AGL: The people story of PI and analytics

Mark Faith (Manager ODC and Technology)

Australian Gas Light Company (AGL)

- We operate the country's largest electricity generation portfolio, we're its largest ASX-listed investor in renewable energy, and we have more than 3.6 million customer accounts.
- Proudly Australian, with more than 180 years of experience, we have a responsibility to provide sustainable, secure and affordable energy for our customers.
- Our aim is to prosper in a carbon-constrained world and build customer advocacy as our industry transforms. That's why we have committed to exiting our coal-fired generation by 2050 and why we will continue to develop innovative solutions for our customers.

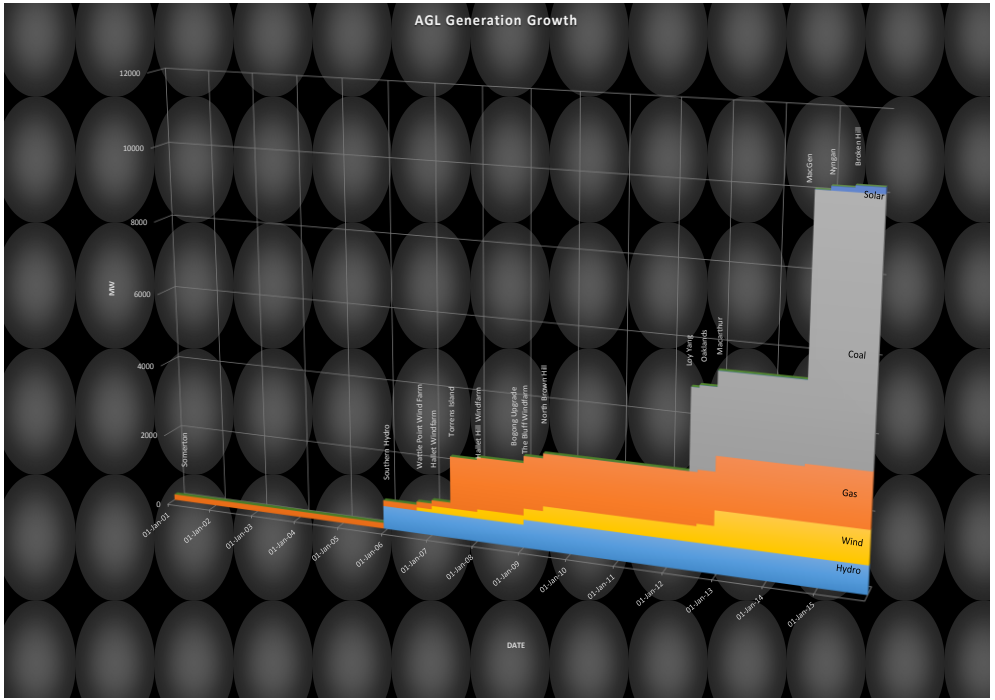
AGL is committed to helping shape a sustainable energy future for Australia.

The AGL Generation Fleet

300-10,000+ MW in 9 Years!

Fast Generation Portfolio Growth via:

- Acquisitions including:
  - Southern Hydro (700MW)
  - Torrens Island Power Station (1280MW)
  - Loy Yang Power Station (2250MW)
  - Macquarie Generation (4560MW)
- Build including:
  - 9 X Wind Farms (1589MW)
  - Bogong Hydro Power Station (150MW)
  - 2 X Solar Power Stations (155MW)



Choosing OSIsoft PI and Partner Products

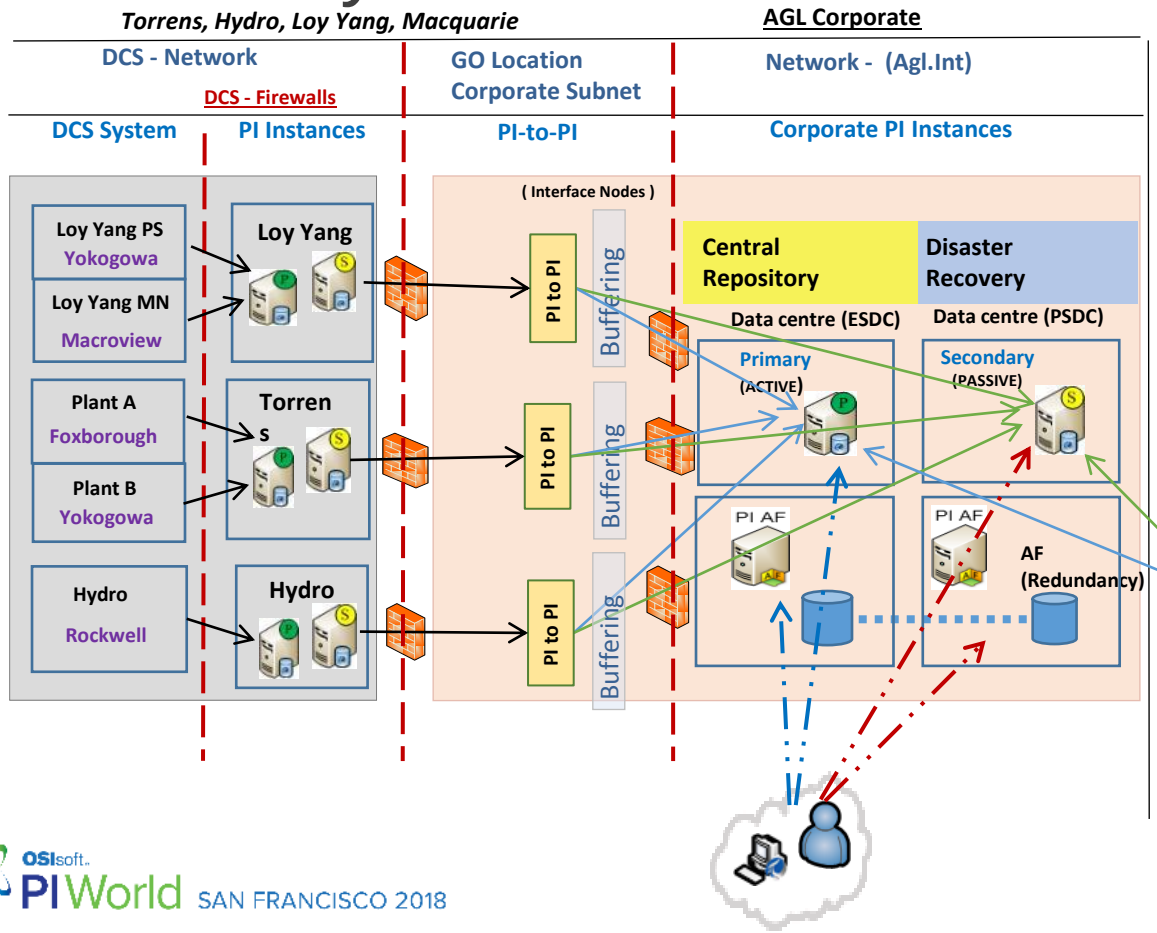
OSIsoft PI Real Time Data Infrastructure

