



PI Alchemy

Turning data into Gold

Presented by **Peter Smith,**
Metallurgy Superintendent



Introduction

Alchemy

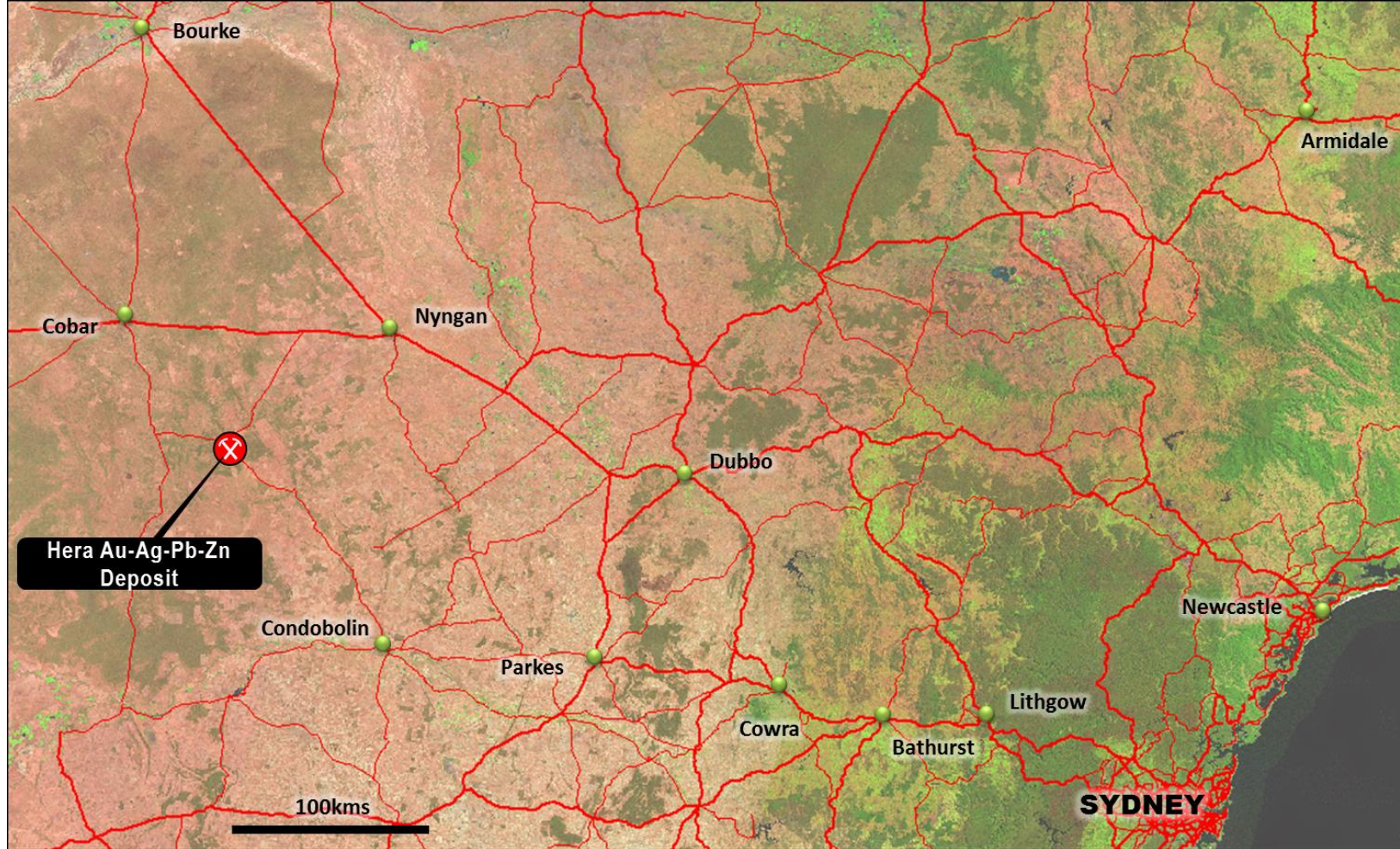
Any magical power or process of transmuting a common substance, usually of little value, into a substance of great value.

PI Alchemy

The process of transmuting raw data, usually of little value by itself, into Operational Intelligence, so that informed decisions can be made to effectively prioritise and generate value.



About Us



Gold-Silver Dore
Lead-Zinc Concentrate

Commercial Production : 2015
March 2016 : Quarterly Report:

