reactive	Apparent	Energy
Current	Current						
Ia : 458.8A	Ia : 2.4A	Vab : 13 913V	PF p1A : -98.4%	kW p1A : 0kW	kvar p1A : 4 kvar	KVA p1A : 6 KVA	MWh Pos : 2240.739 MWh
Ib : 452.9A	Ib : 2.2A	Vbc : 13 737V	PF p1B : -94.2%	kW p1B : -9kW	kvar p1B : 4 kvar	KVA p1B : 9 KVA	MWh Neg : 1324.721 MWh
Ic : 425.3A	Ic : 2.5A	Vca : 13 837V	PF p1C : 40.7%	kW p1C : -6kW	kvar p1C : -2 kvar	KVA p1C : 6 KVA	MWh Pos : 335.83 MWh
Iground : 0A	Iground : 0.2 A	Phase	P : -94.6%	kW tot : 0kW	kvar tot : 2kvar	KVA tot : 12KVA	MWh Neg : 9.625 MWh
Iground : 0A	Frequency	Vag : 8032V					
	Freq : 60 Hz	Vbg : 7975V					
		Vcg : 7945V					
Source 3: Bus A	Source 6: 52A3	Line	Power	Real	Reactive	Apparent	Energy
Voltage	Current						
Vab : 13 914V	Ia : 18A	Vab : 13 910V	PF p1A : -75.6%	kW p1A : 109kW	kvar p1A : -95 kvar	KVA p1A : 146KVA	MWh Pos : 14436.935 MWh
Vbc : 13 736V	Ib : 17.3A	Vbc : 13 744V	PF p1B : -75.3%	kW p1B : 104kW	kvar p1B : -93 kvar	KVA p1B : 139KVA	MWh Neg : 2.398MWh
Vca : 13 836V	Ic : 17.6A	Vca : 13 850V	PF p1C : -74%	kW p1C : 104kW	kvar p1C : -95 kvar	KVA p1C : 141KVA	MWh Pos : 3777.549 MWh
Vag : 8037V	Iground : 0.1 A	Phase	PF tot : -74.9%	kW tot : 316kW	kvar tot : -283kvar	KVA tot : 425KVA	MWh Neg : 6724.196 MWh
Vbg : 7976V	Frequency	Vag : 8032V					
Vcg : 7944V	Freq : 60 Hz	Vbg : 7976V					
Frequency		Vcg : 7948V					
Freq : 60 Hz							



Energy Log-52A1, 52A2, 52A3

UR Relay Diagnostic Screen

Energy Management System
 Nickel Rim South Mine
 GE Multilin F35-1 Protection Relay
 Detailed Meter Data - PAGE 2