The enabling technology that changes our data culture and gets us better results

OSIsoft PI is our real time data infrastructure solution

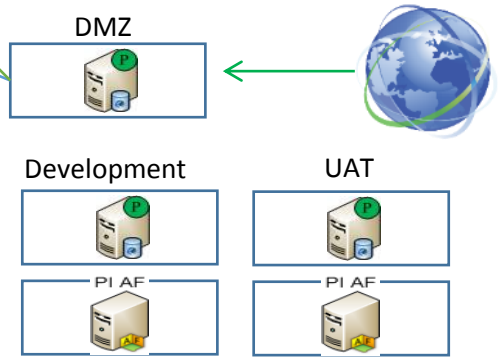
- It incudes the high performance PI Server that acts as a highly adaptable and connectable real time data historian that can connect to almost all power station field devices including, but not limited to:
    - Distributed Control Systems (DCS)
    - Programmable Logic Controllers (PLC)
    - Field Located Digital devices (instruments, controllers etc.)
- Advanced analysis and visualisation tools that greatly increase the value proposition for AGL.
- Mobile data access that is secure for all AGL users.
- Many OSI Partner products that easily connect to OSI PI

AGL – PI System Architecture Hi-Level Overview



Legend

- Metadata links via AGL WAN
- Location PI to Central PI *via PItoPI interface nodes*
- GO Location firewalls
- Network redirect on DR
- SQL Log Shift to PSDC
- PI client software user connections *to Central PI*
- Existing PI client software user connections *to GO locations other than AGLM (future decommission)*
- Data harvested from Internet Sources

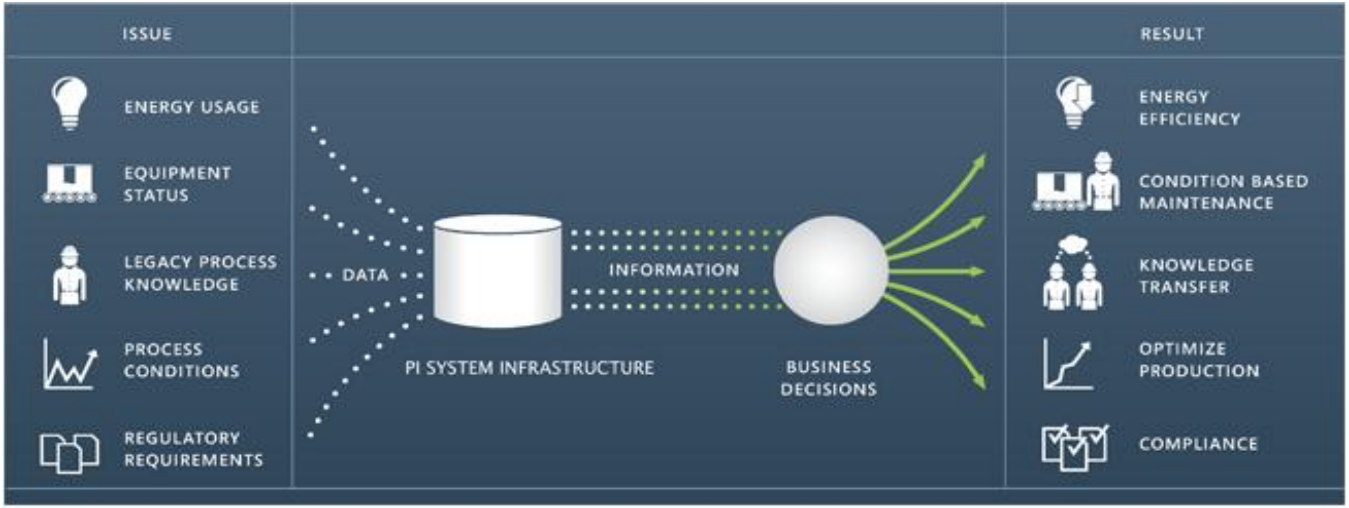


OSI PI - What is next

Adding Value through…

- Operational Excellence
- Reliability Improvements
- Strategy Development
- **Central Diagnostics**

From reactive to proactive



Operational Diagnostic Centre and APR Deployment

Operations Diagnostic Centre

Predict It

Advanced Pattern Recognition

"Finding failures before they find us"

Early Warning System

- Providing diagnostic service to Group Operations Business Units
- Foresight through early fault detection (weeks & months vs hours)

Procurement

- Four initial tender applications
- Predict It software selected
- Centralised or Site Diagnostics
- 3 month evaluation period……

USA site visit to two advanced pattern recognition users

Challenges -

- **Installation**
- Resources
- Site engagement
- Model Build
- Communications

Installation of the Software
That was the easy bit.

