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Large Scale Energy Management:

Implementing a complex metering system

By: Haneet Randhawa

ArcelorMittal
DOFASCO | HAMILTON

World’s largest steel & mining company

- The world's leading integrated steel and mining company
- More than 245,000 employees at 85 plant sites in 60 plus countries
- Approximately 35% of our steel is produced in the Americas, 47% in Europe and 18% in other countries such as Kazakhstan, South Africa and Ukraine
- Key global markets: automotive, construction, household appliances and packaging

ArcelorMittal in Canada

ArcelorMittal employs 10,000 Canadians and makes 40,000 indirect jobs possible

- More than 10,000 employees in Canada:
  - >4,400 in Quebec
  - >5,600 in Ontario
  - Support over 40,000 indirect jobs
- Operations in Flat Rolled, Tubular and Long product steels
- Extensive Iron Ore Mines in Quebec
- Addition of Mary River iron ore mine located on Baffin Island

ArcelorMittal Dofasco

- Established in 1912 – Dominion Steel Castings
- Acquired in January 2006 by Arcelor
- Integration of Dofasco into ArcelorMittal Flat Carbon Americas began February 2007
- Canada's largest producer of flat rolled steels
- Leading supplier to automotive
- Manufacturing focused in the Great Lakes Region (Hamilton, Windsor, Montreal)

Our Hamilton Facilities

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Coke Making
3 Batteries

Iron Making
3 operational blast furnaces

Steel Making
1 Electric Arc Furnace
1 Basic Oxygen Furnace
2 Casters

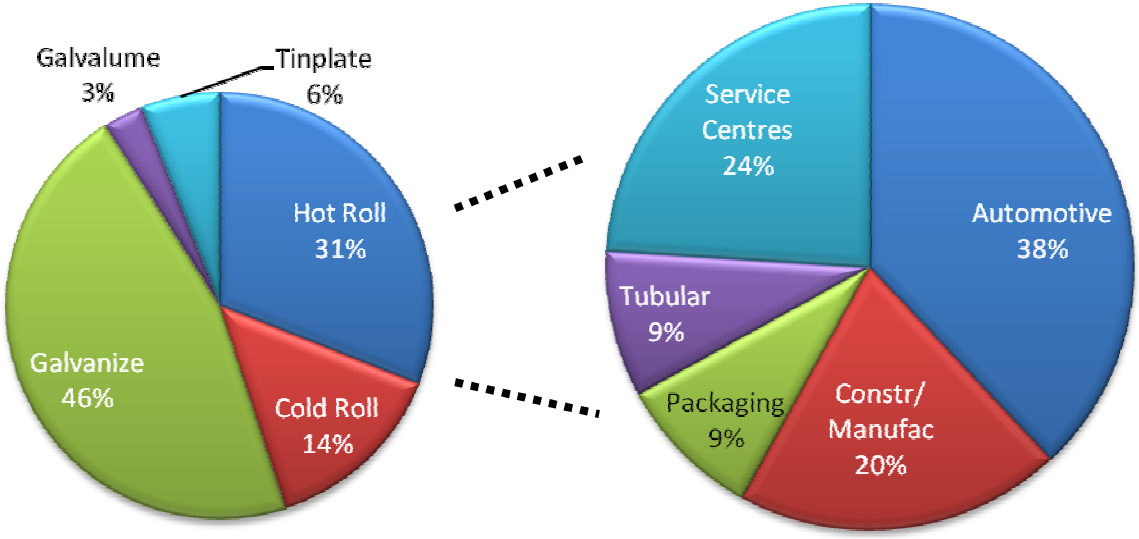
Rolling
1 Hot Strip Mill

Cold Rolling
2 Pickle lines
1 Tinning Line
4 Galvanizing Lines
1 Galvalume

Property
750 acres
In a major urban centre

Products

- High Strength Steel
- Advanced High Strength Steel
- Ultra High Strength Steel



Transforming Tomorrow

- 5,000 non-union employees
- Highly engaged workforce
- Our success has been attributed to strategic investments in operations and relationships with employees, suppliers and the community
- People are our competitive advantage

"Our Product is Steel.
Our Strength is People"

ArcelorMittal Dofasco

Company

- In Hamilton, the site encompasses 750 acres of property…that's almost 570 football fields!
- ArcelorMittal Dofasco is one of the largest consumers of electricity in the Province of Ontario
- The Hamilton site is a fully integrated steel manufacturing facility
  - Electrical Arc Furnace
  - Hot Rolling Mill
  - Cold Rolling Mills
  - Steel Processing Lines