- 83,522 t ore processed
- 14,184 oz Gold
- 5,874 t Pb-Zn Concentrate

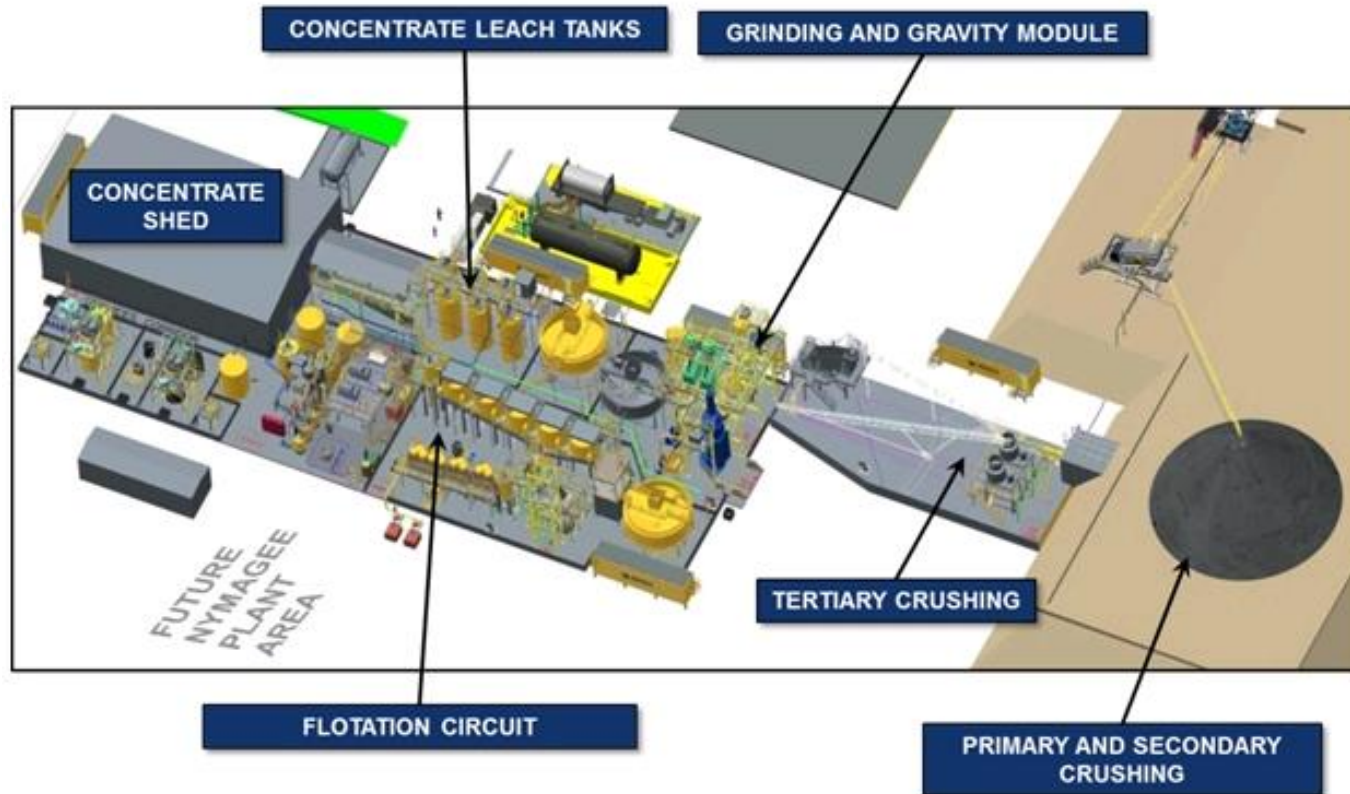
Automation Consultancy

Process Control Optimisation
PI System Integration
PI System Management
Software Development

Hera Processing Plant



Hera Processing Plant





The Challenges

The Challenges

- Plant performance needed to be improved
- **Operational Insight** was difficult to achieve as data was not easy to get, distributed over a number of sources including discrete laboratory reports, process control system
- Time intensive to collate the information needed

Typical Scenario

Manager

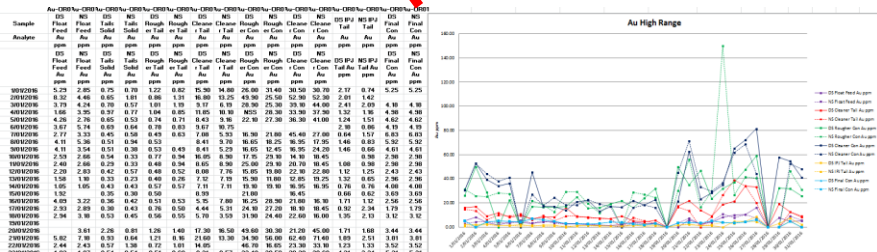
I need a graph
of Au assays for
10 streams
over 30 days



DAILY SAMPLE RESULTS

Sample	Time	Flow	Temp	Pressure	Concentration	Assay	Grade	Recovery	Efficiency	Cost	Profit	Loss	Gain	Net	Margin
1	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
2	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
3	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
4	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
5	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
7	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
8	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
9	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
10	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
11	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
12	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
13	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
14	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
15	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
16	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
17	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
18	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
19	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
20	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
21	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
22	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
23	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
24	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
25	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
26	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
27	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
28	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
29	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100
30	01/01/2016	100	100	100	100	100	100	100	100	100	100	100	100	100	100

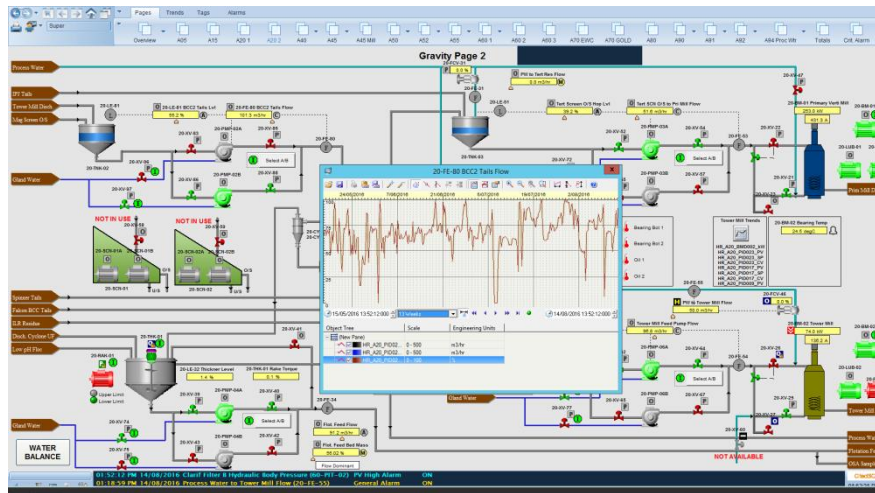
Metallurgist



2

E	F	G	H	I	J	K	L	M	N	O	P	Q	R
SASR-SO548	SASR-SO548	SASR-SO548	SASR-SO548	SASR-SO548	SASR-SO548	SASR-SO548	SASR-SO548	SASR-SO548	SASR-SO548	SASR-SO548	SASR-SO548	SASR-SO548	SASR-SO548
2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1/01/2016	2/01/2016	3/01/2016	4/01/2016	5/01/2016	6/01/2016	7/01/2016	8/01/2016	9/01/2016	10/01/2016	11/01/2016	12/01/2016	13/01/2016	14/01/2016
ME-ICP41a	ME-ICP41a	ME-ICP41a	ME-ICP41a	ME-ICP41a	ME-ICP41a	ME-ICP41a	ME-ICP41a	ME-ICP41a	ME-ICP41a	ME-ICP41a	ME-ICP41a	ME-ICP41a	ME-ICP41a
Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
14	9	13	7	8	9	9	10	10	10	8	7	8	9
15	11	8	13	6	9	11	15	8	7	7	7	5	9
6	1	2	2	2	2	2	2	2	1	3	1	1	2
1	1	<1	2	1	2	2	3	1	2	2	1	<1	2
18	1	2	1	2	2	1	2	2	4	2	1	1	2
2	2	<1	3	1	2	1	3	2	2	2	1	<1	2
85	88	46	53	43	52	33	99	99	82	64	47	99	55
69	58	24	72	43	38	41	100	53	75	75	61	48	55