Challenges -

- Installation
- **Resources**
- Site engagement
- Model Build
- Communications

- One resource – first 6 months
- Three month assistance from Predict It
- Secondment
- Site knowledge

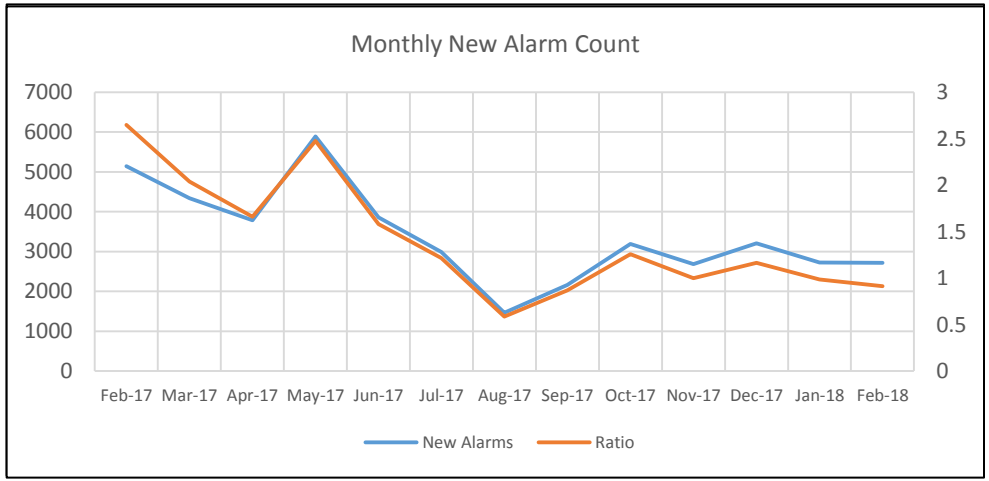
Challenges -

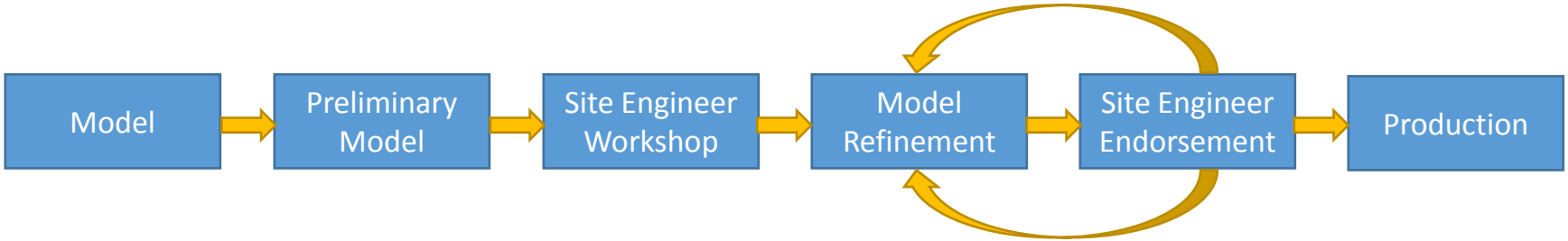
- Installation
- Resources
- **Site engagement**
- Model Build
- Communications

- Started with Site information sessions – Symposiums
- Engage one on one with engineers
- Types of Engagement
  - Welcomes the technology and functionality
  - Passive Resistance
  - Not Engaged – We don’t need this product
    - The most challenging to overcome

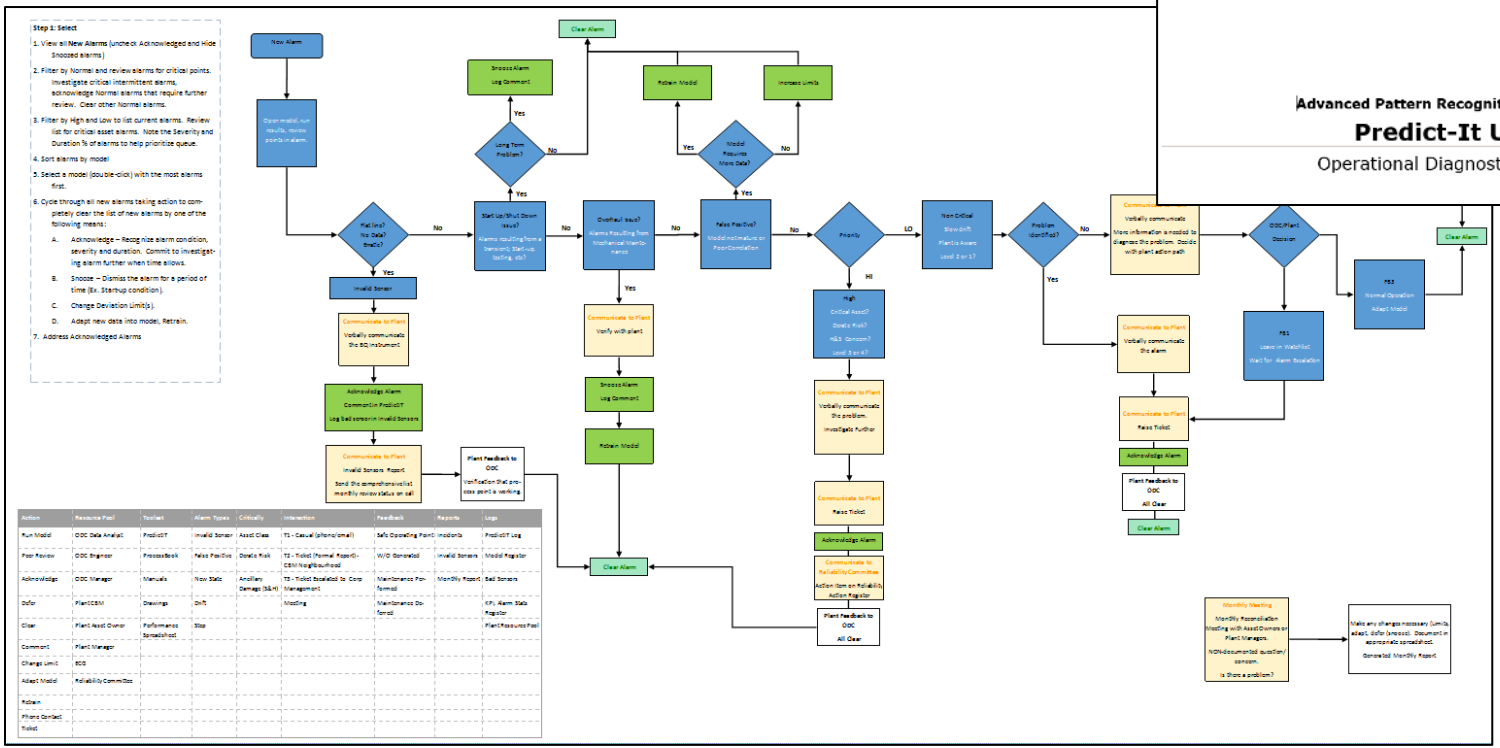
Model Build

Model build must be sustainable
Build engineering and site buy in
Alarm and build management
- Morning – Alarm management
- Afternoon – Model build