Hot Rolled Steel Coil

Electric Arc Furnace

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Hot Mill Stands

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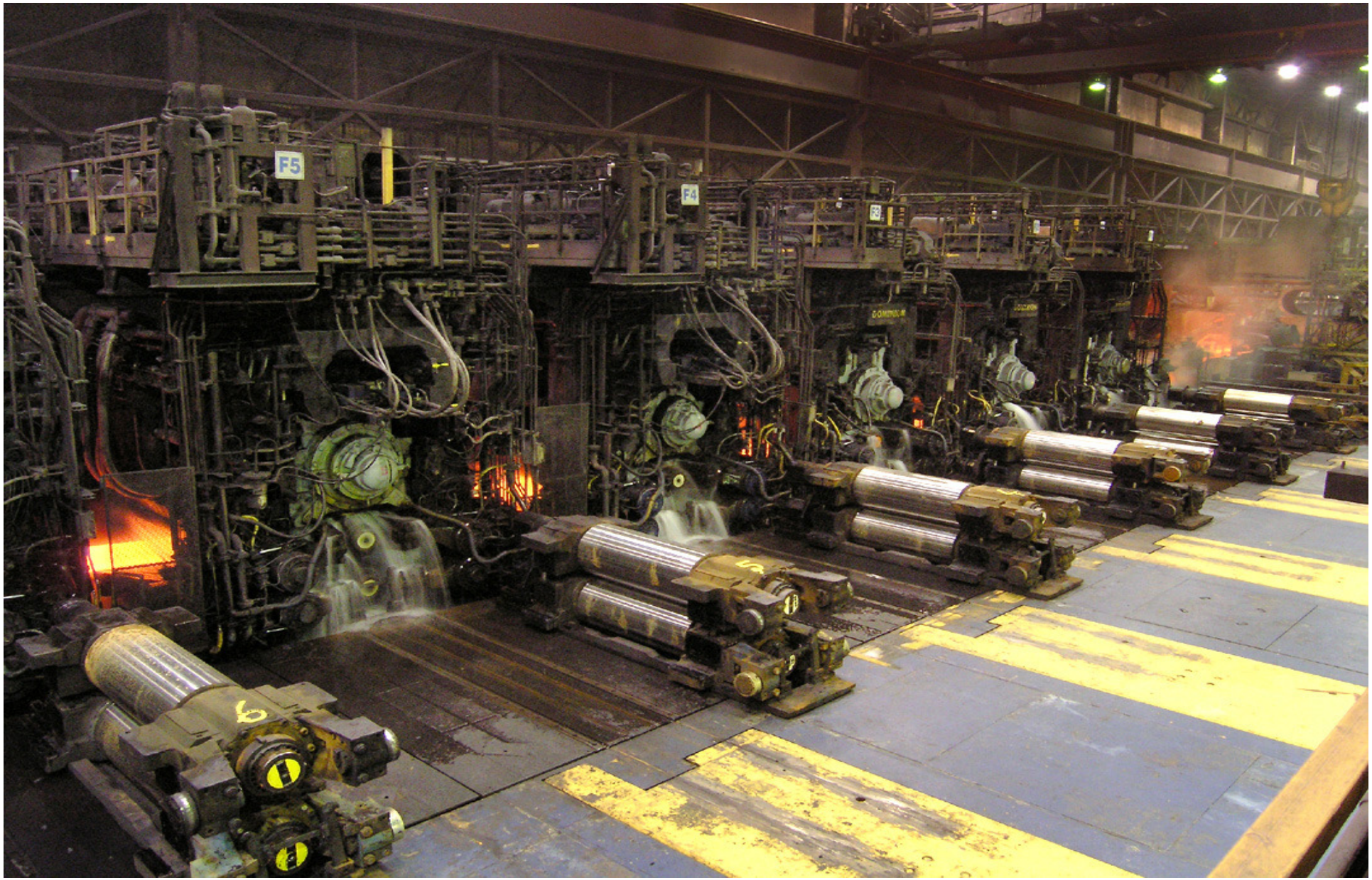