How Plant Data Was Acquired



DAILY SAMPLE RESULTS						
Lab Tech:	Christine					
Date:	10/1/2016					
Au Samples	Date	Sample	Time	Conc	RSD%	Mean
	10/1/16	CAL 0		0.00	40.50	0.001
	10/1/16	CAL 1		1.00	2.00	0.033
	10/1/16	CAL 2		5.00	1.20	0.157
	10/1/16	CAL 3		10.00	1.10	0.302
	10/1/16	CAL 4		20.00	1.40	0.579
	10/1/16	CAL 5		50.00	0.20	1.213
	10/1/16	Blank		-0.04	69.80	-0.001
	3/1/2/15	MC Barren	2000	0.44	1.60	0.015
	3/1/2/15	MC Barren (Line)	2000	1.62	2.10	0.052
	3/1/2/15	MC PLS	2000	22.29	0.50	0.634
	3/1/2/15	MC Barren	0000	3.45	0.7	0.109
	3/1/2/15	MC Barren (Line)	0000	7.54	1.1	0.233
	3/1/2/15	MC PLS	0000	21.63	0.8	0.617
	3/1/2/15	MC Barren	0400	5.01	0.7	0.157
	3/1/2/15	MC Barren (Line)	0400	0.06	9.8	0.003
	3/1/2/15	MC PLS	0400	18.47	1.0	0.537
	3/1/2/15	Tails Liquor	DS	3.67	1.4	0.116
	3/1/2/15	Tails Liquor	NS	0.50	1.6	0.017
	3/1/2/15	ILR Ewin Feed	Batch 277	70.03	0.1	1.701
	3/1/2/15	ILR Ewin Feed x10 DIL	Batch 277	37.99	0.7	0.987
	3/1/2/15	ILR Final Wash	Batch 277	42.93	0.9	1.095
	10/1/16	Process H2O	0600	0.46	1.5	0.015
	10/1/16	MC Barren	0600	5.85	0.7	0.183
	10/1/16	Detox	0600	3.71	1.8	0.118
	10/1/16	MC PLS	0600	20.33	1.0	0.585
	10/1/16	Ewin Spot	0600	53.40	0.9	1.297
	10/1/16	Ewin Spot x5 DIL	0600	10.98	0.9	0.333
	10/1/16	CAL 0		0.00	99.3	0.000
	10/1/16	CAL 1		1.00	1.6	0.032
	10/1/16	CAL 2		5.00	0.7	0.156
	10/1/16	CAL 3		10.00	0.3	0.300
	10/1/16	CAL 4		20.00	0.7	0.568

=IF(ERROR(VLOOKUP(CONCATENATE(TEXT(S56,"mm/yyyy"),",",S412),INDIRECT(CONCATENATE("","S7","T",S55),S56,FALSE),VLOOKUP(CONCATENATE(TEXT(S56,"mm/yyyy"),",",S412),INDIRECT(
E	F	G	H	I	J	K	L	M	N	O	P	Q	R
SAS8-S0548	SAS8-S0548	SAS8-S0548	SAS8-S0548	SAS8-S0548	SAS8-S0548	SAS8-S0548	SAS8-S0548	SAS8-S0548	SAS8-S0548	SAS8-S0548	SAS8-S0548	SAS8-S0548	SAS8-S0548
2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1/01/2016 ME-ICP41a	2/01/2016 ME-ICP41a	3/01/2016 ME-ICP41a	4/01/2016 ME-ICP41a	5/01/2016 ME-ICP41a	6/01/2016 ME-ICP41a	7/01/2016 ME-ICP41a	8/01/2016 ME-ICP41a	9/01/2016 ME-ICP41a	10/01/2016 ME-ICP41a	11/01/2016 ME-ICP41a	12/01/2016 ME-ICP41a	13/01/2016 ME-ICP41a	14/01/2016 ME-ICP41a
Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
14	9	13	7	8	9	9	10	10	10	8	7	8	9
15	11	8	13	6	9	9	11	15	8	7	7	5	9
6	1	2	2	2	2	2	2	2	1	3	1	1	2
1	1	<1	2	1	2	2	3	1	1	2	2	1	<1
18	1	2	1	2	2	1	2	2	4	2	1	1	2
2	2	<1	9	1	2	1	9	2	1	9	<1	<1	2
85	88	46	53	43	52	33	99	99	82	64	47	99	55
69	58	24	72	43	38	41	100	53	75	61	49	58	55

- Discrete lab reports
- High compression of plant data (900 data points)
- Manual assembly into Excel





Phase 1 – Installation & Visualisation



Initial Business Case for a PI System

Streamline the reporting of Laboratory Assays and historise the assay data for subsequent analysis as required

Provide a repository of process data for key plant, equipment and instrumentation to enhance the operational perspective and allow long term statistical analysis of key data streams