Communications



Action	Resource Pool	Toolset	Alarm Types	Criticality	Interaction	Feedback	Reports	Logs
Run Model	OOC Data Analyst	PredictIT	Invalid Sensor	Asset Class	T1 - Casual (phone/email)	Safe Operating Point	Incidents	PredictIT Log
Peer Review	OOC Engineer	Process Book	False Positive	Drastic Risk	T2 - Ticket (Formal Report) - CBM Neighborhood	W/O Generated	Invalid Sensors	Model Register
Acknowledge	OOC Manager	Manuals	Slow Static	Ancillary Damage (S&H)	T3 - Ticket Escalated to Corp Management	Maintenance Performed	Monthly Report	Bad Sensors
Defer	PlantCBM	Drawings	Drift		Meeting	Maintenance Deferred		KPI: Alarm State Register
Clear	Plant Asset Owner	Performance Spreadsheet	Step					Plant Resource Pool
Comment	Plant Manager							
Change Limit	BCG							
Adapt Model	Reliability Committee							
Retrain								
Phone Contact Ticket								

Everybody has an opinion

Talk to the Engineers

We are the experts

Create SAP Notifications

Don’t talk to the Engineers

Talk to Maintenance

Don’t talk to Maintenance

Let the Sites look after the models

Talk to the Operators

Create Tickets

I wouldn't do it that way

You need to do it this way

Send Emails





Communications – Stepped Approach

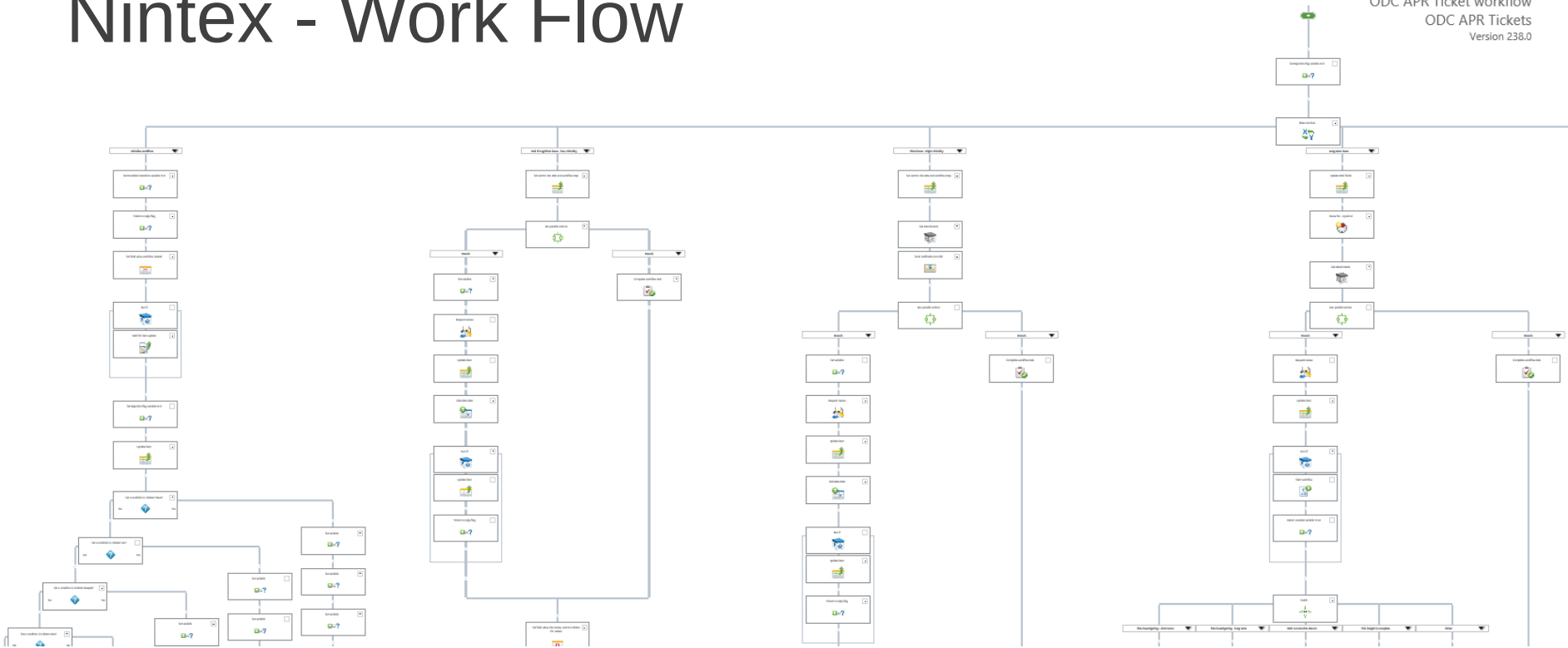
Initial direct communications with site engineer

ODC email address

Nintex Ticket system – Plant Insights

- Easily accessible
- Work flow
- History

Nintex - Work Flow



Nintex - Ticketing

Ticket Header information

Free text information

Attached supporting documentation

ODC Plant Insight - Details

Insight ID	225	Title *	LY Unit 2 Turbine Bearing 5 vibration step change
Site	Loy Yang Station	Tag name *	LYP.U2.540C060.PV
Unit Select *	Unit 2		
Insight Type *	Pi Tag	Tag description *	Turb Brg 5 Vibration
Severity *	2		
APR Model No	249	Tag value *	4.4 mm/sec
WO No.			
		Expected value *	3.6 mm/sec
		Average peer value *	Normally below 3 mm/sec
		Alert Date *	14/03/2018

Plant Insight Details

Deepak Patel (19/03/2018 3:44 PM):
Reply received form Neil Griffiths:"

Hi Ken,

I haven't yet been able to find anything abnormal that might explain the recent increase in bearing 5 & 7 vibrations. All electrical, seal oil, stator water, etc readings appear to be normal.