Steel Processing Line

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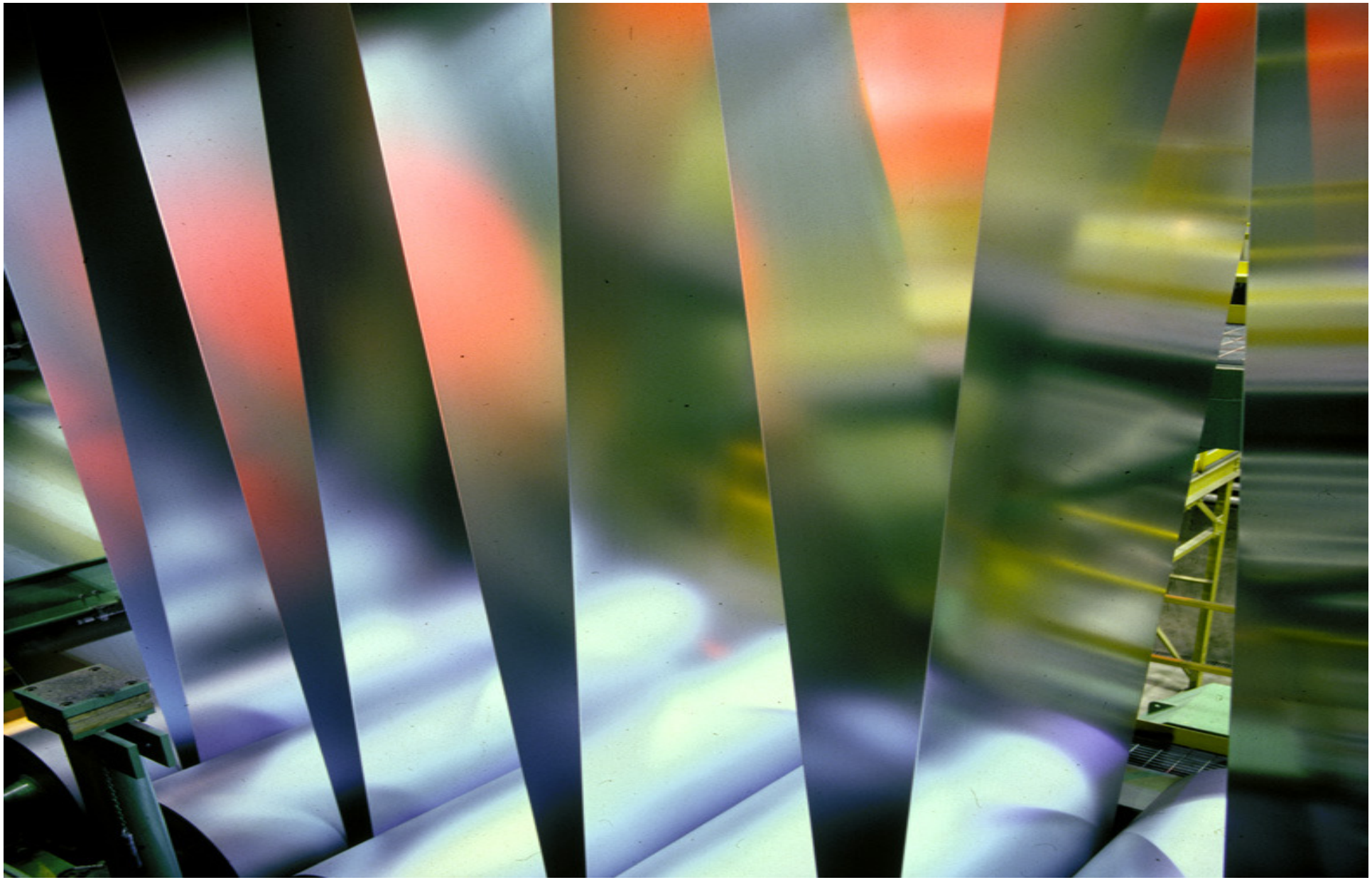
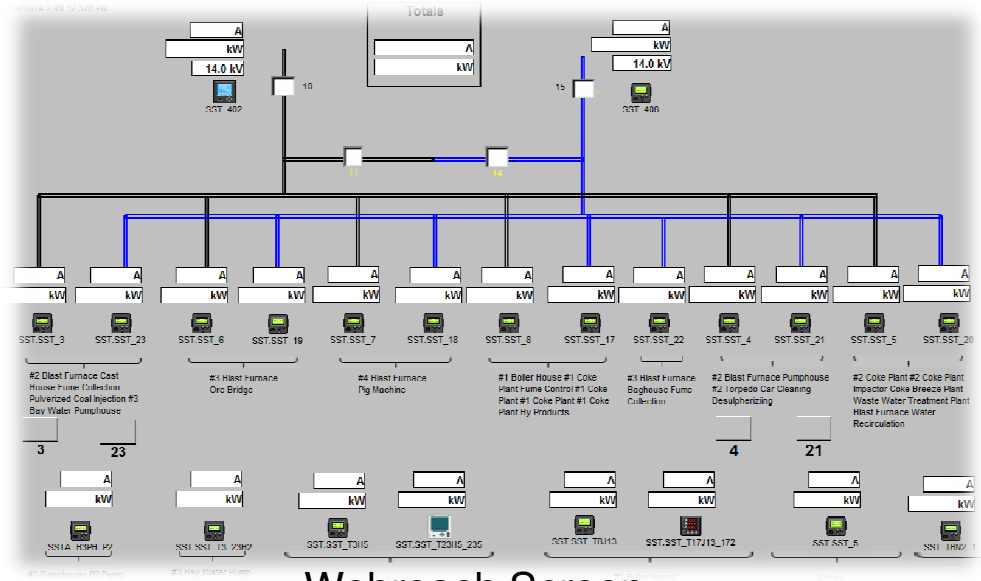


Introduction

My Role

- Coordinate with our High Voltage Electrical group for metering installations and provide our electricians with installation schematics
- Coordinate with our Business Units for shutdown installation opportunities
- Lead our Process Automation team to provide ION meters onto our corporate ION Enterprise application - Webreach utility
- Provide technical expertise with other energy reduction projects utilizing ION meters



Webreach Screen

Project Objectives

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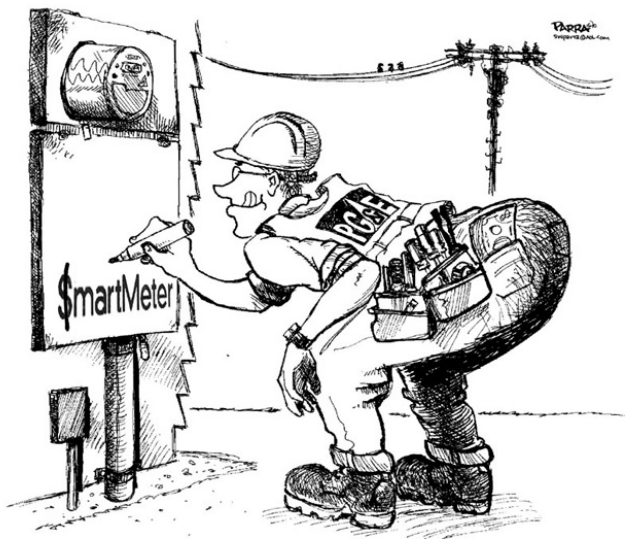
Drivers

