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TRANSFORM YOUR WORLD

PIMS Technology Refresh

Rethinking PIMS and Operational Intelligence Delivery in Vale Base Metals

UC16NA_02MM0

Presented by **Norman Doucet**

VALE

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Agenda

1. Vale Company Profile
2. Business Challenge
3. Problems Encountered
4. Process Improvement Initiatives
    a. SAP Integration – (SAPIO)
    b. Smelter – Converter Skimming
    c. Mine Backfill Batch Reporting
    d. Process Mimics
    e. Mine Crusher KPI report

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We are what we do

Mission

To transform natural resources into prosperity and sustainable development

Vision

To be the number one global natural resources company in creating long term value, through excellence and passion for people and the planet

Values

1. Life matters most
2. Value our people
3. Prize our planet
4. Do what is right
5. Improve together
6. Make it happen

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In 1997, Vale was largely a Brazilian exporter with 10,865 employees, and an aggressive strategy to grow its business.

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Today, Vale is active in over 35 countries around the world with over 85,000 employees. It is the leader in iron ore production and one of the top three nickel producers.

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Vale Base Metals

- Vale's Base Metals Business consists of nickel, copper, cobalt, aluminum, precious metals and PGMs. Vale (through the former Inco), has been operating in Sudbury for more than a century.
  - Headquartered in Toronto, Canada
  - North Atlantic Operating Regions:
    - Manitoba (Thompson)
    - Ontario/UK (Sudbury, Port Colborne, Clydach & Acton)
    - Newfoundland/Labrador (Voisey's Bay & Long Harbour)
  - Asia Pacific Regions
    - Indonesia
    - New Caledonia

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Business Challenge

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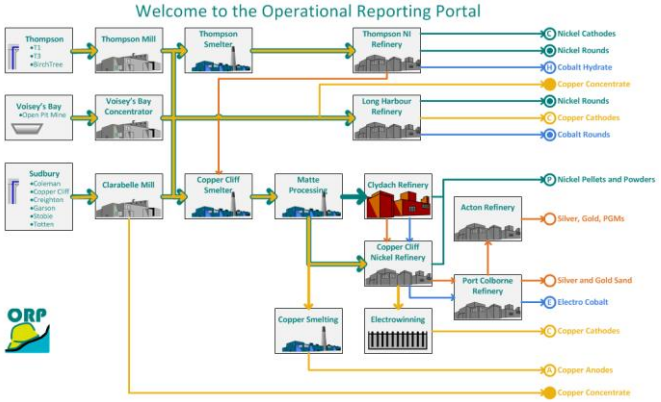
PIMS Tech Program Architecture and Software Refresh



COMPANY and GOAL

In 2012, Vale Base Metals initiated a roadmap project to identify and scope opportunities to leverage Operational Intelligence capabilities

CHALLENGE

Aging infrastructure and software platforms limited ability to meet business needs for advanced reporting and analytics

- Improve PIMS Performance, Uptime and Reliability
- Simplify PIMS Use, Integration, support
- Reduce Time to Market
- Migrate required business reports and displays

SOLUTION

Three projects launched to address aging hardware, out of date PI software and PIMS Reporting Eco-system

- Physical Architecture (PA)
- Redundant Data Collection (RDC)
- Reporting and Analysis Framework (RAF)

RESULTS

New capabilities offered by Asset Framework, Event Frames, and SharePoint have provided insight into age old report challenges

- Improved performance, Uptime and reliability
- Shorter time to market through self serve tools
- Restored user confidence

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Redundant Data Collection (RDC)

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Redundant Data Collection

COMPANY and GOAL

At the foundation of any PIMS system, is the data collector (API node). We needed to improve data collection and reliability

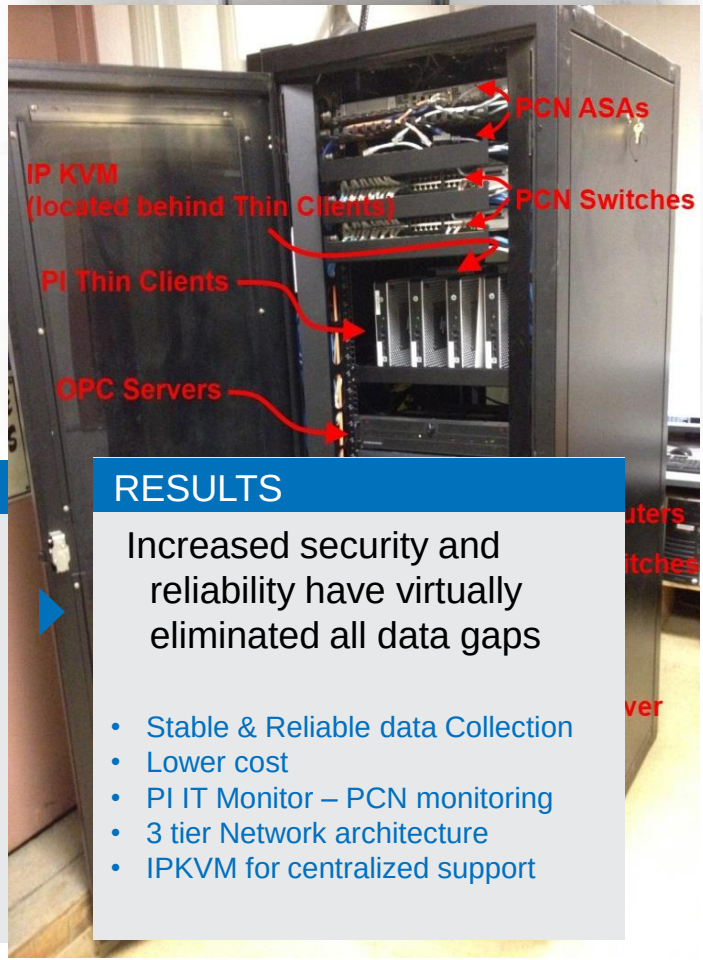
CHALLENGE

Aging infrastructure and non redundant data collection threatened PIMS reporting

- Gaps in Data
- Loss of confidence in PIMS
- Interruptions to Analysis and troubleshooting