I noticed that the bearing 5 & 7 vibration levels also did an upward step change when the unit came back to service after the trip on 8/3/18.

One possible explanation could be shorted turns within the rotor winding. These can show up as increased bearing vibrations and can develop during winding contraction/expansion, eg, unit trips.

Shorted turns are unlikely to be the cause of the increased vibrations, as the rotor is fairly new (manufactured in 2010 and less than 7 years operation).

I will arrange electrical testing during to be done during the U2 minor outage later this year to confirm this.

Neil

Deepak Patel (15/03/2018 10:16 AM):
Reply received from Ken Grove:"

Hi Griffo,

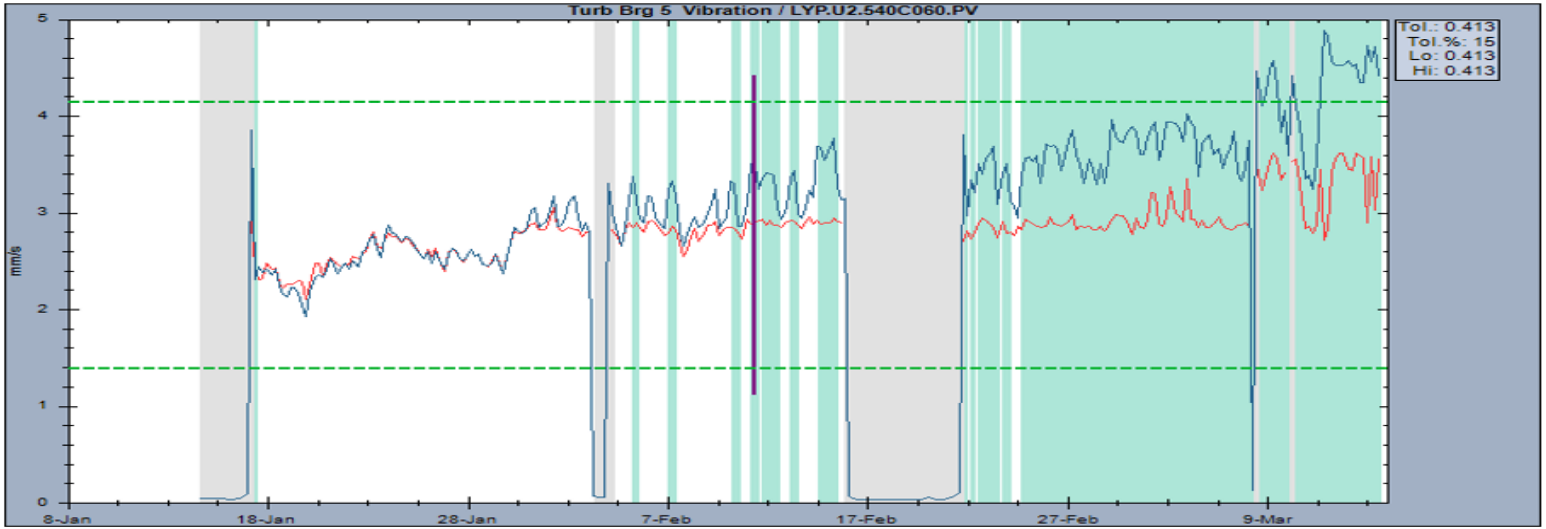
Unit 2 Bearing 5 vibration has been gradually increasing over the past couple of months. See trend below.

LY Unit 2 Turbine Bearing 5 vibration step change_14032018.docx

Loy Yang Station Unit 2 TG – Turbine Bearing 5 Vibration step change

Tag: LYP.U2.540C060.PV

Chart: LY Unit 2 Turbine Bearing 5 vibrations over last 2 months



For Predict-it trend…

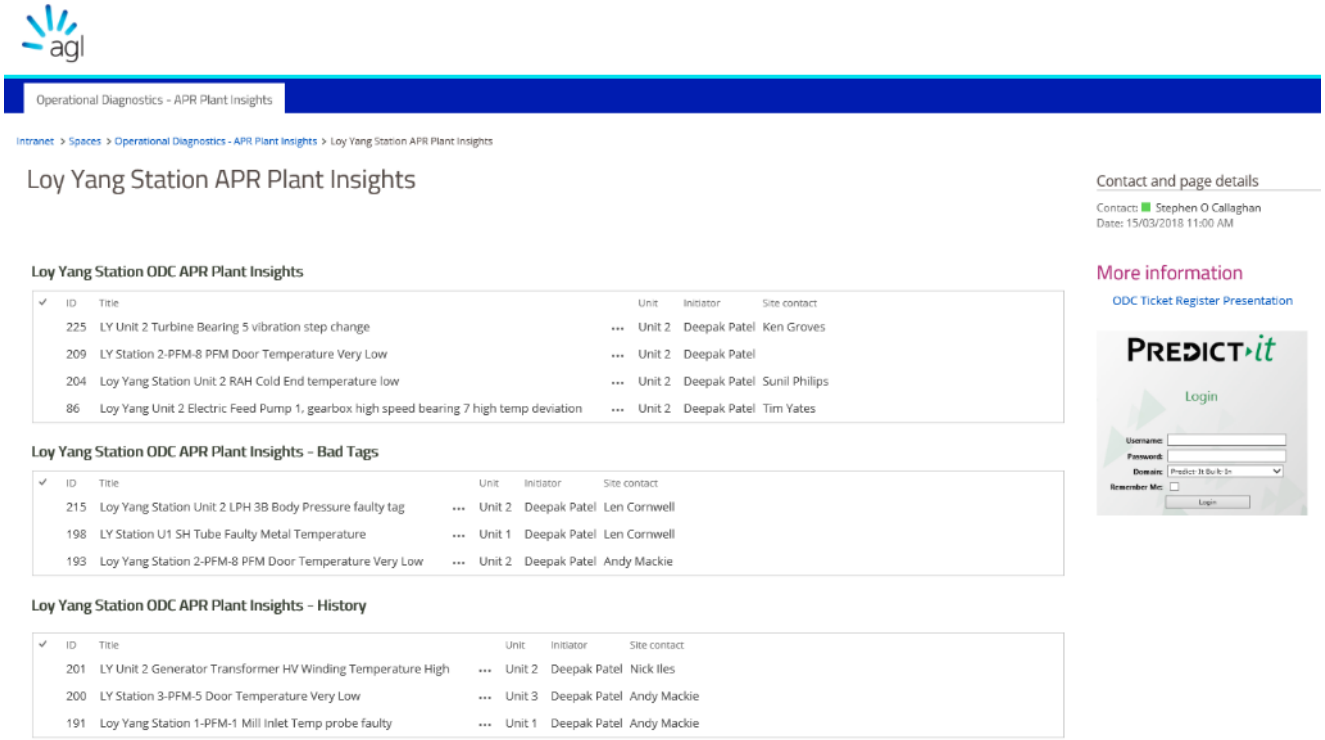
Blue trend = Actual value, Red trend = Predicted value, Green highlighted area = Predict-it alarm, Gray highlighted area = Model not running