Hera Minesite

Report Date	16/03/2016
Shift Date	15/03/2016
2	3

Solutions		Time	Shift	Batch No.	Au	Cu	Pb	Zn	Fe	Ag	SiO ₂	pH	Titration ppm	WAD CN	DO	Misture %
					ppm	%	%	%	%	%	%				ppm	ppm
MC Barren	✓	2000	NS		-0.03								11.31	3332		
MC Barren	✓	0000	NS		0.08								11.41	3328		
MC Barren	✓	0400	NS		0.00								11.28	3334		
MC Barren	✓	0800	DS		0.08								11.41	3328		
MC Barren	✓	1200	DS		-0.05								11.82	3322		
MC Barren	✓	1600	DS		0.07								11.34	3327		
MC Dexas	✓	2000	NS		0.37								9.70	0		
MC Dexas	✓	0000	NS		0.32								9.21	0		
MC Dexas	✓	0400	NS		0.29								9.11	0		
MC Dexas	✓	0800	DS		0.27								8.90	0	20	
MC Dexas	✓	1200	DS		0.13								8.57	0	20	
MC Dexas	✓	1600	DS		0.13								8.18	0	199	
MC PLS	✓	2000	NS		20.38								11.43	3038		
MC PLS	✓	0000	NS		19.36								11.24	2940		
MC PLS	✓	0400	NS		18.71								11.04	2940		
MC PLS	✓	0800	DS		18.71								11.09	2946		
MC PLS	✓	1200	DS		18.17								11.63	2946		
MC PLS	✓	1600	DS		18.01								11.41	2744		
MC Barren - Line	✓	2000	NS													
MC Barren - Line	✓	0000	NS													
MC Barren - Line	✓	0400	NS													
MC Barren - Line	✓	0800	DS													
MC Barren - Line	✓	1200	DS													
MC Barren - Line	✓	1600	DS													
MC Barren - Line	✓	2000	NS													
Process Water Dam	✓	0000	DS		0.43								8.62	0	0.00	
Process Water Line	✓	0800	DS		0.41								8.80	0	0.00	
Tails Lopper	✓		DS		0.70											
Tails Solen	✓		DS		0.47											
			DS												0.00	
I.R.E. Ewin Feed	✓		NS													
I.R.E. Wash	✓		NS													
I.R.E. Ewin Feed	✓		DS	328	559.5											
I.R.E. Wash	✓		DS	328	104.1											
EW PLS	✓	0800	DS		85.37											
EW PLS	✓	1200	DS													
EW PLS	✓	1600	DS													
Lunch Feed Solen	✓	0800	DS													
Lunch Tank 1 Solen	✓	0800	DS													
Lunch Tank 2 Solen	✓	0800	DS													
Lunch Tank 3 Solen	✓	0800	DS													
Lunch Tank 4 Solen	✓	0800	DS													
Lunch Tank 5 Solen	✓	0800	DS													
Lunch Tank 6 Solen	✓	0800	DS													

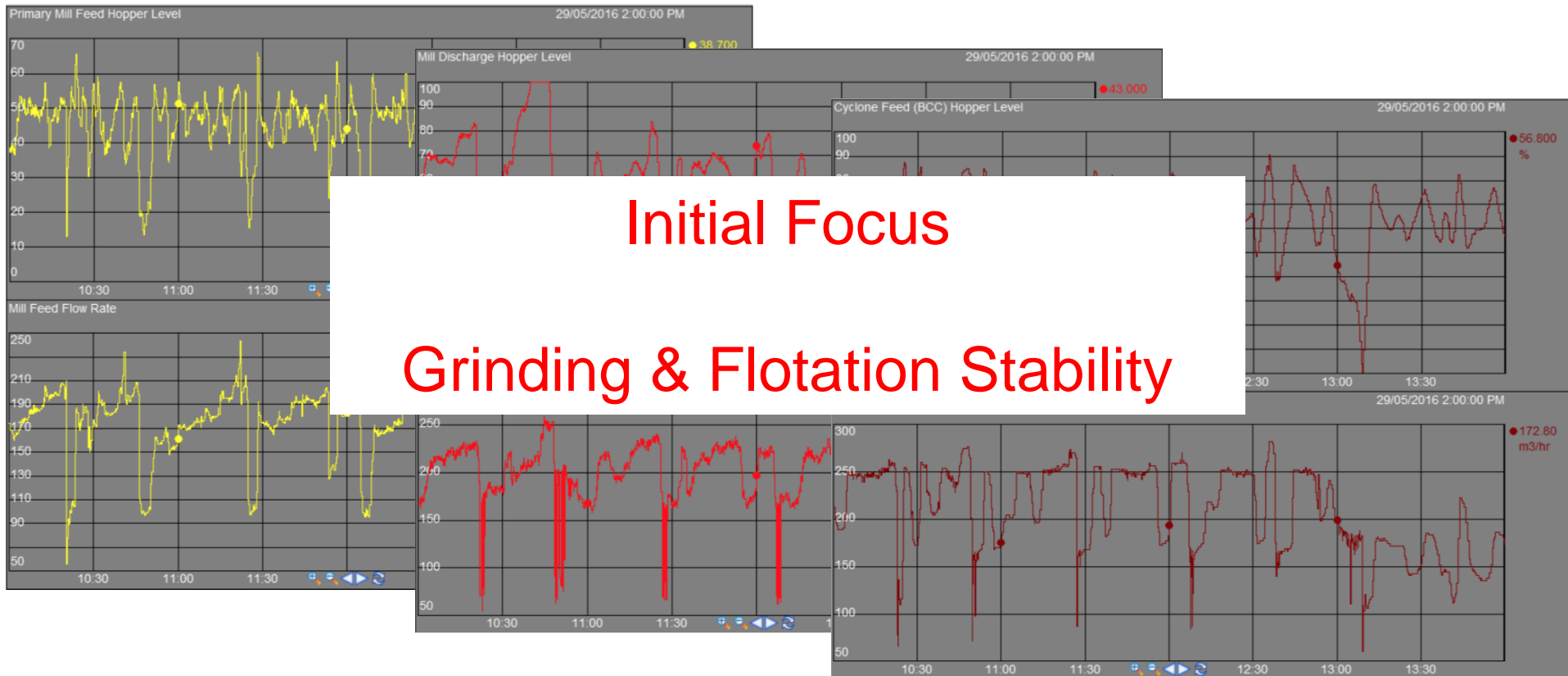
Figure 10 consists of four subplots arranged in a 2x2 grid, showing the evolution of three populations (MC Barren, MC Pregnant, and MC Barren Line) over time (Shift Time) for two different parameter sets (pH and pH₂). The x-axis for all plots is Shift Time, ranging from 2000 to 16000. The y-axis for the left column plots is N (Number of individuals), and for the right column plots is N (Number of individuals) and Free Space (Number of individuals).