SUB_FPR_001

Meter Time: 1159638185.s

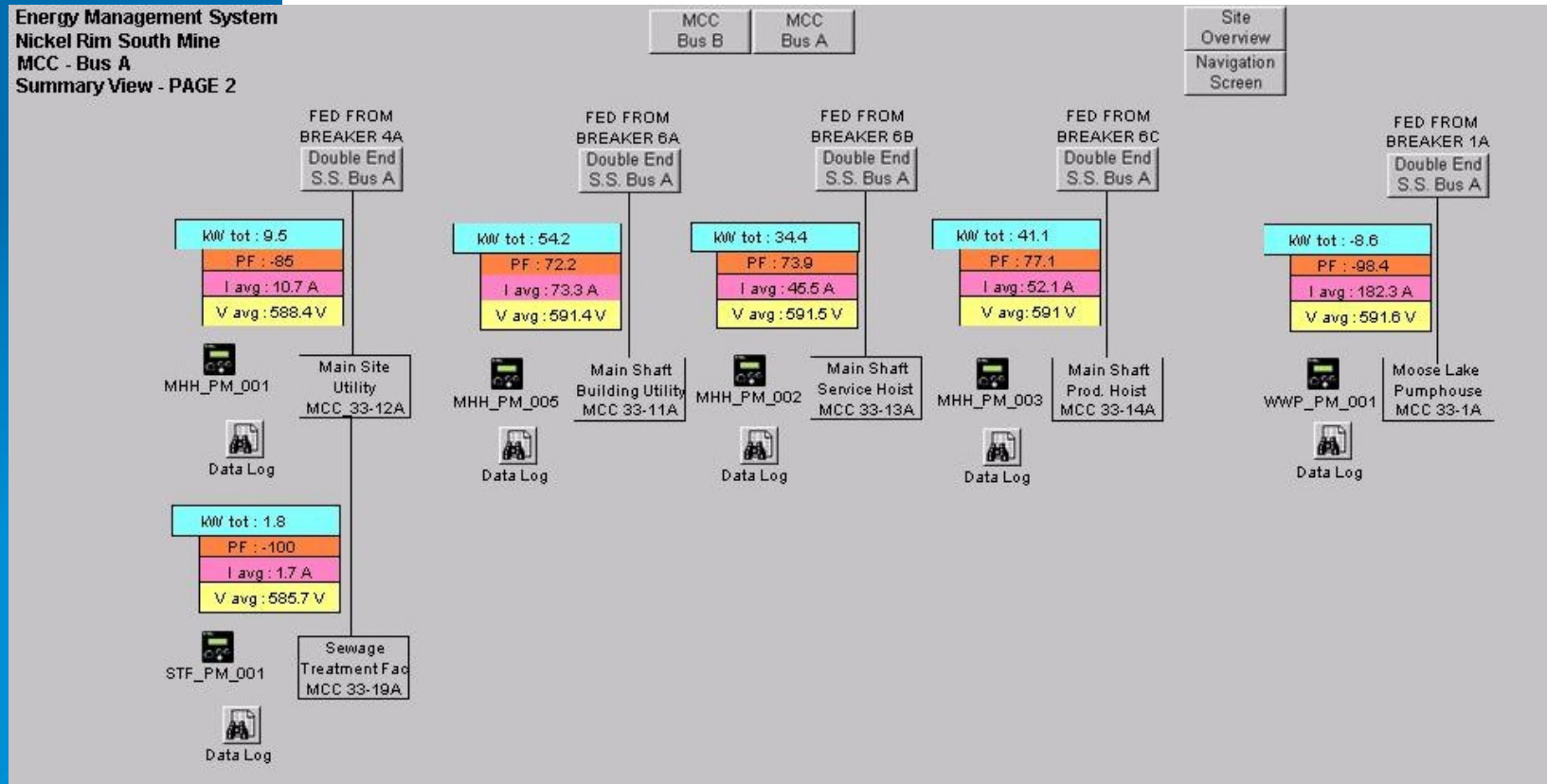
Page 1 Page 2

RELAY HEALTHY

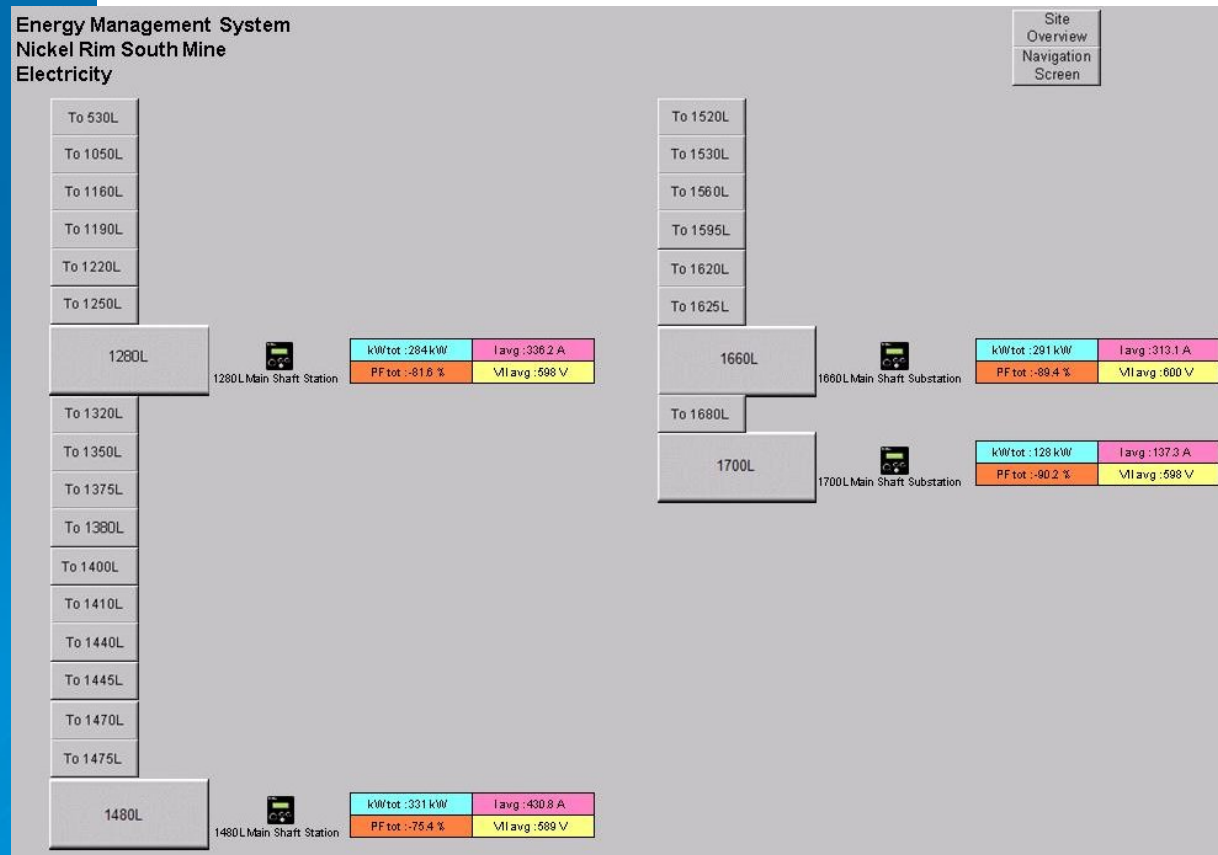
Relay Error Code : 0

Relay Status Legend	Alarm and Fault Status
1: OFF Any Self Test Error	52T1 Alarm: OK
2: OFF IRIG-B Failure	52T1 Aux. Contact Status Fault: OK
4: OFF DSP Error	52T1 Lockout Signal to Gen. Control: OK
8: OFF No DSP Interrupts	Trip/Open Signal to 52T1: Normal
32: OFF Unit Not Calibrated	52A1 Alarm: OK
64: OFF Prototype Firmware	52A1 Aux. Contact Status Fault: OK
1024: OFF Flexlogic Error Token	Trip/Open Signal to 52A1: Normal
2048: OFF Equipment Mismatch	52A2 Alarm: OK
4096: OFF Unit Not Programmed	52A2 Aux. Contact Status Fault: OK
16384: OFF System Exception	Trip/Open Signal to 52A2: Normal
32768: OFF Latching Out Error	52A3 Alarm: OK
65536: OFF SNTP Failure	52A3 Aux. Contact Status Fault: OK
524288: OFF Battery Failure	Trip/Open Signal to 52A3: Normal
1048576: OFF Primary Ethernet Failure	52B6 Aux. Contact Status Fault: OK
2097152: OFF Secondary Ethernet Failure	Trip Signal to 52B6: Normal
4194304: OFF EEPROM Data Error	Trip Signal to 89T1: Normal
8388608: OFF SRAM Data Error	Trip Signal to 52G: Normal
16777216: OFF Program Memory	52TIE Aux. Contact Status Fault: OK
33554432: OFF Watchdog Error	Set for Any Contact Status Fault: OK
67108864: OFF Low On Memory	Set for Any Trip Condition: Normal
134217728: OFF Remote Device Off	Set for Any HMI Forced or Blocked Status Signals: Not Active
268435456: OFF Direct Device Off	
536870912: OFF Direct Ring Break	
1073741824: OFF Any Minor Error	
2147483648: OFF Any Major Error	