Nintex - Dashboard

Tailored Dashboards

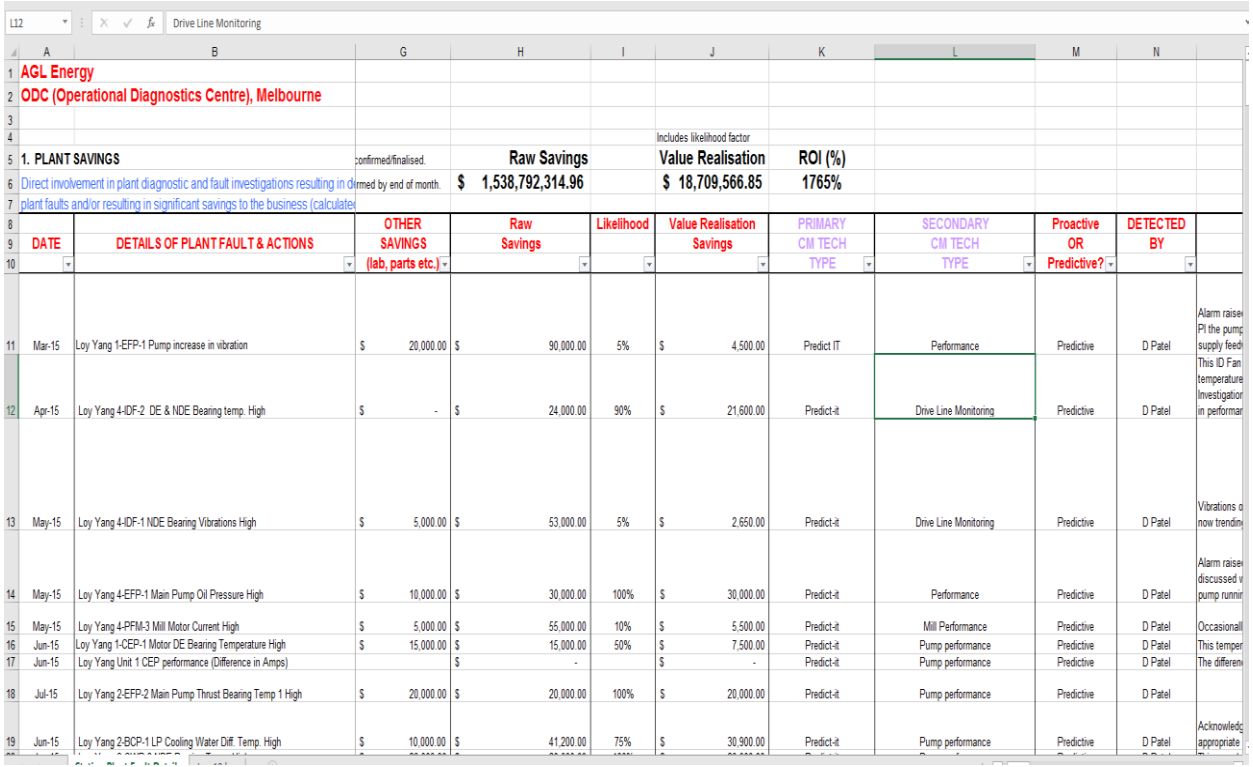
Business Unit Overview

Engineering Reviews



Value Realisation

- VR a must to stay in Business
- Monthly Reporting
- VR to Date: $18.7M

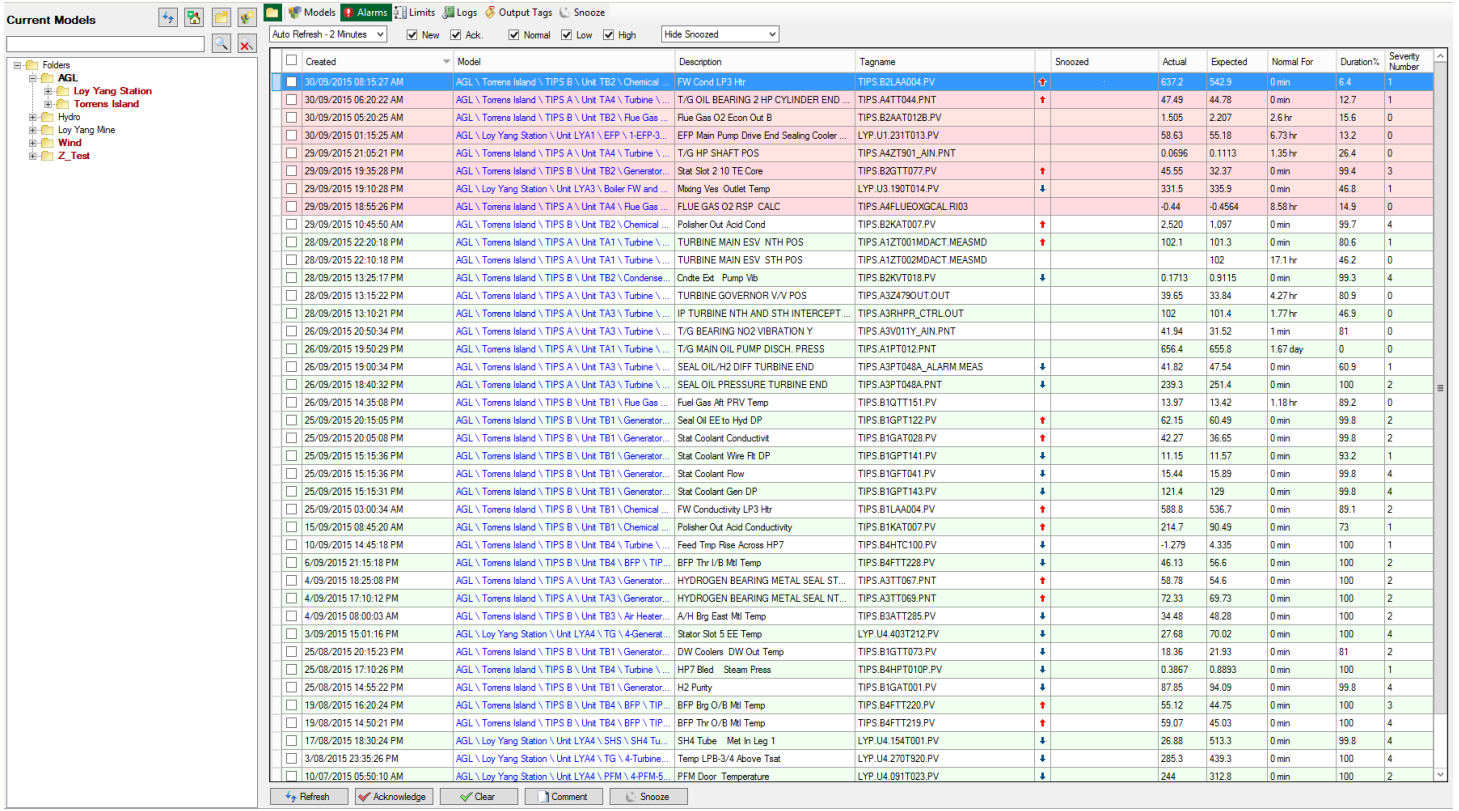


L12 | Drive Line Monitoring

	A	B	G	H	I	J	K	L	M	N
1	AGL Energy									
2	ODC (Operational Diagnostics Centre), Melbourne									
3										
4						Includes likelihood factor				
5	1. PLANT SAVINGS		confirmed/finalised.	Raw Savings		Value Realisation	ROI (%)			
6	Direct involvement in plant diagnostic and fault investigations resulting in d		rmed by end of month.	$ 1,538,792,314.96		$ 18,709,566.85	1765%			
7	plant faults and/or resulting in significant savings to the business (calculate									
8			OTHER	Raw	Likelihood	Value Realisation	PRIMARY	SECONDARY	Proactive	DETECTED
9	DATE	DETAILS OF PLANT FAULT & ACTIONS	SAVINGS	Savings		Savings	CM TECH	CM TECH	OR	BY
10			(lab, parts etc.)				TYPE	TYPE	Predictive?	
11	Mar-15	Loy Yang 1-EFP-1 Pump increase in vibration	$ 20,000.00	$ 90,000.00	5%	$ 4,500.00	Predict IT	Performance	Predictive	D Patel