- Top Left Plot (MC Barren):** Shows the evolution of the MC Barren population (N) for pH (red line) and pH₂ (blue line). The pH population fluctuates between approximately 0.02 and 0.10, while the pH₂ population fluctuates between approximately 0.02 and 0.10.
- Top Right Plot (MC Pregnant):** Shows the evolution of the MC Pregnant population (N) for pH (red line) and pH₂ (blue line). The pH population fluctuates between approximately 0.02 and 0.10, while the pH₂ population fluctuates between approximately 0.02 and 0.10.
- Bottom Left Plot (MC Barren Line):** Shows the evolution of the MC Barren Line population (N) for pH (red line) and pH₂ (blue line). The pH population fluctuates between approximately 0.02 and 0.10, while the pH₂ population fluctuates between approximately 0.02 and 0.10.
- Bottom Right Plot (MC Pregnant Line):** Shows the evolution of the MC Pregnant Line population (N) for pH (red line) and pH₂ (blue line). The pH population fluctuates between approximately 0.02 and 0.10, while the pH₂ population fluctuates between approximately 0.02 and 0.10.

- 1 day to update & report 1 month of data for 1 assay
- 1 day history per spreadsheet

- 30 mins to update & report 1 month of data for hundreds of assays
- All assays historised

Identifying & Justifying Process Improvement Campaign





Phase 2 – Initial Grinding, Flotation and Cyanide Optimisation



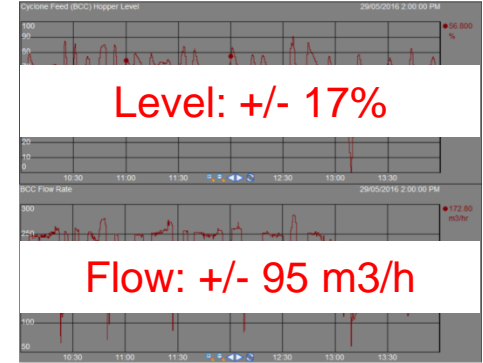
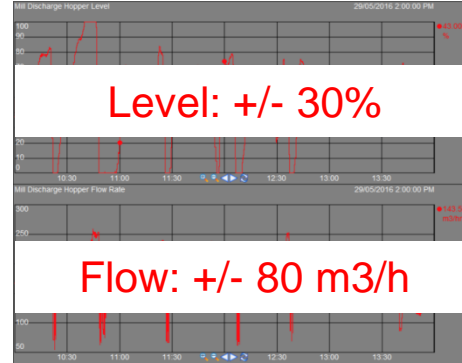
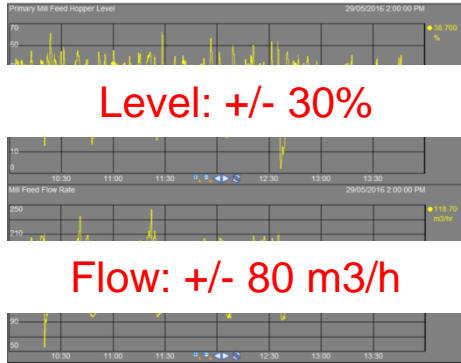
Using the PI System to Measure & Validate Process Improvement

Mill Feed

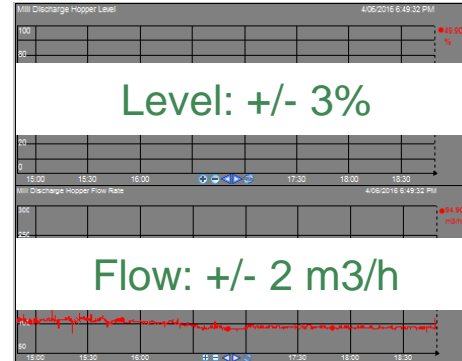
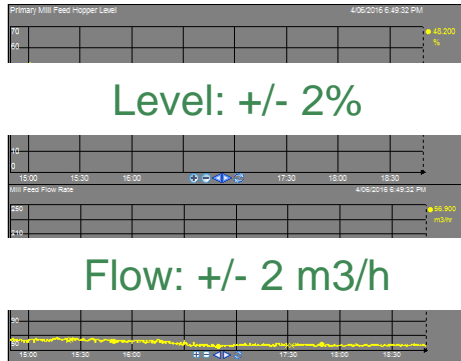
Mill Discharge