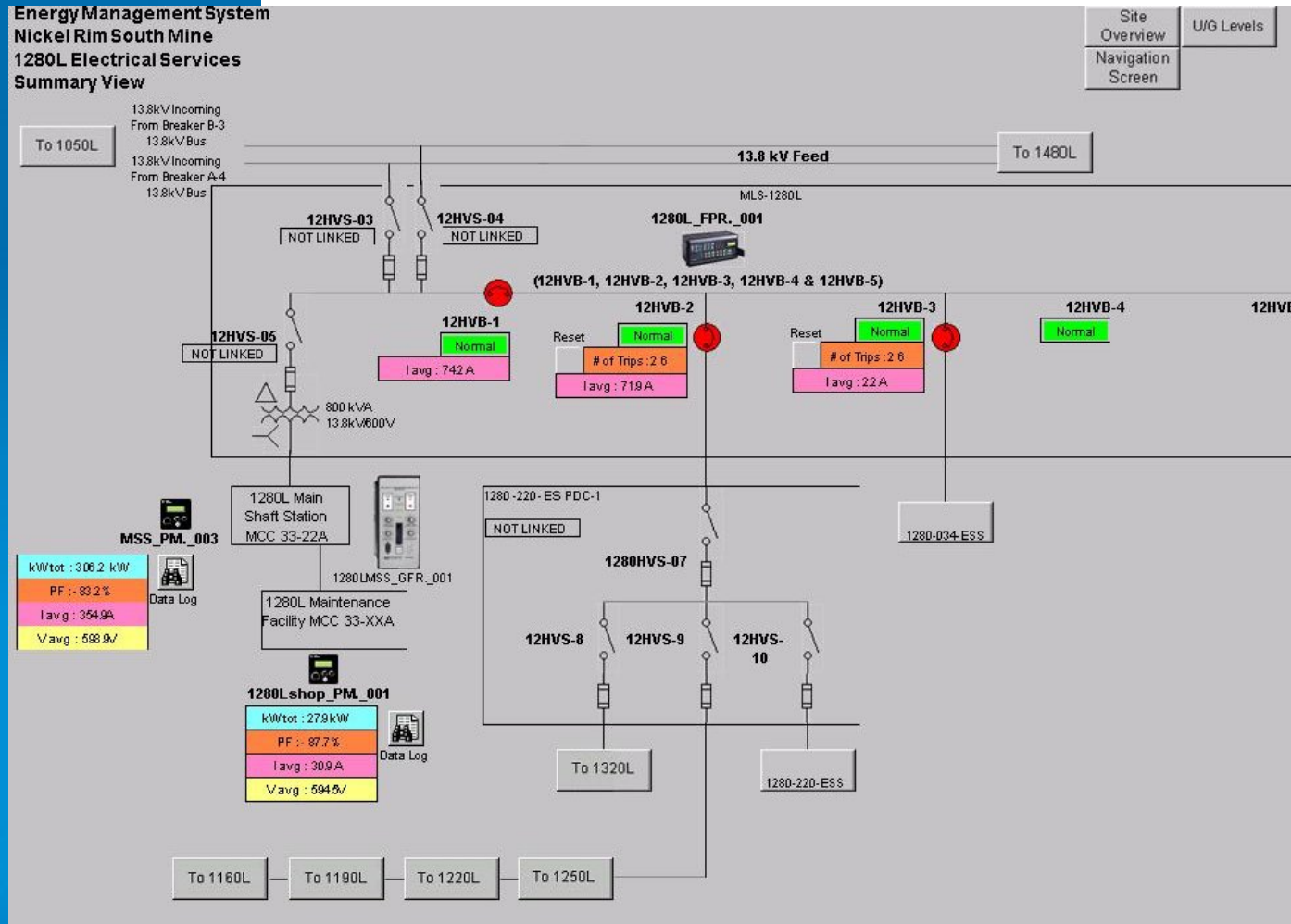
600V Distribution Single Line



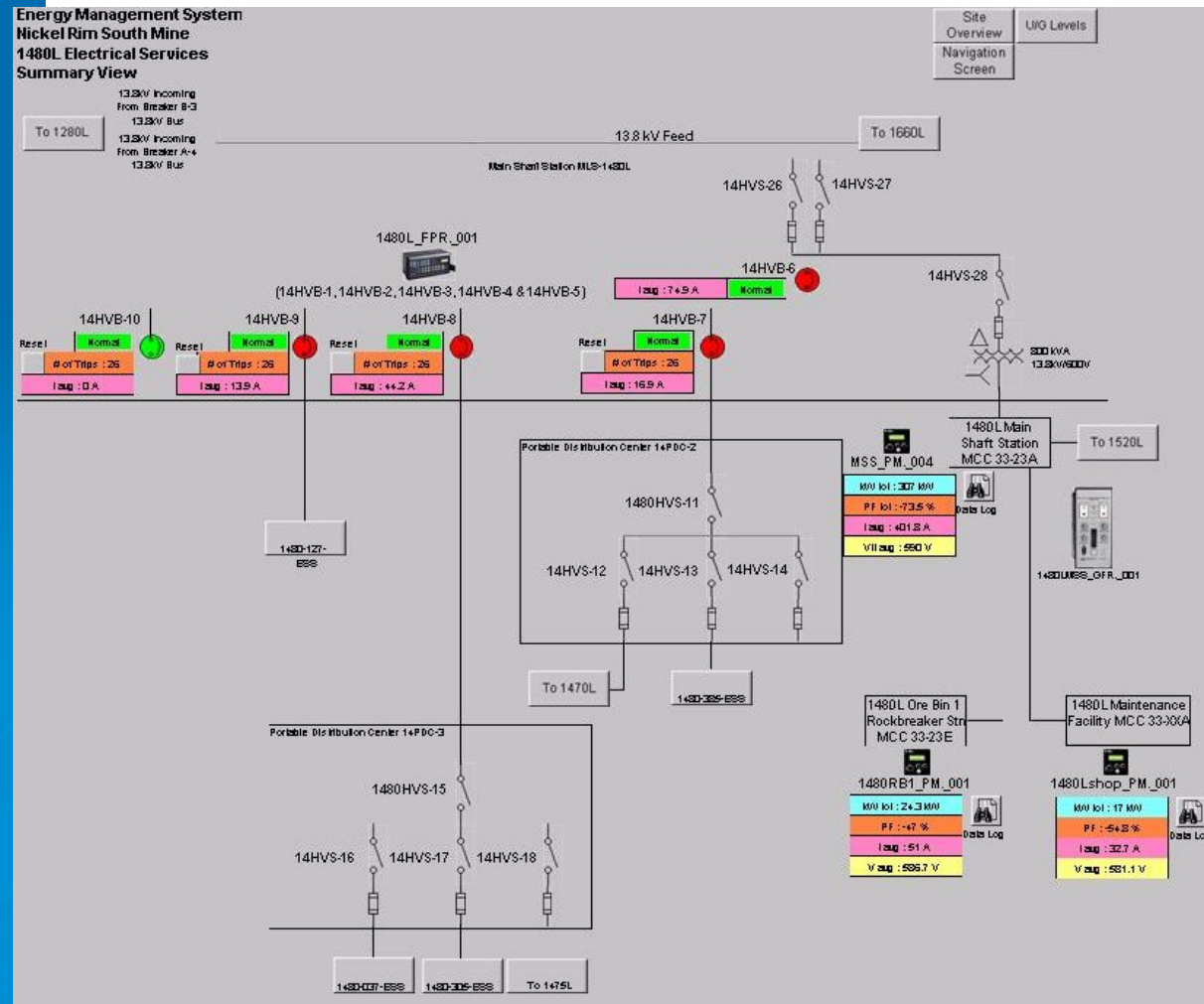
Underground Navigation Screen



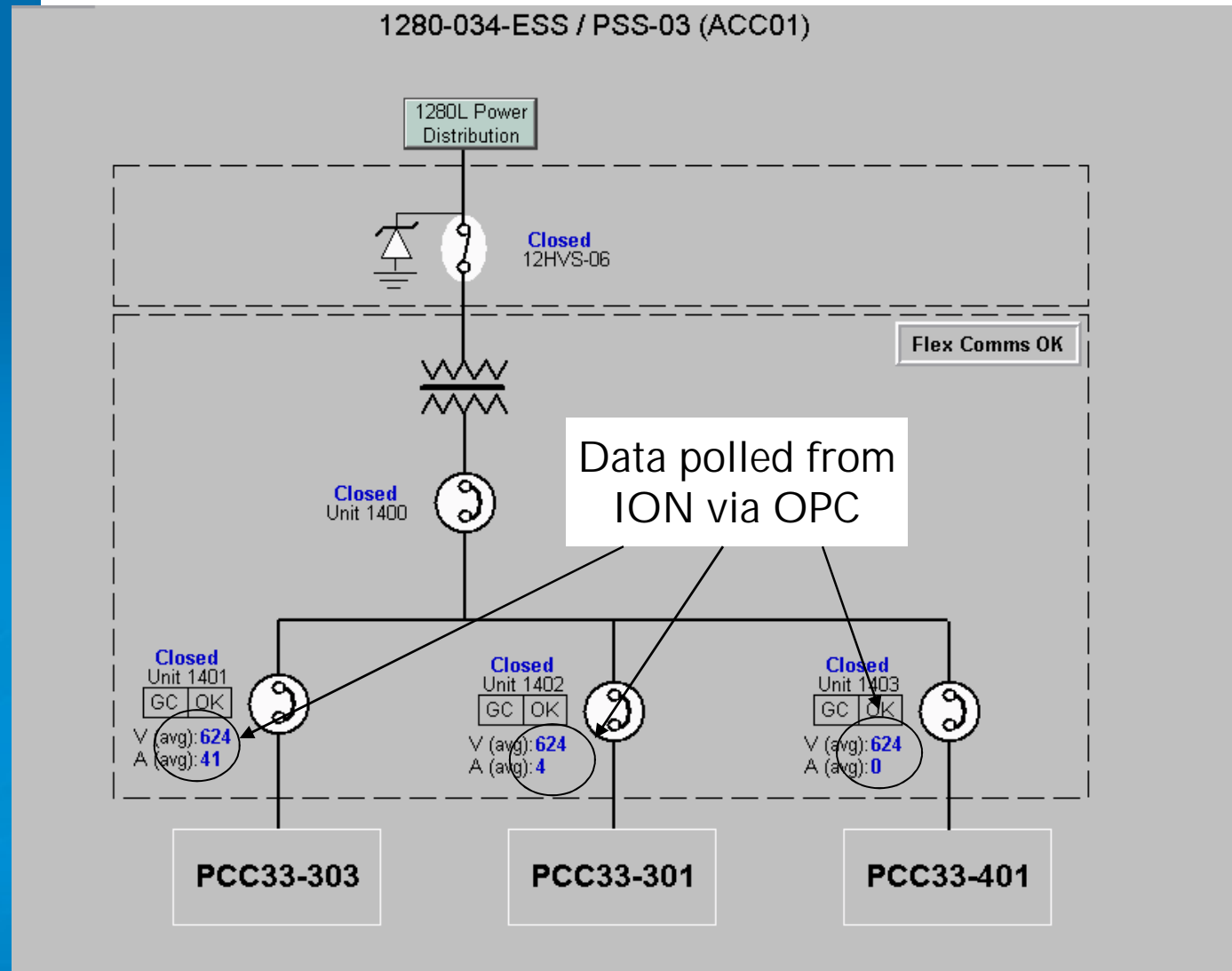