12	Apr-15	Loy Yang 4-IDF-2 DE & NDE Bearing temp. High	$ -	$ 24,000.00	90%	$ 21,600.00	Predict-it	Drive Line Monitoring	Predictive	D Patel
13	May-15	Loy Yang 4-IDF-1 NDE Bearing Vibrations High	$ 5,000.00	$ 53,000.00	5%	$ 2,650.00	Predict-it	Drive Line Monitoring	Predictive	D Patel
14	May-15	Loy Yang 4-EFP-1 Main Pump Oil Pressure High	$ 10,000.00	$ 30,000.00	100%	$ 30,000.00	Predict-it	Performance	Predictive	D Patel
15	May-15	Loy Yang 4-PFM-3 Mill Motor Current High	$ 5,000.00	$ 55,000.00	10%	$ 5,500.00	Predict-it	Mill Performance	Predictive	D Patel
16	Jun-15	Loy Yang 1-CEP-1 Motor DE Bearing Temperature High	$ 15,000.00	$ 15,000.00	50%	$ 7,500.00	Predict-it	Pump performance	Predictive	D Patel
17	Jun-15	Loy Yang Unit 1 CEP performance (Difference in Amps)		$ -		$ -	Predict-it	Pump performance	Predictive	D Patel
18	Jul-15	Loy Yang 2-EFP-2 Main Pump Thrust Bearing Temp 1 High	$ 20,000.00	$ 20,000.00	100%	$ 20,000.00	Predict-it	Pump performance	Predictive	D Patel
19	Jun-15	Loy Yang 2-BCP-1 LP Cooling Water Diff. Temp. High	$ 10,000.00	$ 41,200.00	75%	$ 30,900.00	Predict-it	Pump performance	Predictive	D Patel