- Eliminate manual meter reading – cost reduction
- Provide power quality data within our power distribution network
- Provide digital fault recording statistics for root cause analysis after events
- Enable demand reduction initiatives to load shed
- Improved cost accounting per business unit – accuracy and real time
- Provide energy usage measurements to our improvement teams
  - Catalyst to allow energy reduction studies and data mining
- Allows for easier Measurement and Verification reporting for OPA energy savings projects

Project Scope

- Following a top down approach from the 15kV high voltage distribution level to the 600V substation level
- Install 200 digital meters, replacing rotating disc kilowatt hour meters or new meter placement
  - 15kV level: 165 ION meters installed
  - 600V level: 35 ION meters installed
- Meters were retrofit into existing switchgear cabinets and connected to the plant IT network
- Meters were then integrated to our PowerLogic ION Enterprise
  - Develop Webreach screens as per our SLD
  - Query installed meters using Web Reporter
  - Monthly business unit reports



Implementation Plan

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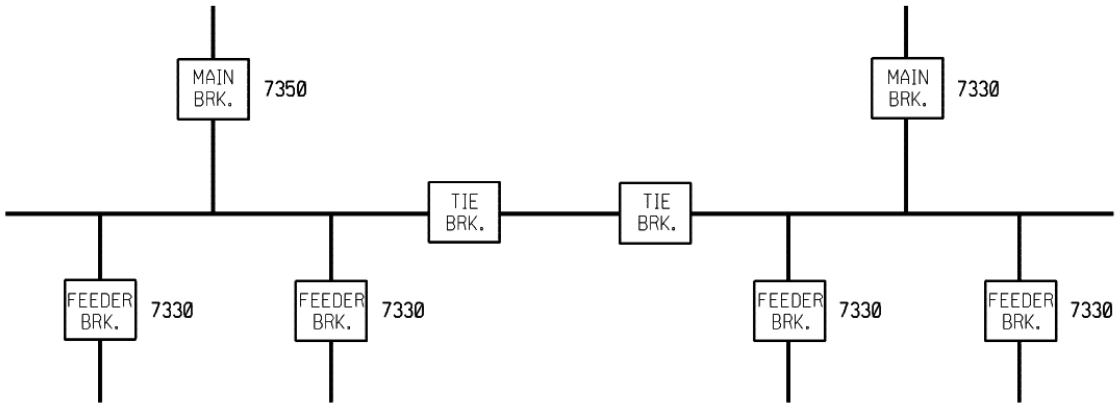
- Meters were pre-wired, pre-programmed, tested in cages and directly replaced by our maintenance personnel during shutdown opportunities
  - Reduce risk
  - Reduce installation time
  - Allowed higher reliability start up
- Several internal maintenance groups were involved in the coordination of equipment shutdown for the installation of ION meters – HV and LV groups
- Involved corporate IT to provide network drops and IP address
  - Groups of meters were daisy chained to network drops
- Post installation, the protection was verified and metering data validated
- ESA inspected and approved installation

Installation

15KV STATIONS SUPPLIED FROM DOFASCO 230KV SUBSTATIONS

TYPICAL



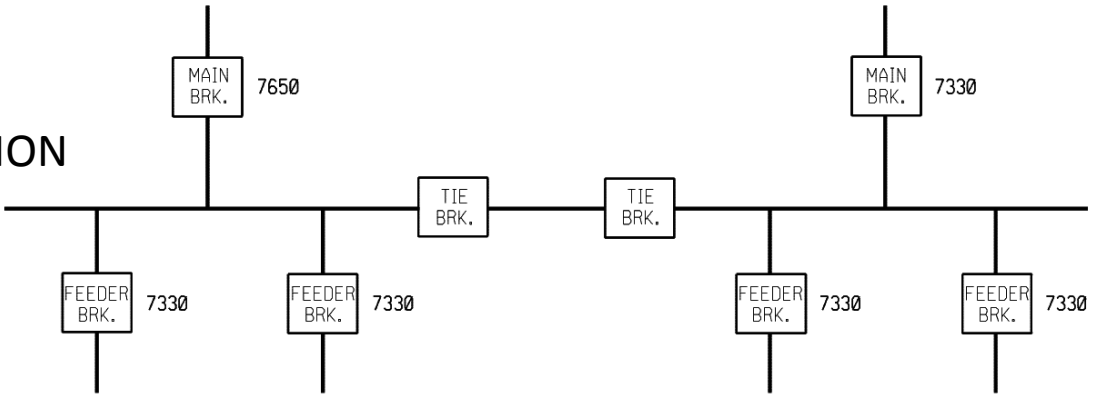
Installed at least one of ION 7350 or ION 7650 high end meters at the main breakers