1280L Single Line Overview



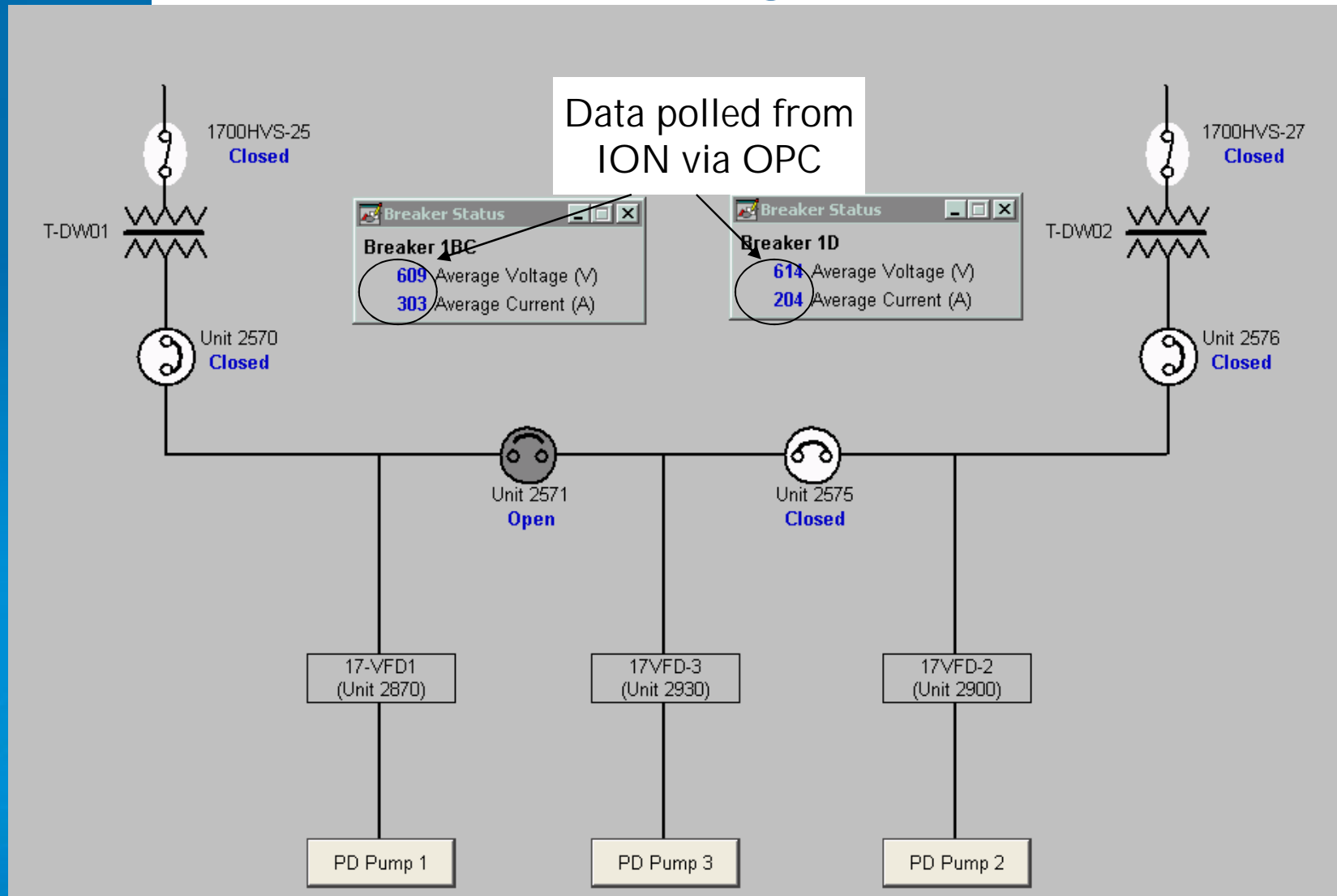
1480L Single Line Overview



RSView HMI Single Line



RSView HMI Single Line



Conclusion

- ION Enterprise integrates well with standard Power Measurement ION meters, limited functionality with third party meters;
- Powerful tool for reporting and troubleshooting;
- Future software revisions should allow for same functionality when integrating 3rd party meters as available with ION meters.

Ni Rim South

Questions?