SOLUTION

Implementation of solid state redundant data collectors, data sources and network infrastructure



RESULTS

Increased security and reliability have virtually eliminated all data gaps

- Stable & Reliable data Collection
- Lower cost
- PI IT Monitor – PCN monitoring
- 3 tier Network architecture
- IPKVM for centralized support

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Physical Architecture(PA) and Reporting and Analysis Framework (RAF)

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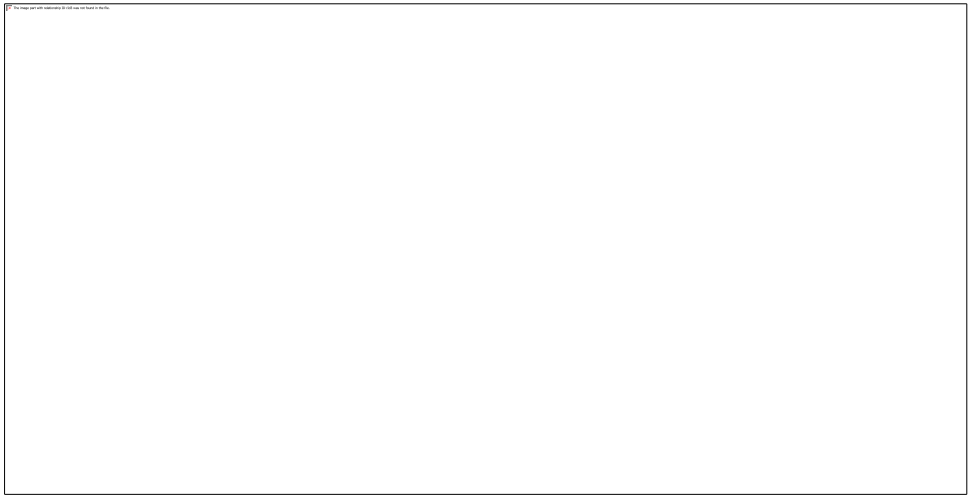
Solution Architecture

- Complete Refresh of all servers
- Latest OSIsoft software
- MS SharePoint – ORP
  - One “Stop Shop” for reports
  - Better Performance
  - Shorter “time to market”
  - Self serve report publishing
  - Sharepoint submission and workflow
  - Training sessions covering all plants in Canada and UK



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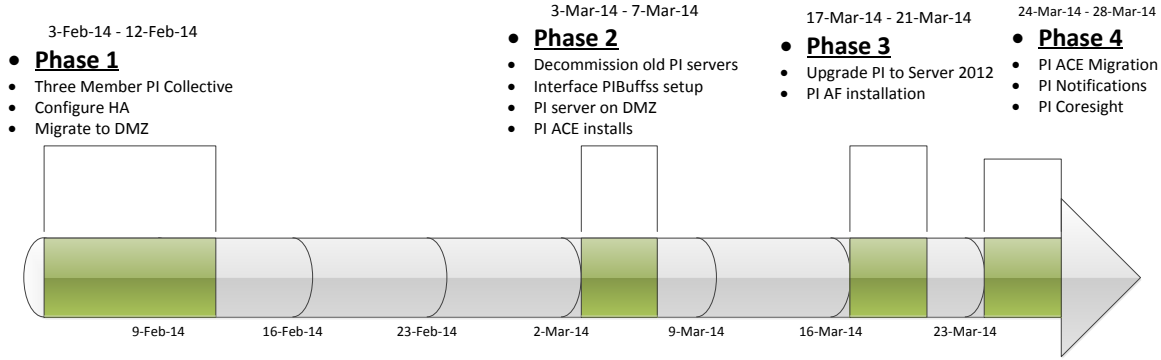
PI Software installation and configuration - OSIsoft Field Service Engineers Key to success

Challenge

- PI System Uptime of 99.99%
- Ensure that the Business impact was small to none
- Thorough Application Testing
- Upgrades done in off shift
- Staggered approach to allow for stabilization



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Project Team

- Chris Bertrand-(Program Manager)
- Khaled Elsharkawi-(Project Manager)
- Norm Doucet-(Technical Lead)
- Joy Lobo-(PI Support)
- Alejandro Molano-(OSIsoft)

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Problems Encountered

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Software Related Issues

- IE8 on Vale standard desktop
  - No HTML5 support
  - IE11 through Citrix (Slow due to aging Citrix architecture)
- In-House applications that were not HA friendly
  - Application design assuming non buffered single PI Server
  - Custom SDK applications throwing errors, required code modification
- Ability to trend relational data (LIMS) in PI Coresight
  - Legacy in house application had the ability to trend all assays in the LIMS system
  - In PI Coresight we are able to trend defined assays through RDBMS

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Hardware-Solid State Drive Failures

Challenge

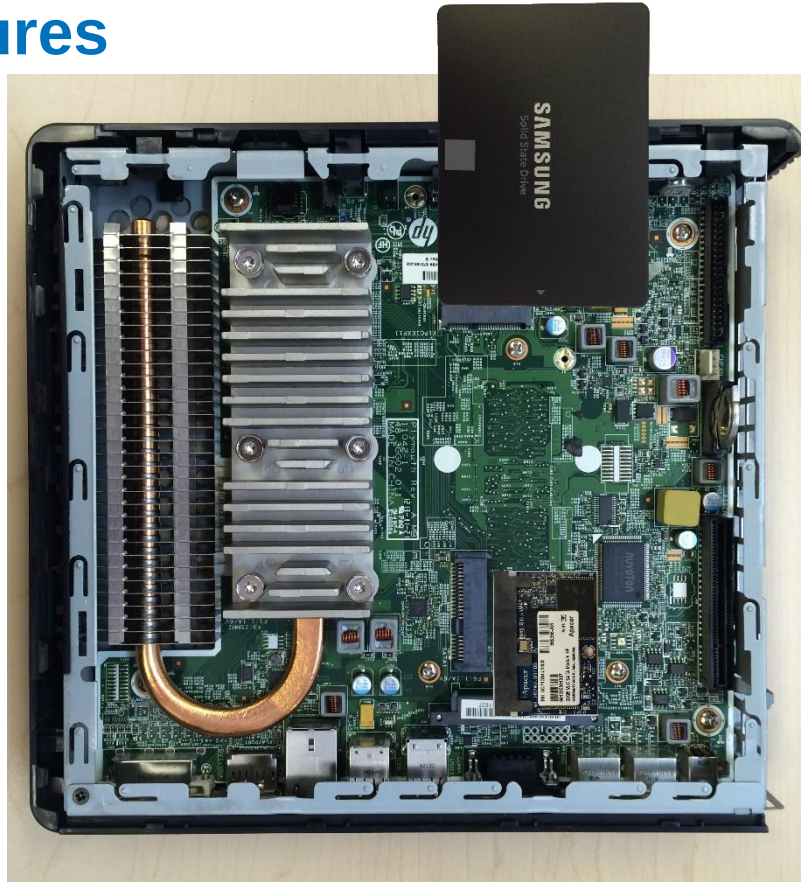
- After two years of service, Solid state drives began to fail