ION 7330 installed on HV feeder breakers

Low Voltage: Installed ION 7330E and ION 6200 meters

15KV STATIONS SUPPLED FROM HORIZON UTILITIES - HYDRO ONE

TYPICAL



Analog to Digital

Analog Power Consumption Meter to Digital ION 7330 Meter

Analog to Digital

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Analog Power Consumption Meter to Digital ION 7330 Meter

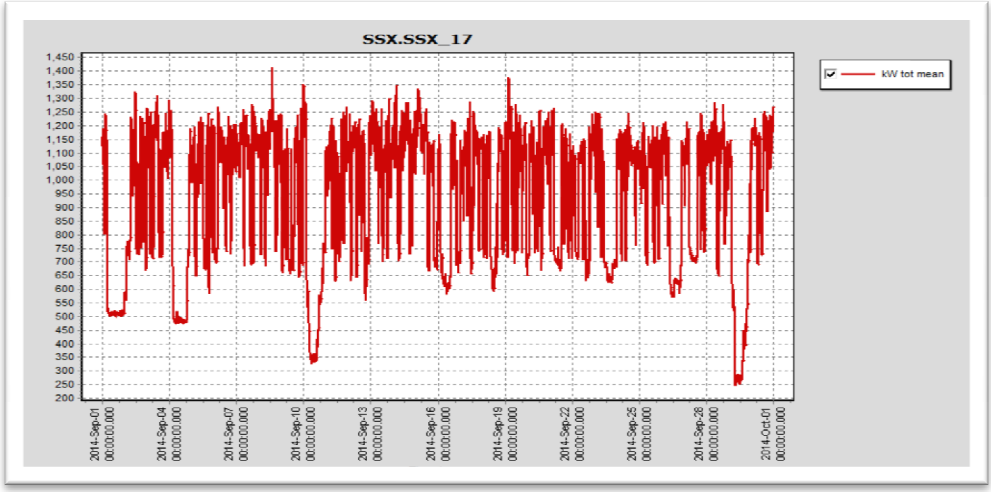
ION Solution

- Provide data measurements of harmonics and flicker caused by heavy equipment
- Our power quality monitoring has been improved at our facility that allows remedial equipment to be installed, such as filter systems
  - Promotes action plans to address issues
- ION Data is able to be utilized to address:
  - Data logging
  - Monitoring Power Usage
  - Events Recording
  - Network capability
  - Current and Voltage Harmonics
  - Active, Reactive, Apparent power

ION 7650 Meter

Benefits

- Remote monitoring from your personal computer
  - Improve safety and reduces risk when taking manual measurements
- Allows load studies by manufacturing improvement teams
  - Energy savings through process optimization
- Meters provide power quality and waveform capture for events
- Improving metrics for demand reduction
  - Getting to zero energy
- Harmonic case studies on new drive installations and effect on bus quality
- Reconcile IESO utility bills with ION Revenue meters
- Historical power consumption, PQ profiles, trending, min/max are now all available with a click of a button!



Sample of kW reading over a month

Going Beyond Metering

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- Our High Voltage took advantage of the metering system by utilizing the ION enterprise modules and features
- The team receives wireless email notifications 24/7 on any critical alarms on the power system
- Critical alarms such as
  - Temperature excursion
  - Trip battery alarms
  - Protection/Breaker trip on main and feeder breakers
  - Sags/swells

- Other business units use the metering data to monitor OPA and energy project performance