Cyclone Feed

Before



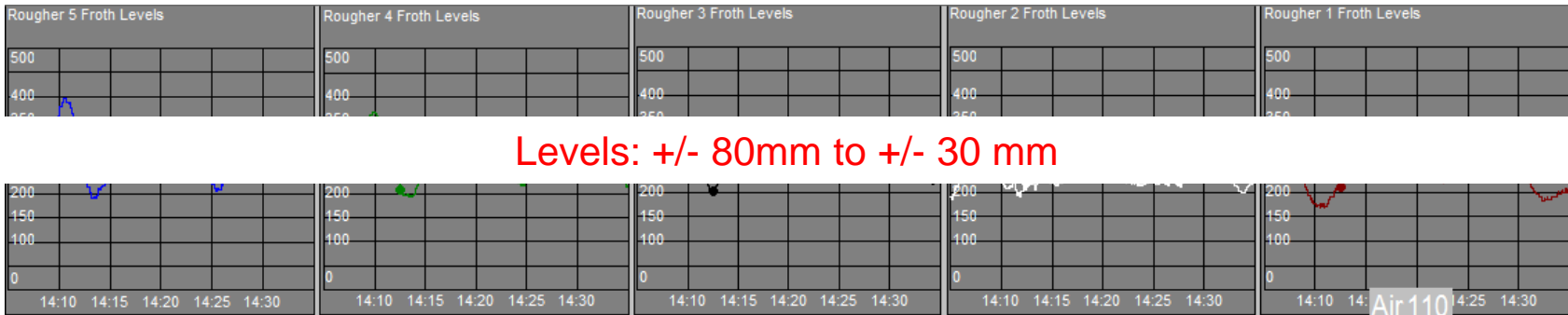
After



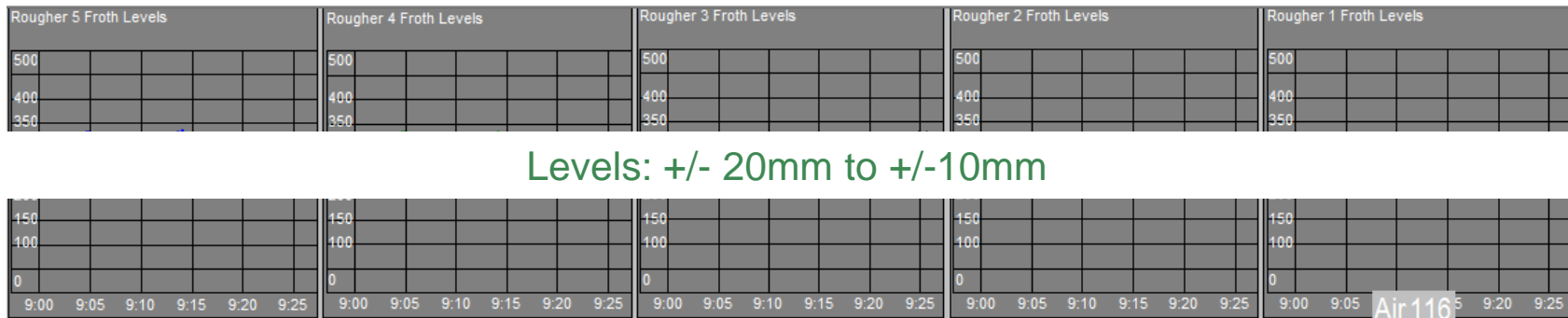
Using the PI System to Measure & Validate Process Improvement

Rougher Flotation Cell Levels

Before



After

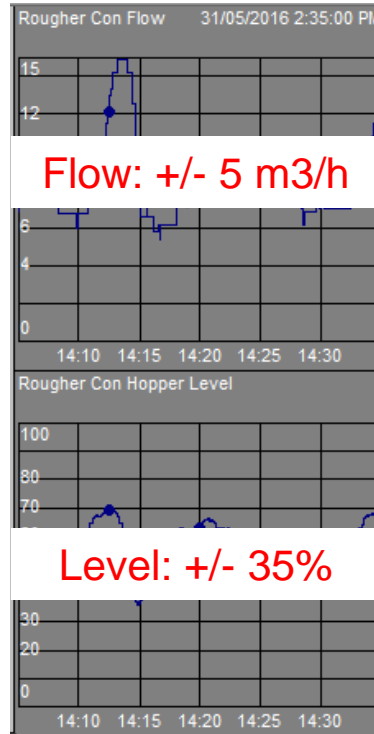


Using the PI System to Measure & Validate Process Improvement

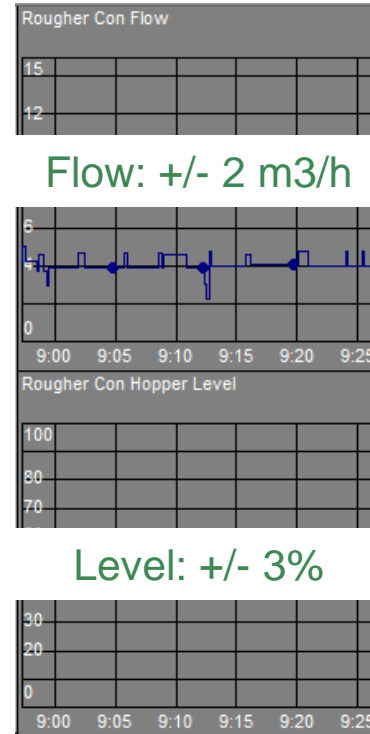
Rougher
Con Flow

Rougher
Con Level

Before



After





Phase 3 – Benefit Realisation

What Does Improved Stability Give Us?

- Improved Grinding Efficiency
- Improved Classification Efficiency
- Reduced wear rates
- Reduced energy consumption
- Reduces reagent consumption
- Reduced spills / cleanups
- Reduced water consumption
- Improved throughput
- Improved plant recovery
- Reduced Operator stress/fatigue

How Much is Stability Worth?

+1% Plant Gold Recovery = approx. USD\$750,000 per annum

Considering:

- PI System Costs
- Installation Costs
- Optimisation Costs
- Small Plant (~ 45 t/h)