Solution

- Upgrade failed 32GB MLC SSD's
- Replace with 120GB 3D V-NAND drive

Results

- Extend Drive life to ~10years
- Reduce risk of data loss



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Hardware-Ground loop interference

Challenge

- Multiple IPKVM failures
- PC's have external DC Power supply with "floating" ground and IPKVM has reference ground
- Electromagnetic interference in the data signal

Solution

- Ground all PI Interface nodes to same ground potential as IPKVM

Result

- IPKVM software glitches and lock-ups eliminated

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Process Improvements
Applications and Use Case

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SAP Integration – (SAPIO)

- **Challenge**
- New Global SAP implementation
  - Required PI data to support SAP Maintenance module
- **Solution**
- TIBCO middleware (Global Standard)
- PI System 2012
  - PI Asset Framework to structure our information
  - Notifications & Asset Analytics
    - Custom delivery channel to create Event Frames
  - Event Frames to keep track of events

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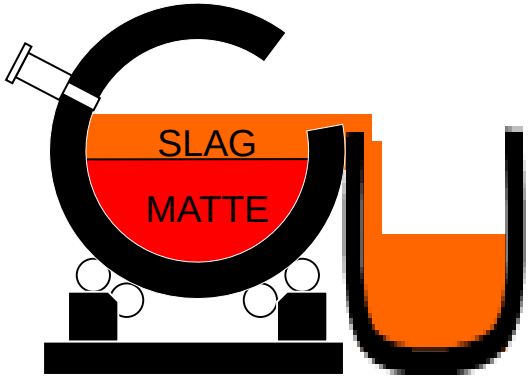
Smelter - Converter Skimming



What is Skimming?

- The process of removing slag from the converters.
- This is done to reduce iron (Fe) in the Matte.
- Slag rises to the top of the converters and can be skimmed (decanted) by rotating the converter.
- A skim cycle (at least 4) in a converter charge (batch) can either be “Skimming” or “Reverse Skimming”.
- “Reverse Skimming” increases Cobalt yield.

Skimming Slag

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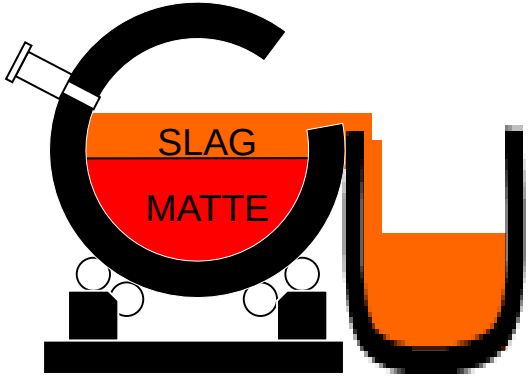
Smelter - Converter Skimming



Challenge

- Operator favoring “Skimming” rather than “Reverse Skimming”
  - Significant loss in Cobalt recovery
- Adherence to “Reverse Skimming” tracked manually
  - Complexity of rules and multiple control variables
- Too difficult with PIMS technology before PIMS Tech Program refresh
  - (PI Server, Module Database, ACE)

Skimming Slag

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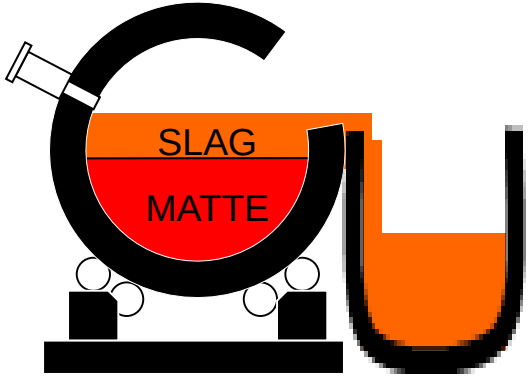
Smelter - Converter Skimming



Solution

- Build AF model and Event Frames to detect “Skims” & “Reverse Skims” based on several criteria.

- Automatic Compliance tracking
  - Successful “Reverse Skim”
  - Missed Opportunities to perform a “Reverse Skim”
  - No Opportunity to perform a “Reverse Skim”

Skimming Slag

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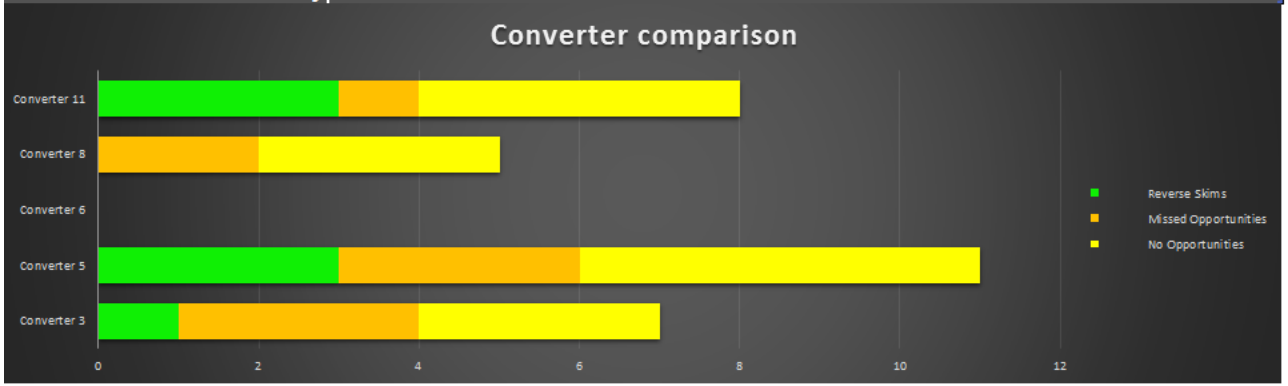
Smelter Reverse Skimming Report