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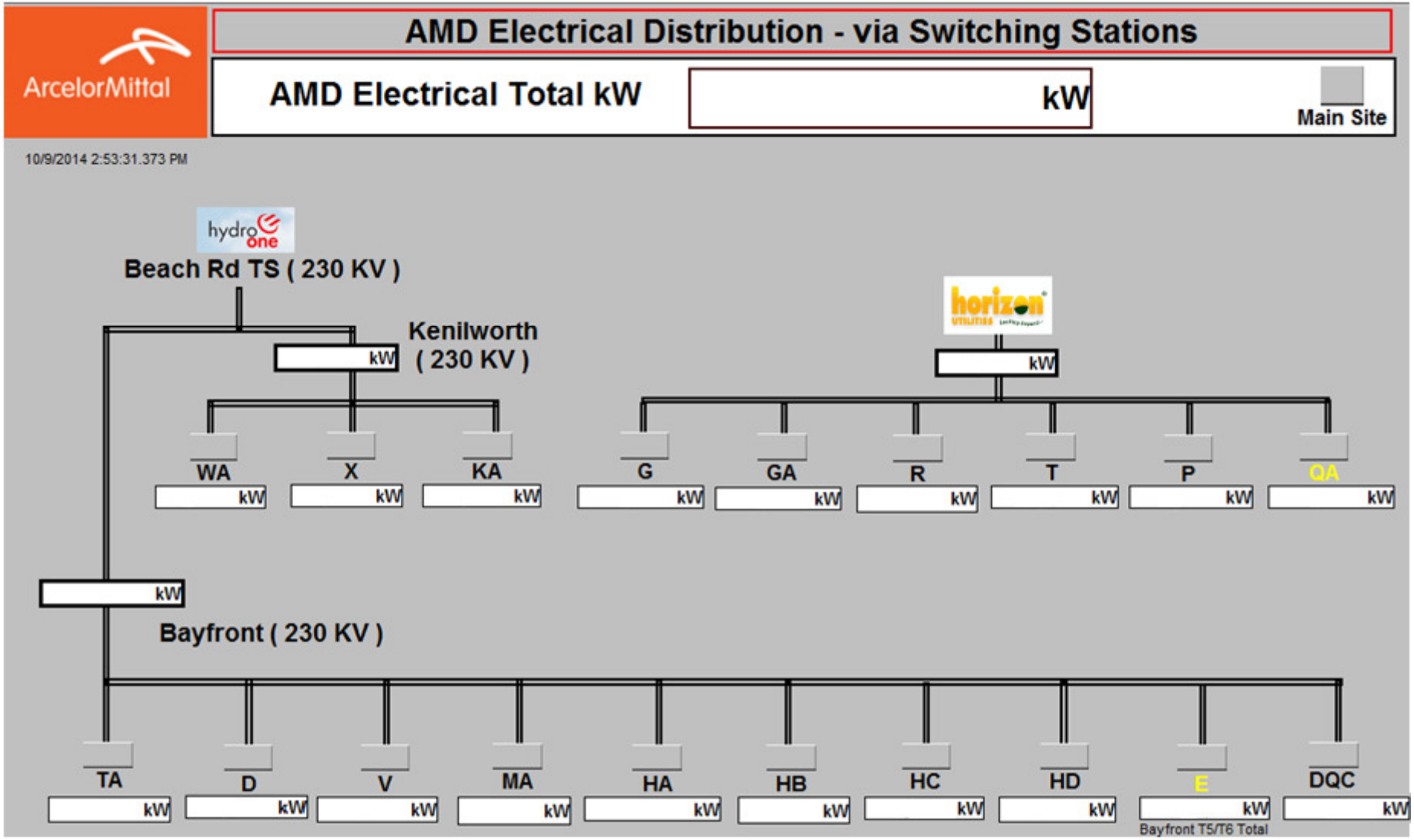
Electrical Distribution Overview



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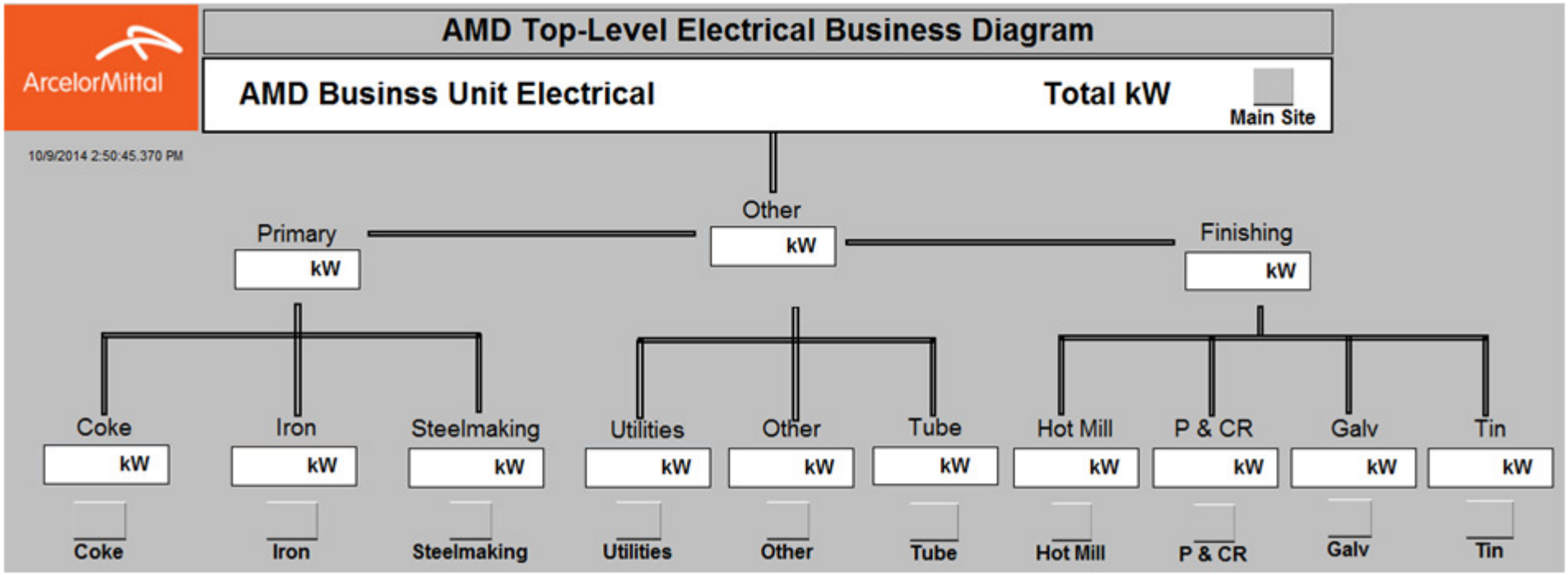
Electrical Business Unit Overview



