Development of a Cost-Effective Energy Management Information System

Presented by Alvaro Rozo on behalf of Katherine van Nes – Hatch Ltd.
ArcelorMittal Hamilton East (AMHE)
Energy Management Information System

Presentation Topics

• Project Background
• Approach
• Components of an EMIS
• Components of the AMHE EMIS

Project Cost Effectiveness Highlights
Focus on Energy

- Approximated Operational Costs (Mining)
ArcelorMittal Hamilton East

- Part of ArcelorMittal Long Carbon North America
- Produces variety of steel wire products
- Renowned for cold heading products and oil-tempered wire
Project Drivers

- Small facility
- Several million on natural gas and electricity costs
- Natural Gas (including steam) accounting for 85% of energy consumption (GJ)
- Electricity disproportionately accounting for 50% of overall cost

*Expected savings 5 – 8 %*
# Energy Management Audit

- Benchmarked AMHE energy management practices via ISO50001 gap analysis
- Identified and ranked preliminary energy savings opportunities
- Preliminary energy models created
- Energy drivers determined
- Preliminary implementation plan and architecture (cost assessment)
- Feasibility of EMIS examined
- Paid for via OPA Industrial Accelerator program

<table>
<thead>
<tr>
<th>SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 1 - Executive Management Responsibility</td>
</tr>
<tr>
<td>Section 2 - EnMS Leader Responsibility</td>
</tr>
<tr>
<td>Section 3 - Energy Policy</td>
</tr>
<tr>
<td>Section 4 - Energy Management Plan</td>
</tr>
<tr>
<td>Section 5 - Baselines, Performance Indicators, Objectives, Targets and Action Plans</td>
</tr>
<tr>
<td>Section 6 - Communication, Training and Comprehension</td>
</tr>
<tr>
<td>Section 7 - Documentation and Operational Control</td>
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<tr>
<td>Section 8 - Design and Procurement</td>
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<tr>
<td>Section 9 - Monitoring, Measurement, Analysis and Evaluation</td>
</tr>
<tr>
<td>Section 10 - Internal Auditing and Corrective Actions</td>
</tr>
<tr>
<td>Section 11 - Management Review of the Energy Management System</td>
</tr>
<tr>
<td>TOTAL AGGREGATE SCORE</td>
</tr>
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EMIS Audit Options

<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Manual Data Entry Only</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of Meter Readings</td>
<td>Shift / Day at best</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Networking Connections to Meters</td>
<td>✗</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Historian Application Required on Site (Required Site Hardware, Software Licensing, Support)</td>
<td>✗</td>
<td></td>
<td>(Use existing SQL Express)</td>
<td></td>
<td>(Corporate Data Historian, Local data)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy data analysis services</td>
<td>✗ (by AMHE)</td>
<td>✗ (by AMHE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approx. EMIS Implementation Cost incl. Software licensing, excl. meter purchase and installation</td>
<td>Minimal (by AMHE)</td>
<td>Not Available</td>
<td>$ 210,000 excl data historian, energy consulting, project management and expenses</td>
<td>$ 6,000 excl energy consulting, project management and expenses</td>
</tr>
<tr>
<td>Approx. Annual Cost</td>
<td>Minimal (by AMHE)</td>
<td>Not Available</td>
<td>$ 12,000</td>
<td></td>
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</tbody>
</table>

$ Savings Note
Project Approach

WP 01 - Foundational Activities
• Foundational activities to set basis for implementation of EMIS

Stage Gate Review
• Budget
• Schedule
• Implementation Resource Reqs (ITI) and RASCI update

WP 02 - Energy Metering
• Energy metering specification, procurement and installation
• Site data collector
• Networking to site data collector
• Configuration and testing of tags in Centralized Historian

WP 03 - EMIS Implementation and Testing
• Configuration
• Internal Testing
• User Acceptance Testing

WP 04 - EMIS Commissioning and Handover
• System Commissioning
• User Training
• System Handover

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Components of an EMIS

- Energy Account Centers
- Meters and Inputs
- Data Capture and Integration
- Data Analysis and Reporting
- Management Systems, People and Procedures

Source: Natural Resources Canada’s “Energy Management Information Systems Planning Manual and Tool"
Energy Account Centers
Metering and Inputs
Energy Account Centers

Energy Account Centre (EAC): “The organization level at which energy performance should be managed”

EAC Definition Principles:
- Combined (i.e. all energy sources)
- Process Areas as starting point
- General mapping to finance cost centers
- Target largest AMHE energy drivers
- Maximum information / minimum cost