--> SELECT REPORT CRITERIA

Start Time	9/29/2015 13:44
End Time	10/6/2015 13:44

Event	Converter 3	Converter 5	Converter 6	Converter 8	Converter 11	TOTAL
Charges	1	2	0	1	2	6
Cycles	25	22	0	42	19	108
Regular Blows	7	11	0	5	8	31
Reverse Skims	1	3	0	0	3	7
Missed Opportunities	3	3	0	2	1	9
No Opportunities	3	5	0	3	4	15
Matte During AirBlow	4	2	0	5	1	12
% of Blows with Matte Delivery	100.00%	33.33%		250.00%	25.00%	



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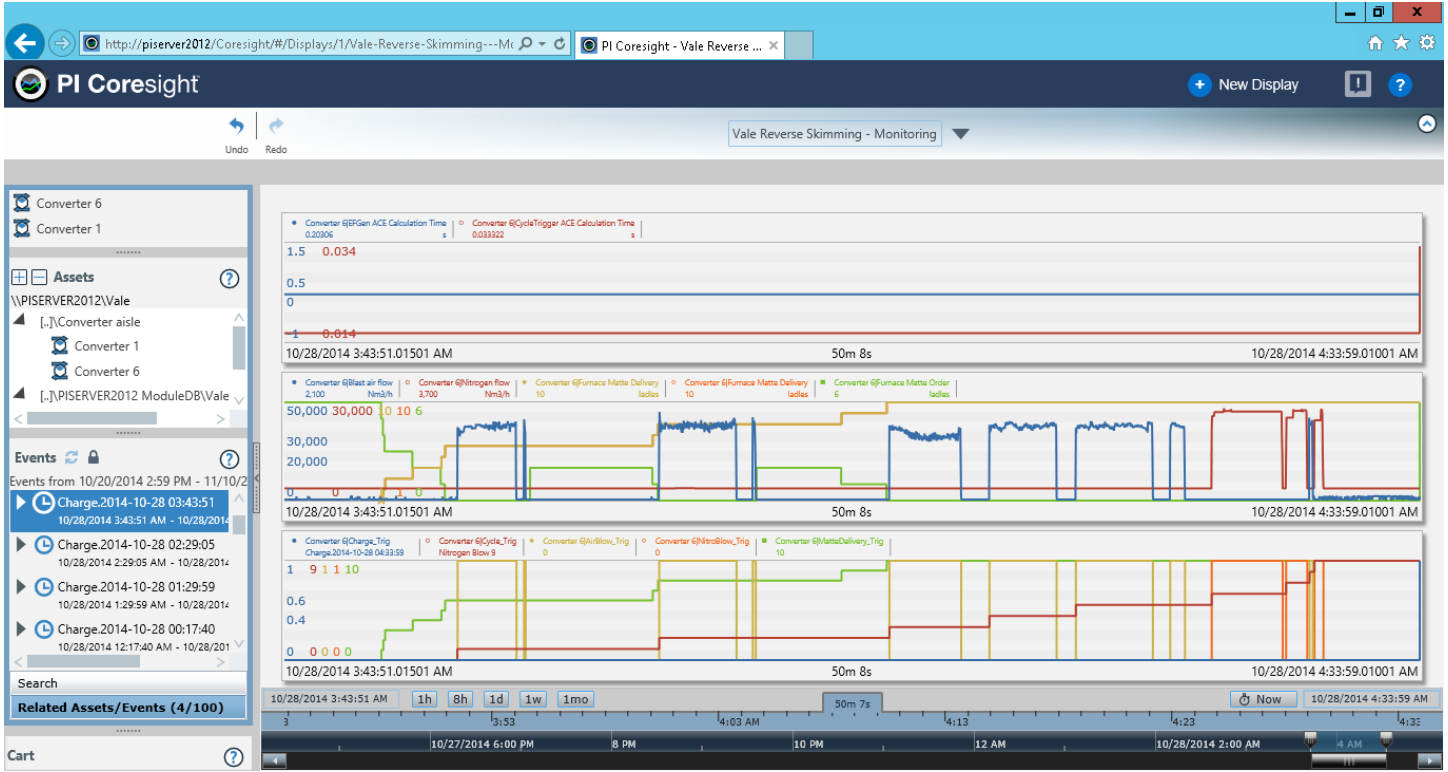
Sample Display in PI Coresight – Event Selection Zooms on Data



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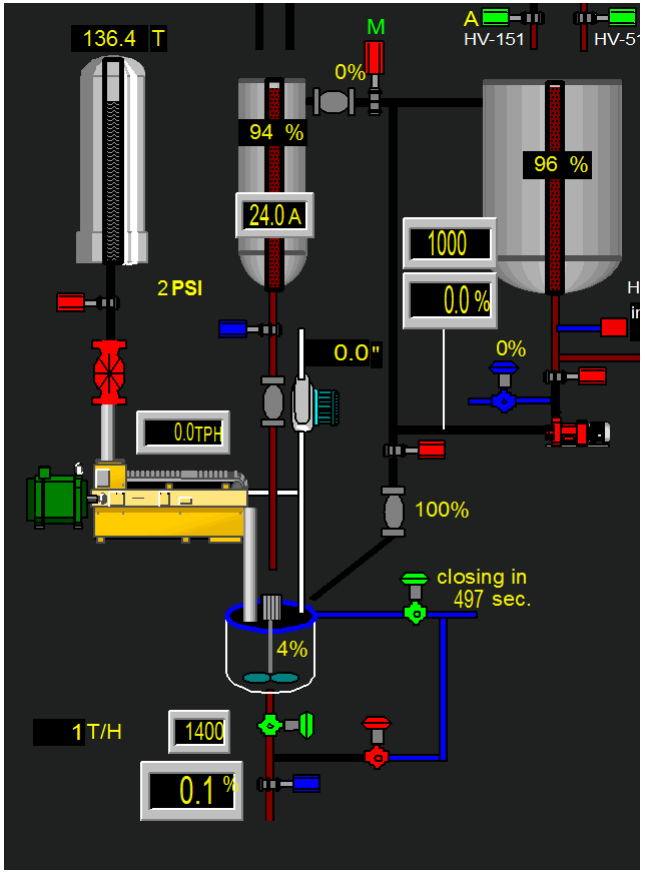
Mine Backfill Batch Reporting