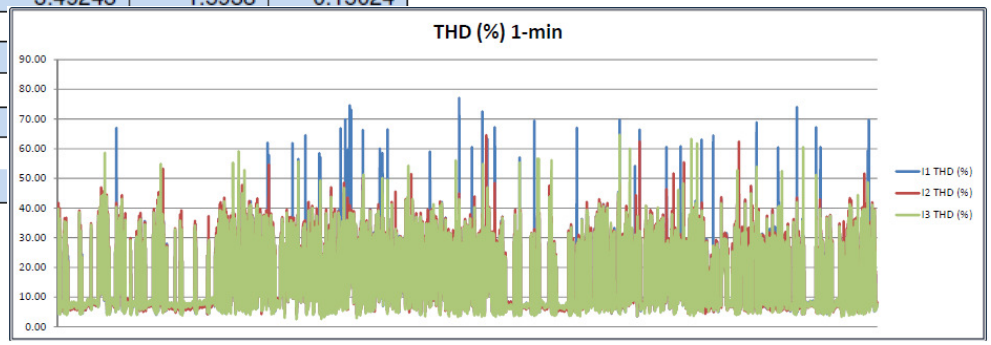
High level electrical consumption plant wide across various process departments

Load Study Examples

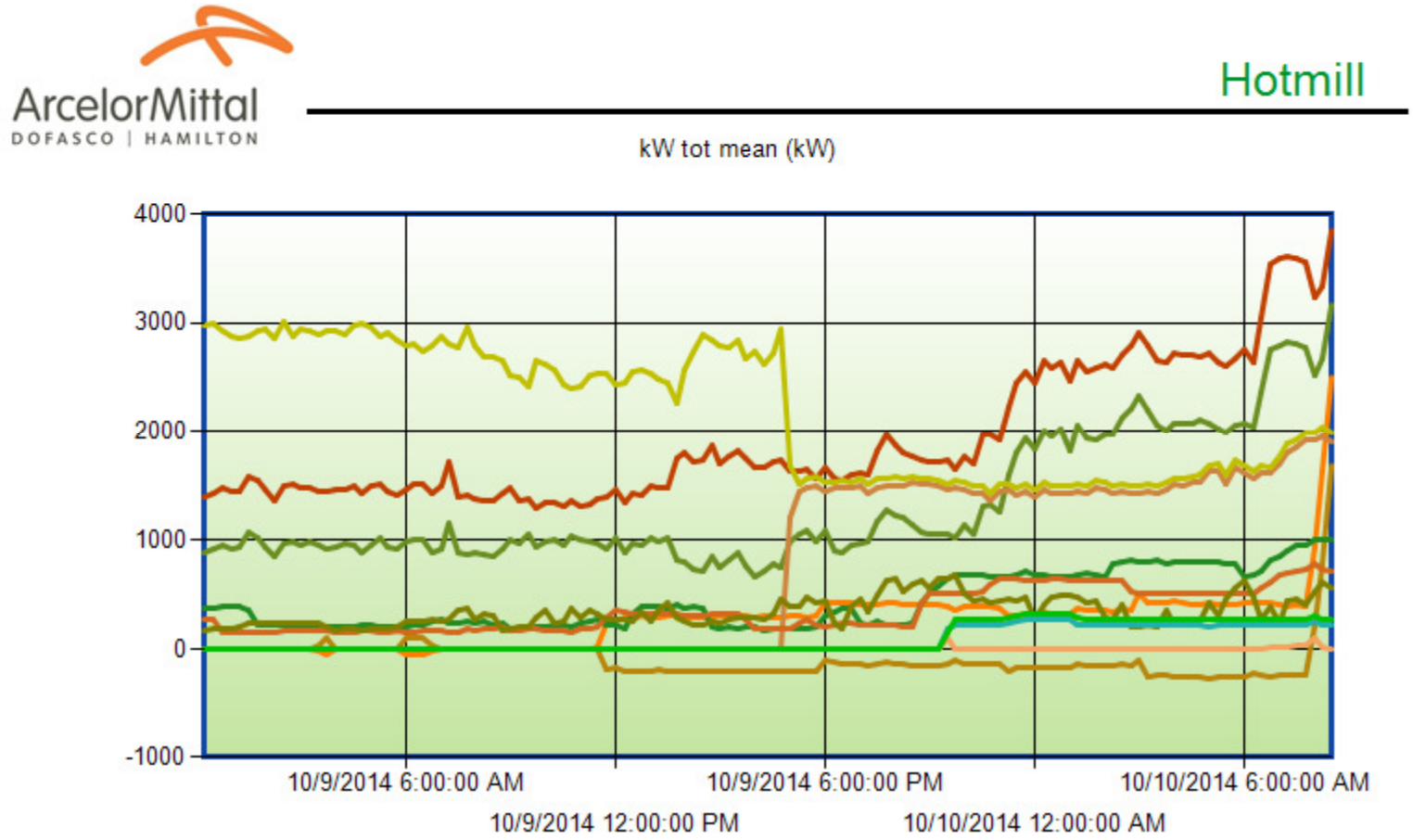
- Virtual meters are created for specialized load studies, such as 1 minute samples for high harmonic load profiles
  - E.g. #1 CPCM: Monitored the effect of transformer performance due to various VFD operation modes
  - E.g. Ore Bridges: Failure analysis on transformers due to high harmonic and repetitive energization of transformer
  - E.g. Generation Load Flow: Determine historic load consumption capacity (min/max) on each bus