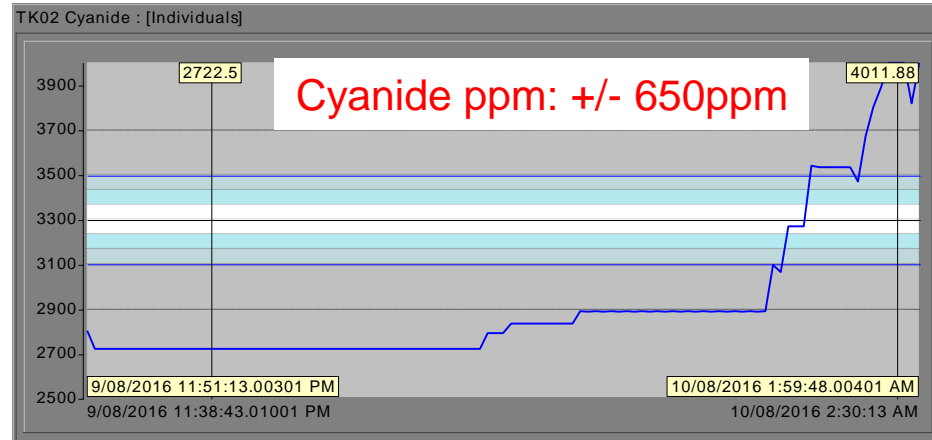
**+1% Recovery
Improvement**

=

**12 Day Payback
Period**

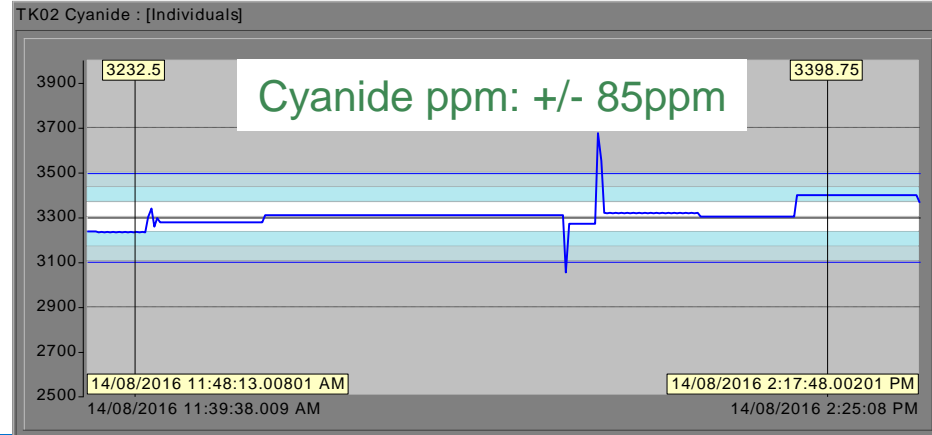
Cascade Loop Development in Key Areas (August)

Before



Tank 5 Cyanide
First pass
cascade loop

After



Improvement Opportunity – Cyanide Reagent Control

TK02 Cyanide : [Individuals]

193

0

\$1 per tonne Reduction in Cyanide

=

\$300,000 per year

3700

3300

2900

2500

14/08/2016 10:48:48.01001 AM

14/08/2016 2:45:08 PM

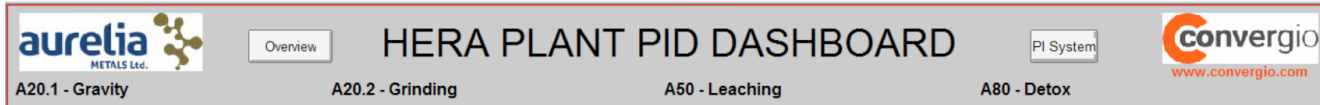


OSIsoft.

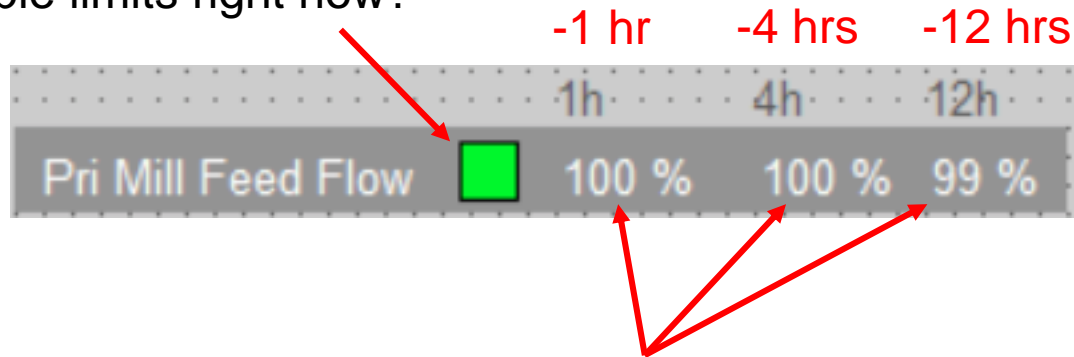
EMEA USERS CONFERENCE • BERLIN, GERMANY

© Copyright 2016 OSIsoft, LLC

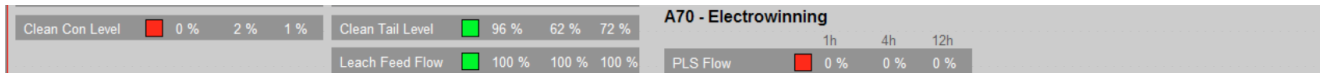
25



Is the measurement within acceptable limits right now?



What % of time has the measurement been within acceptable limits?