Challenge

- Backfilling is a process used to fill voids after extraction of minerals underground is completed
  - Plugging of pipe line
  - Pipe line burst due to high pressures
  - Pipe line burst due to line deterioration
  - Liquefication of the backfill
  - Equipment failure

Solution

- Model process with Event Frames
- Provide Sharepoint DataLink Reports
- Provide visualization through PI Coresight



Sandfill Plant

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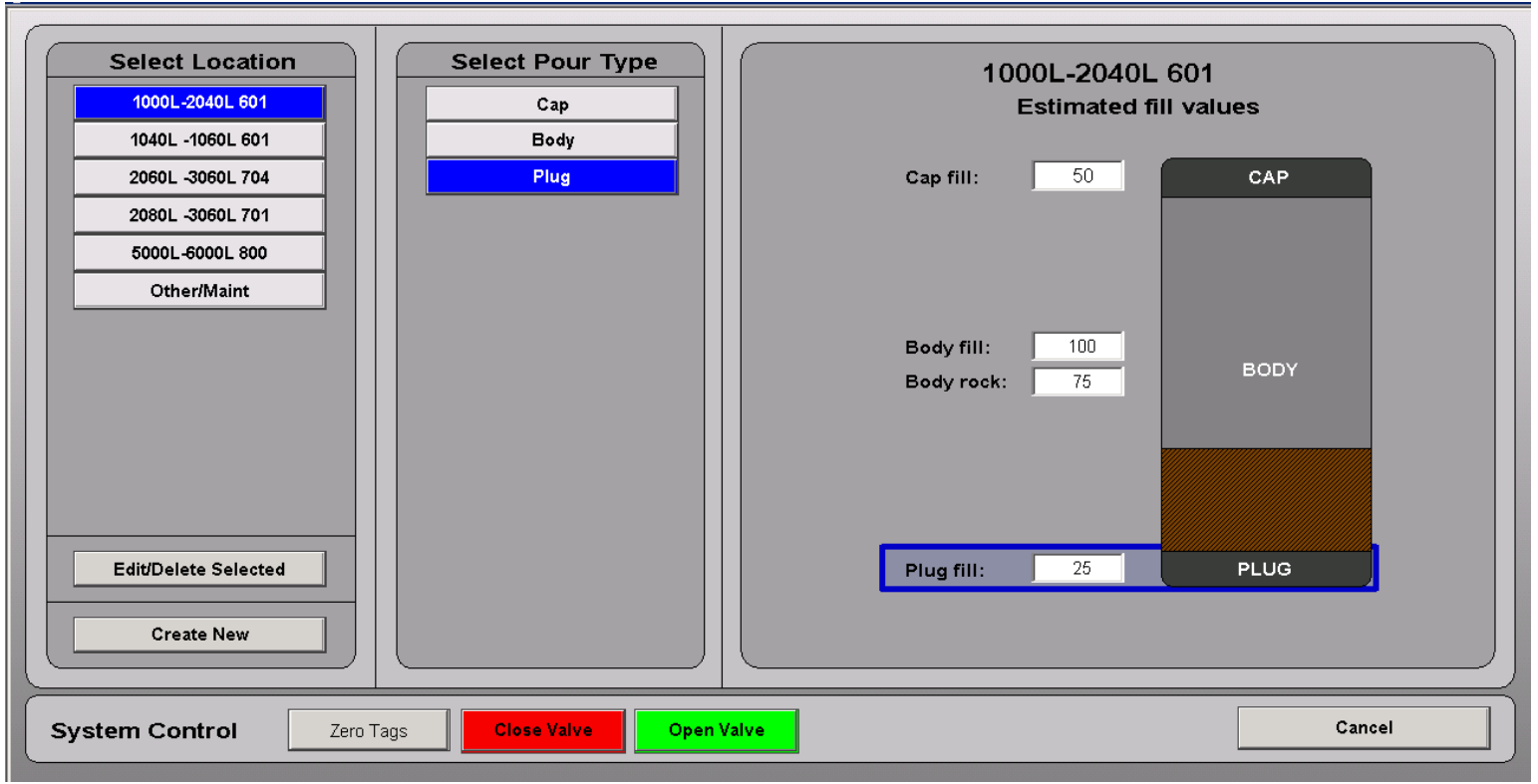
Mine Backfill Operator HMI input screen
Bridging the divide on IT/OT convergence