Average Harmonics Breakdown								
		3rd Harmonic	5th Harmonic	7th Harmonic	9th Harmonic	11th Harmonic	13th Harmonic	15th Harmonic
1 minute	I1	0.90833	13.08808	3.76667	0.18899	3.57323	1.57716	0.16248
	I2	0.79943	13.05844	3.87273	0.18742	3.52628	1.62066	0.14684
	I3	0.76248	13.02481	3.76148	0.20873	3.49243	1.5938	0.15024
3 minute	I1	0.90828	13.08969	3.76652	0.18899			
	I2	0.79944	13.06004	3.87256	0.18743			
	I3	0.76248	13.02644	3.76132	0.20873			
15 minute	I1	0.90847	13.09757	3.76284	0.18906			
	I2	0.79961	13.06698	3.87425	0.18749			
	I3	0.76292	13.0334	3.76284	0.18906			

Harmonic Studies



Trend Reports



Sample report from users via Web Reporter

Lessons Learned

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- Legacy issues when validating metering data post installation
  - E.g. CTs have incorrect wiring, leading to polarity and phasing issues
- Limited shutdown windows
- Meter quantities determined by available budget
  - Prioritized meter installations
- Business unit energy consumption reallocated
- Validating ION Enterprise software with our corporate I.T.
- Application Challenges
  - Latency on daisy chain network (T style)
  - Database storage
  - In-house resources to maintain and update ION enterprise – added workload

Third Party Support

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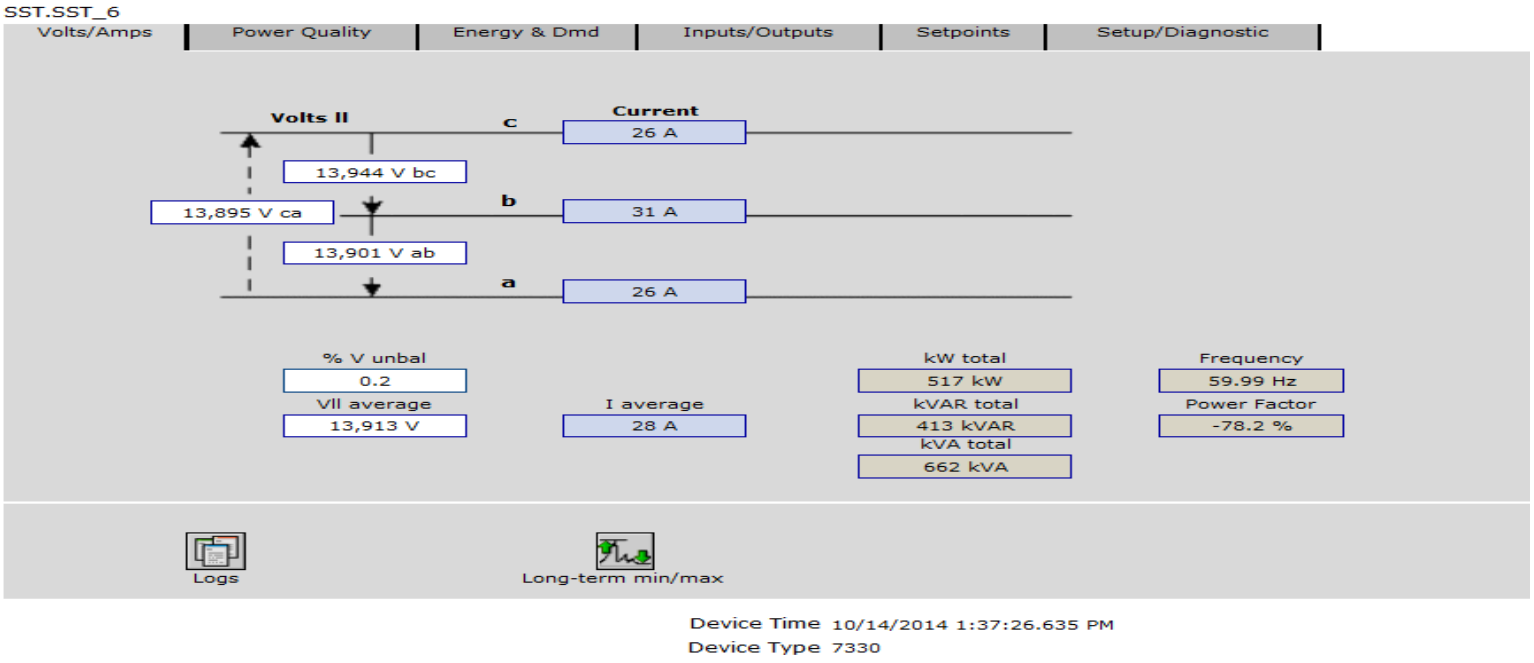
Langford Associates and Schneider Electric

- Provided product knowledge for technical support and troubleshooting
- Provided expertise in ION enterprise modules for special case load studies
- ION Enterprise software commissioning
- Annual contract on telephone support with ION priority service



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Questions?