$ Savings Note
Typical Mining EACs

<table>
<thead>
<tr>
<th>Primary Energy Account Centre</th>
<th>Secondary Energy Account Centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Mining</td>
<td>Drilling</td>
</tr>
<tr>
<td></td>
<td>Blasting</td>
</tr>
<tr>
<td></td>
<td>Excavation</td>
</tr>
<tr>
<td></td>
<td>Transport</td>
</tr>
<tr>
<td></td>
<td>Handling of waste rock</td>
</tr>
<tr>
<td></td>
<td>Dewatering</td>
</tr>
<tr>
<td>2 - Crushing &amp; Conveying</td>
<td>Primary Crushing</td>
</tr>
<tr>
<td></td>
<td>Pebble Crushing</td>
</tr>
<tr>
<td></td>
<td>Conveying</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary Energy Account Centre</th>
<th>Secondary Energy Account Centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 – Mill Processing</td>
<td>Grinding</td>
</tr>
<tr>
<td></td>
<td>Gravity Recovery</td>
</tr>
<tr>
<td></td>
<td>Screening &amp; Thickening</td>
</tr>
<tr>
<td></td>
<td>Leach/Carbon-in-Leach</td>
</tr>
<tr>
<td></td>
<td>Carbon Stripping</td>
</tr>
<tr>
<td></td>
<td>Cyanide Destruction</td>
</tr>
<tr>
<td></td>
<td>Tailings Reclaim</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary Energy Account Centre</th>
<th>Secondary Energy Account Centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 – Surface Facilities</td>
<td>Camp Water &amp; HVAC</td>
</tr>
<tr>
<td></td>
<td>Water Treatment Plant</td>
</tr>
<tr>
<td></td>
<td>Oxygen Plant</td>
</tr>
</tbody>
</table>
A Note on Metering

- Meters are expensive
- Strategic planning in identified derived and needed meters

<table>
<thead>
<tr>
<th>Meter Identifier</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Substation 'C'</td>
<td>61-frame East</td>
</tr>
<tr>
<td></td>
<td></td>
<td>61-frame West</td>
</tr>
<tr>
<td></td>
<td></td>
<td>62-frame</td>
</tr>
<tr>
<td>2</td>
<td>Substation 'C'</td>
<td>63,64,65,66 - Frames</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oil Temper</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stabilizer Drive / Strander</td>
</tr>
<tr>
<td>3</td>
<td>Substation 'D'</td>
<td>23,24,25,26,27,28,55 - Frames</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stabilizer Heating</td>
</tr>
<tr>
<td>4</td>
<td>Substation 'A'</td>
<td>Wire Mill South (30,31,34 - frame)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wire Mill South (30,31,34 - frame)</td>
</tr>
<tr>
<td>5</td>
<td>Old Boiler Room</td>
<td>Surface Furnace &amp; Rx Gen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kaeser Compressor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Natural Gas Meter</td>
</tr>
<tr>
<td>6</td>
<td>Substation 'B'</td>
<td>13-Frame</td>
</tr>
<tr>
<td></td>
<td></td>
<td>#1 Cleaning line</td>
</tr>
<tr>
<td>7</td>
<td>Substation 'B'</td>
<td>14-Frame</td>
</tr>
<tr>
<td>8</td>
<td>#2 Cleaning Line</td>
<td>#2 Cleaning Line &amp; #3 Crane</td>
</tr>
</tbody>
</table>

$ Savings Note
Data Capture and Integration
AMHE Site Characteristics

- 10 separate process areas
- Over 50 active energy consumers
- Electricity, natural gas, steam
- Minimal plant floor data collection
- Equipment independently controlled
- PI System infrastructure in AMM/Contrecouer (No PI components in AMHE)
- Existing Ekho installation in Contrecouer
Resultant Architecture

Energy Data Management

- Totalization
- Conversions
- Calculation of Derived / Virtual Metering Points
- Aggregations by Unit, Work Cell and EAC Entities
- Normalisation of Energy Data
- Correlations against baselines, targets and thresholds
- Events and Alarms

Historian

Data Collector

- Electrical Consumption Data from Meters
- Natural Gas Consumption Data from Meters
- Steam Gas Consumption from Meters

9 Meters, 24 Pts
11 Meters
4 Meters

Union Gas
Environment Canada
IESO
SAP
Interfaces

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PI Infrastructure

- No additional onsite physical infrastructure
- Connection to sub-metering (no PLCs)
- Bring back all available variables
- Detailed variable analysis
- Calculations
  - Derived meters (today and future)
  - Totalizations in required contexts (kW to kWh, flow to scf/lbs)
  - Conversion (steam to natural gas)
PI Infrastructure – Future Opportunities