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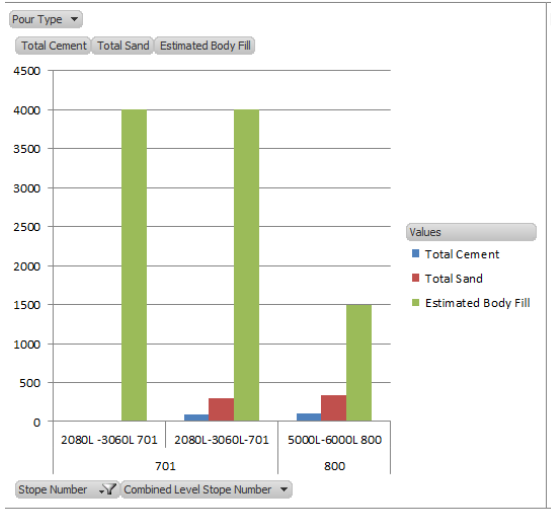
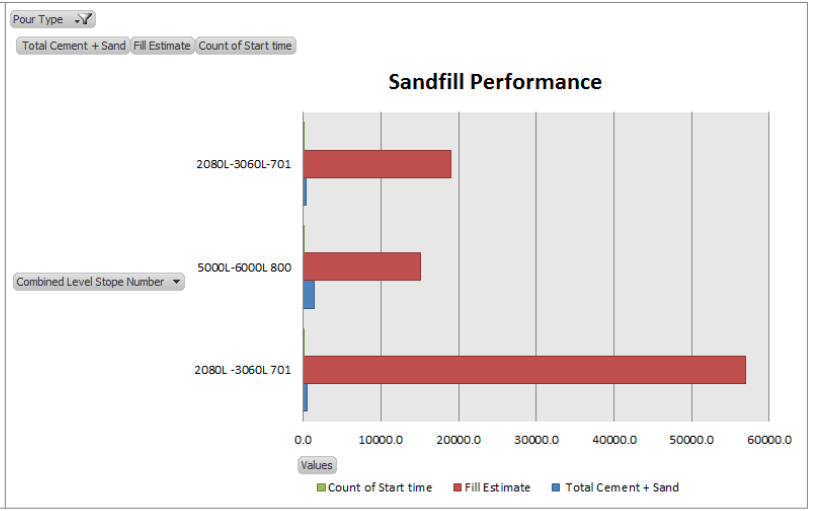
Mine Backfill Report

Start Time	9/6/2015 0:00
End Time	9/20/2015 0:00

Stope Number	Pour Type	Bottom Sill Level	Top Sill Level	Start time	End time	Estimated Cap	Estimated Plug	Estimated Body Rock	Estimated Body Fill	Total Cement	Total Sand	Total Rock
701												
	Body	3060	0	26-May-15 12:58	27-May-15 11:21	5000	7000	3000	4000	138.2	455.7	0
	Cap	3060	0	28-May-15 13:37	28-May-15 13:38	5000	7000	3000	4000	1.1	3.5	0
	Plug	3060	0	26-May-15 11:08	26-May-15 11:59	5000	7000	3000	4000	57.8	188.2	0
800												
	Body	6000	0	26-May-15 10:28	27-May-15 12:57	100	175	750	1500	262.1	860.9	0
	Cap	6000	0	28-May-15 13:35	28-May-15 13:37	100	175	750	1500	1.8	5.9	0
	Plug	6000	0	26-May-15 09:41	26-May-15 10:27	100	175	750	1500	52.6	171.5	0





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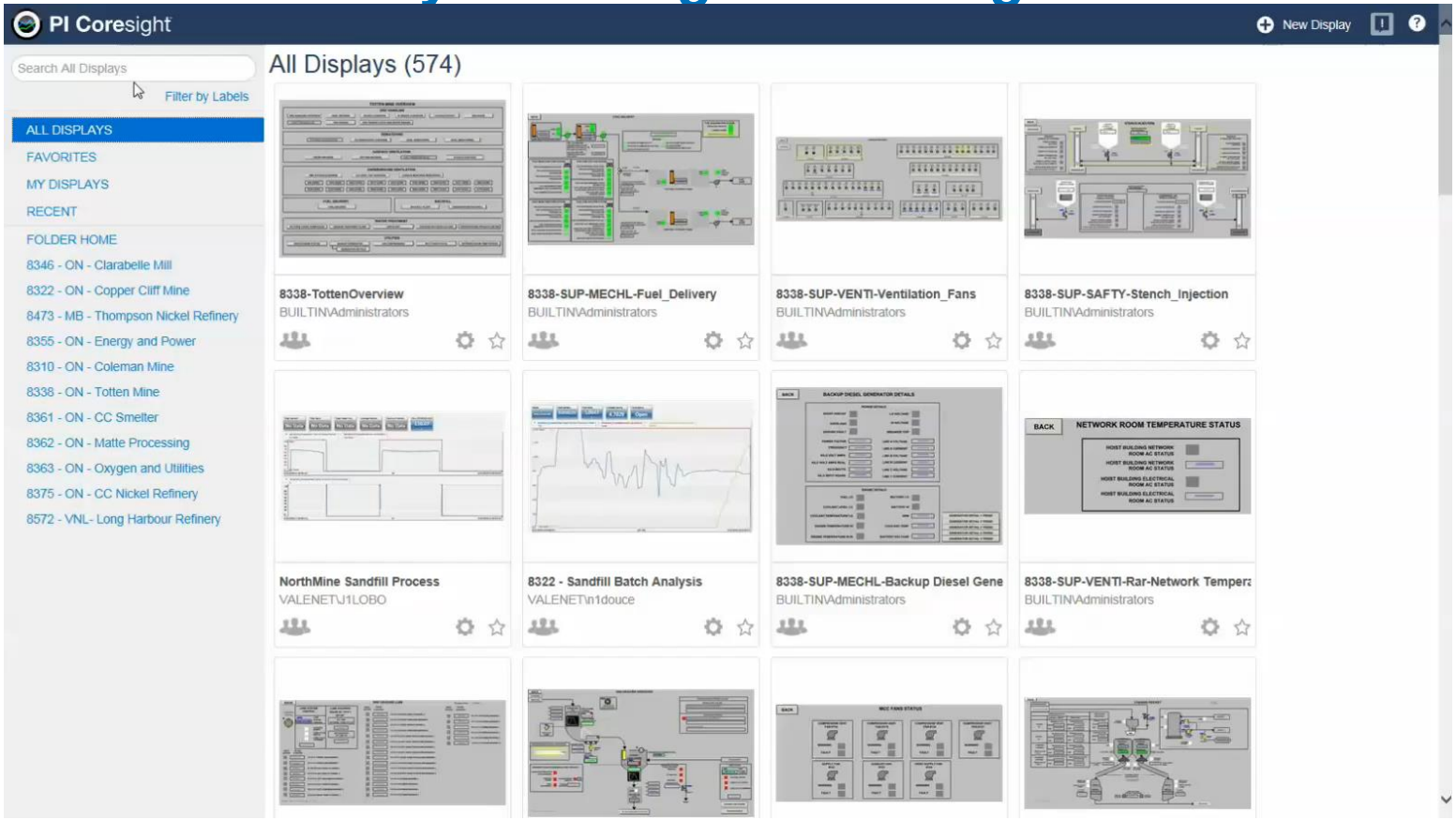
Mine Backfill Analysis using PI Coresight