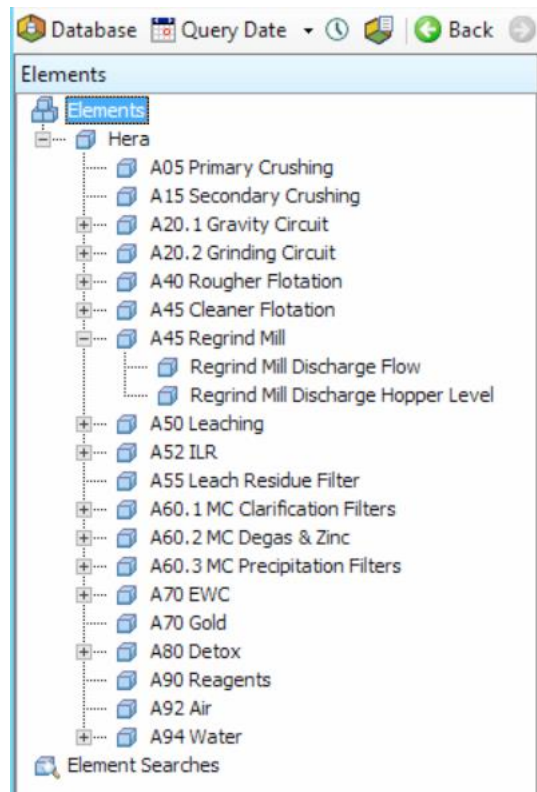
convergio INFINITUM™ – Loop Analytics

PID_Template

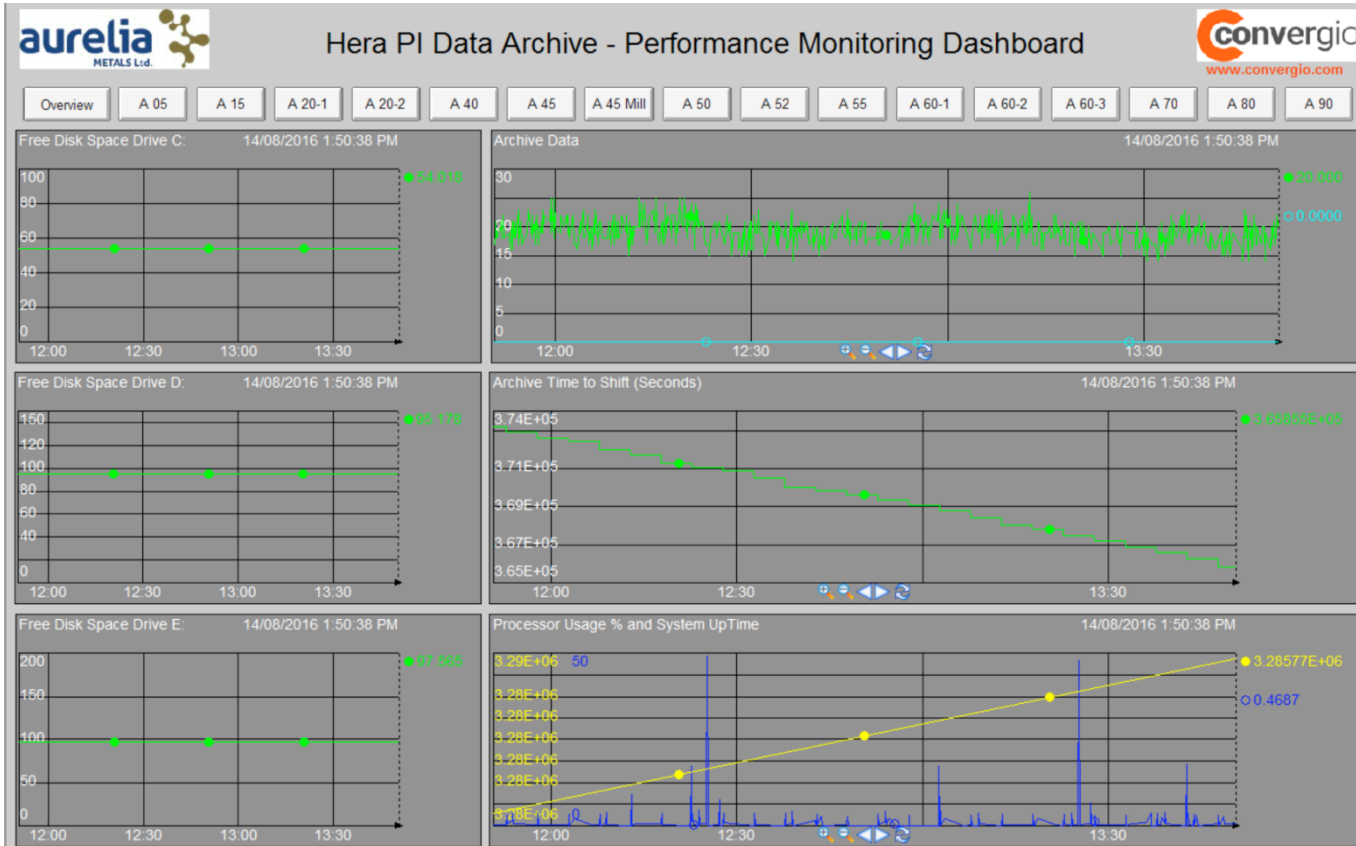
General Attribute Templates Ports Analysis Templates

Filter

	Name	Description
	CV	Control Variable
+	CV Parameters	CV Parameters
	ID	PID Loop Number
	InControl	The status indication of whether the lo...
	Performance 1	The % of time the PV is within the upp...
	Performance 4	The % of time the PV is within the upp...
	Performance 12	The % of time the PV is within the upp...
+	PID Tuning Parameters	PID Tuning Parameters
	PV	Process Value
+	PV Parameters	PV Parameters
	SP	Set Point value
+	SP Parameters	SP Parameters



Asset Framework (AF)





Phase 4 – Squeezing More Value Out Of The PI System



More Process Improvement Opportunities

- Plant Water Pressure Optimisation
- Flotation Cell Reagent Optimisation
- On Stream Analyser Integration
- Grinding Circuit Reconfiguration
- Flotation Level Advanced Control
- Merryl-Crowe Reagent Optimisation
- Gravity Circuit Optimisation

More Maintenance Improvement Opportunities

- Automatic Equipment Runhours Reporting (AF and Totalisers)
- Automatic Equipment Utilisation & Availability Reporting (AF and PI System Analytics)

Contact Information

Peter Smith

psmith@aureliametals.com

Metallurgy Superintendent
Aurelia Metals



Gavin Strack

gavin.strack@convergio.com

Director
Convergio



Questions

Please wait for the **microphone** before asking your questions

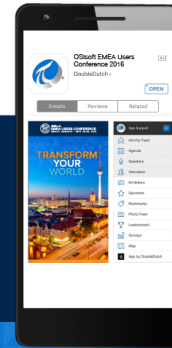


State your **name & company**

Please remember to...

Complete the Online Survey for this session

Download the Conference App for OSISOFT EMEA Users Conference 2016



- View the latest agenda and create your own
- Meet and connect with other attendees



search **OSISOFT** in the app store

<http://ddut.ch/osisoft>



감사합니다

谢谢

Danke

Merci

Gracias

Thank You

ありがとう

Спасибо

Obrigado

Cheers Mate



OSIsoft.

EMEA USERS CONFERENCE • BERLIN, GERMANY

© Copyright 2016 OSIsoft, LLC



OSIsoft®

EMEA USERS CONFERENCE

BERLIN, GERMANY • SEPT 26-29, 2016



OSIsoft.

EMEA USERS CONFERENCE • BERLIN, GERMANY

© Copyright 2016 OSIsoft, LLC