- Leverage Asset Framework and Asset Framework Templates
- Leverage Enhanced Calculation Engine and Templates
Data Analysis and Reporting
AMHE Key Functionality

1. Reduced base load
2. Reduced variability (against energy drivers)
3. Increased efficiency (via operational opportunities)
Specific Functionality Geared to AMHE

**Phase 1**
- Energy Consumption Analysis
- Cost of Consumption Analysis
- Consumption Per Tonne Processed
- Energy Intensity Analysis
- ECM Analysis
- Consumption CUSUM Analysis
- Alarming

**Phase 2**
- Electricity Power Factor Analysis
- GHG Emissions
- Billing Discrepancy Analysis
- Consumption Real Time Control Charts
- Electricity Demand Analysis

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Ekho Functionality

• Operational Management and Intelligence Software

PERFORMANCE MANAGEMENT, KPI’S, OEE

PRODUCTION

DOWNTIME

QUALITY

HEALTH & SAFETY

MAINTENANCE

ENERGY MANAGEMENT

FOUNDATION MODULES
Management Dashboard

Electricity Hourly Cost

- HOEP Price
- Predispatch Price
- Actual Cost of Consumption
- Estimated Cost of Consumption

1,000,000.00

Electricity Cost
- Electricity Consumption
- Natural Gas Consumption
Energy Consumption
# Energy Conservation Measure

The Energy Management Portal allows users to track and analyze energy consumption across various assets and periods. The platform provides detailed data on energy usage, including electricity and natural gas consumption, before and after implementation of energy conservation measures. The portal includes a Timeline feature that visually represents changes in energy consumption over time, helping users identify trends and make informed decisions for future optimization.

The table below summarizes energy conservation measures implemented over a specified period (06/01/2013 to 03/11/2014).

<table>
<thead>
<tr>
<th>Asset</th>
<th>Start Time</th>
<th>End Time</th>
<th>Description of Change Made</th>
<th>EventID</th>
<th>Before (1 Week(s))</th>
<th>During</th>
<th>After (1 Week(s))</th>
<th>Natural Gas (GJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straighten &amp; Cut</td>
<td>Oct 6 2013 9:00PM</td>
<td>Jan 1 1900 12:00AM</td>
<td>Test 3.0 kg</td>
<td>277564</td>
<td>-49.68</td>
<td>-97.06</td>
<td>-157.92</td>
<td>-157.92</td>
</tr>
<tr>
<td>#3 Oil Temper</td>
<td>Sep 28 2013 9:00PM</td>
<td>Jan 1 1900 12:00AM</td>
<td>OCM Demo</td>
<td>277568</td>
<td>277558</td>
<td>358.14</td>
<td>-157.98</td>
<td>791.26</td>
</tr>
<tr>
<td>#2 Cleaning Line</td>
<td>Sep 13 2013 9:00PM</td>
<td>Jan 1 1900 12:00AM</td>
<td>Event Frame Creation</td>
<td>277559</td>
<td>277558</td>
<td>358.14</td>
<td>-157.98</td>
<td>791.26</td>
</tr>
<tr>
<td>#1 Cleaning Line</td>
<td>Jul 30 2013 9:00PM</td>
<td>Sep 27 2013 9:00PM</td>
<td>Test</td>
<td>277553</td>
<td>277552</td>
<td>358.14</td>
<td>-157.98</td>
<td>791.26</td>
</tr>
</tbody>
</table>

### Timeline

- #1 Cleaning Line - From Dec 31 2012 9:00PM To Sep 20 2013 8:59PM
- #1 Pusher Furnace - From Dec 31 2012 9:00PM To Rev. 1 2013 8:59PM
- Plant Air - From: Jan 30 2013 9:00PM To Nov 20 2013 8:59PM
- #2 Cleaning Line - From Sep 6 2013 9:00PM To Sep 20 2013 9:00PM
- #2 Cleaning Line - From: Sep 6 2013 9:00PM To Sep 20 2013 9:00PM

The portal also includes graphs that provide a visual representation of energy consumption trends, enabling users to identify patterns and make data-driven decisions for energy efficiency improvements.
Energy Intensity and Baseline Calculation
CUSUM Analysis
Wrap Up
Cost Effective EMIS Development

• Audit
• Options analysis
• Stage gate review following planning
• EAC definition
• Meter placements
• Meter selection
• Architecture
• Functional Requirements definition geared to need

Funding
Ontario Power Authority Industrial Accelerator Program
- Audit financed
- Horizon Utilities 80% up to $75,000
- Union Gas 50% up to $100,000
Katherine van Nes, P.Eng, PMP

- kvannes@hatch.ca
- Information Management Consultant / Project Manager
- Hatch Engineering
THANK YOU