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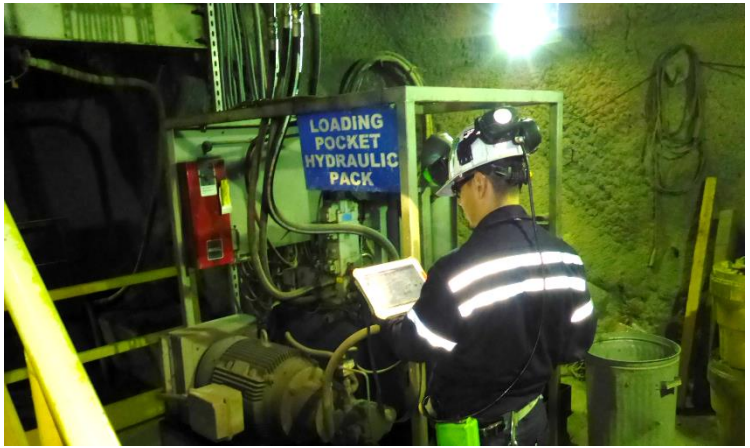
Process Mimics

Problem

- Business requires access to Process Graphics without negative impacts on PCN

Solution

- Create PI ProcessBook displays
- Host displays in Operational Reporting Portal and PI Coresight
- Displays available on Desktops, tablets, and smart phones on Wide Area Network, and Internet



Underground wireless access to PI Coresight displays

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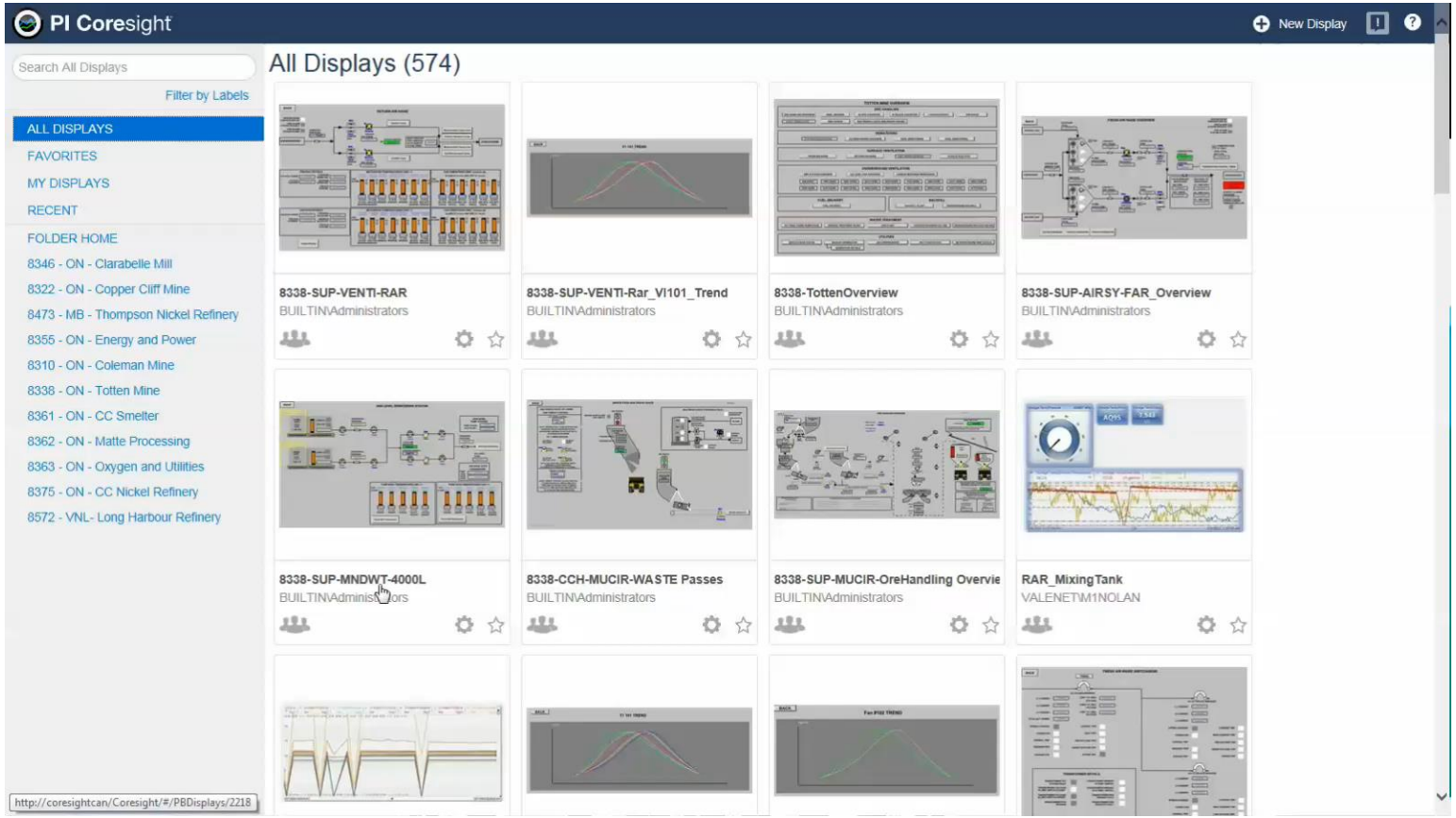
Process Mimic Demo



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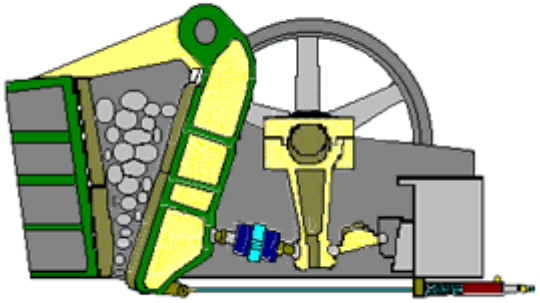
Mine Crusher KPI Report

Problem

- Multiple Crusher failures
  - Bearings overheating
  - Hydraulic toggle relief valve actuations

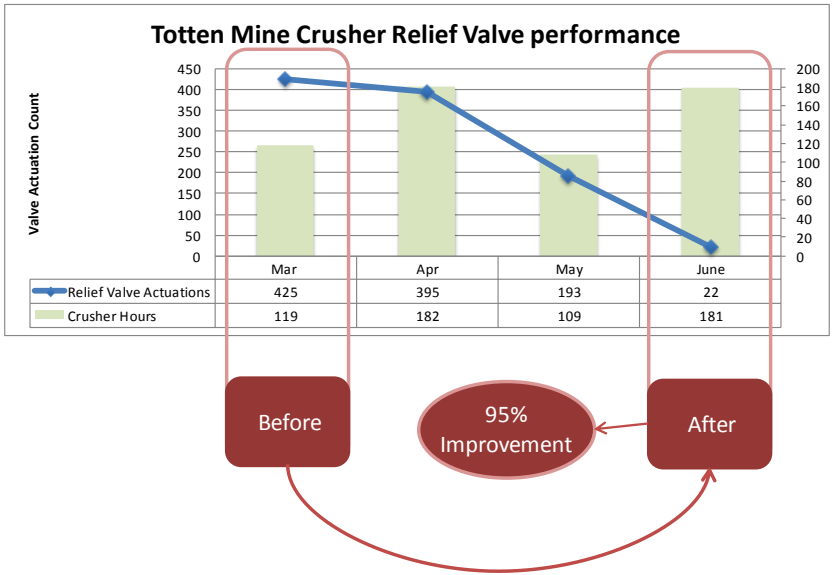


Solution

- Monitor bearing temp. to ensure operator adherence.
- Monitor Rollback time to indicate potential premature bearing failure
- Monitor Relief valve actuations

Results

- Plant Engineers quantified and justified liner redesign to avoid future failures
- Liner changed in May 2014
- Realized a drastic decrease in crushing forces at the hydraulic toggle



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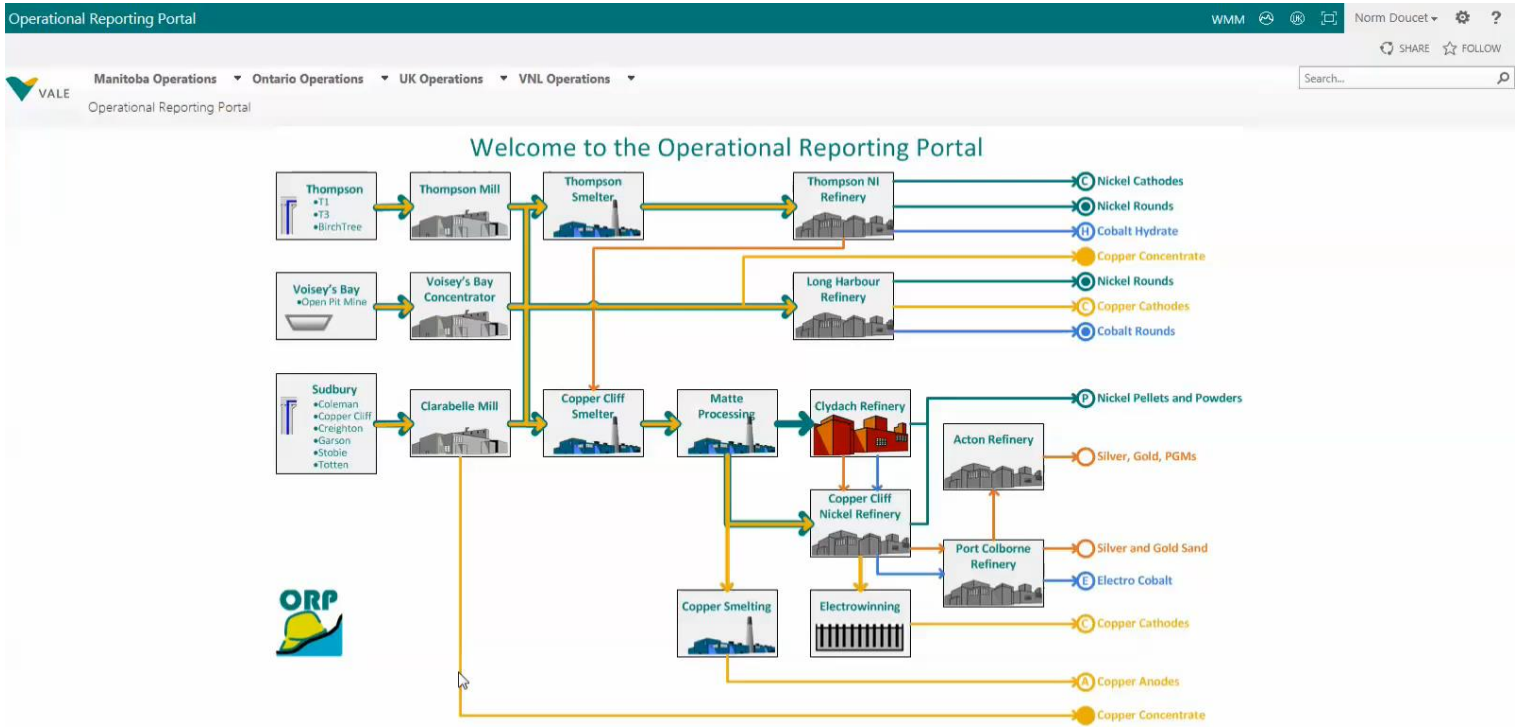
Crusher Report Demo – Webparts and Excel DataLink Server



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Closing Remarks

Foundation
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谢谢

Danke

Gracias

Merci

Thank You

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