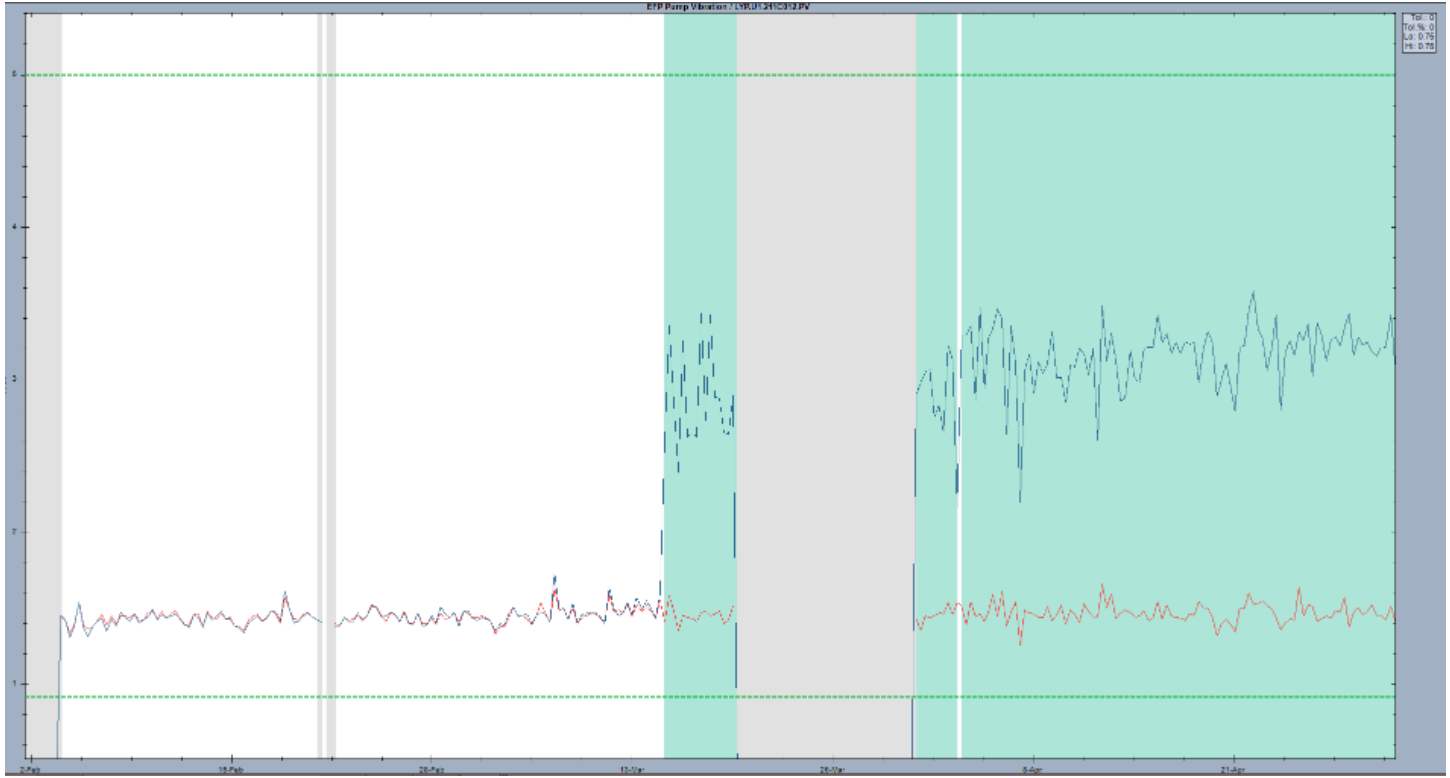
1-EFP-1

- 1-EFP-1 Alarm raised
- Initial Investigation



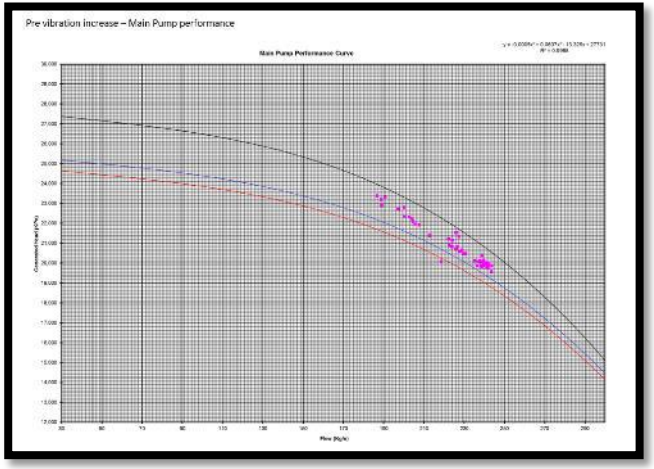
1-EFP-1

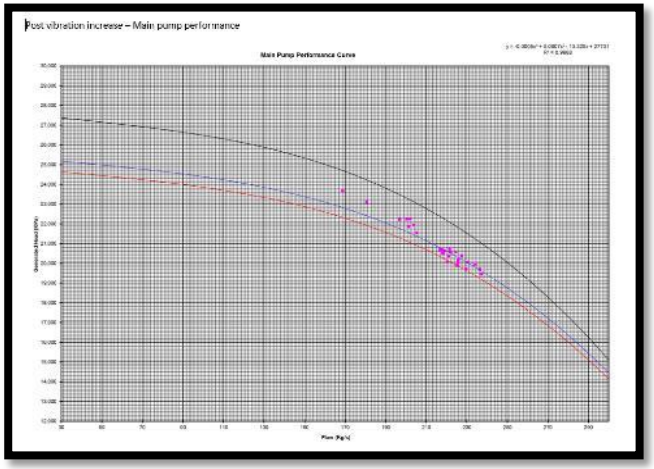
- 1-EFP-1 Alarm raised
- Initial Investigation



1-EFP-1

- 1-EFP-1 Alarm raised
- Initial Investigation
- Performance Monitoring via PI system
- Vibration increase and Performance loss confirmed





1-EFP-1

- 1-EFP-1 Alarm raised
- Initial Investigation
- Performance Monitoring via PI system
- Vibration increase and Performance loss confirmed
- Communication with site Engineer and Condition Monitoring Team
- Formal Communications with agreed actions

AGL Energy in action.

Ticket: ODC0001 / Loy Yang Station 1-EFP-1 High Vibrations

PREDICT-it Predictive Modeling for Process Data

Plant:	1-Electric Feed Pump-1 1-EFP-1	**Model:** **Tag:**	Loy Yang\Unit1\1-EFP-1_Mech *LYP.U1.211C012.PV*
Date Alarmed:	14/3/2015	**Notification Date:**	7/4/2015
Alarm Description:	1-EFP-1: Main pump experienced a step change in vibrations of approx. 1.5 mm/sec, with the pump now operating at 3mm/s. Previous to the step change vibrations had been steady at 1.5 mm/s. This step change and alarm within the APR software was noticed during the model build for the feed pump. The pump was taken out of service within 3 days of the step change and returned to service on the 31st April with the increased levels. A step change in main pump performance was also noticed at the time of the step change in vibrations. Drop in performance of 2.5%.		
Alarm Deviation:	Expected Value: Actual Value: Deviation:		
Actions:	ODC to increase the vibration limit to 4 mm/s and the ODC to continue to monitor. Business Unit to schedule a rebuild of the pump.		

Further Information:

2/4/15: Tim Yates/Peter Fanning

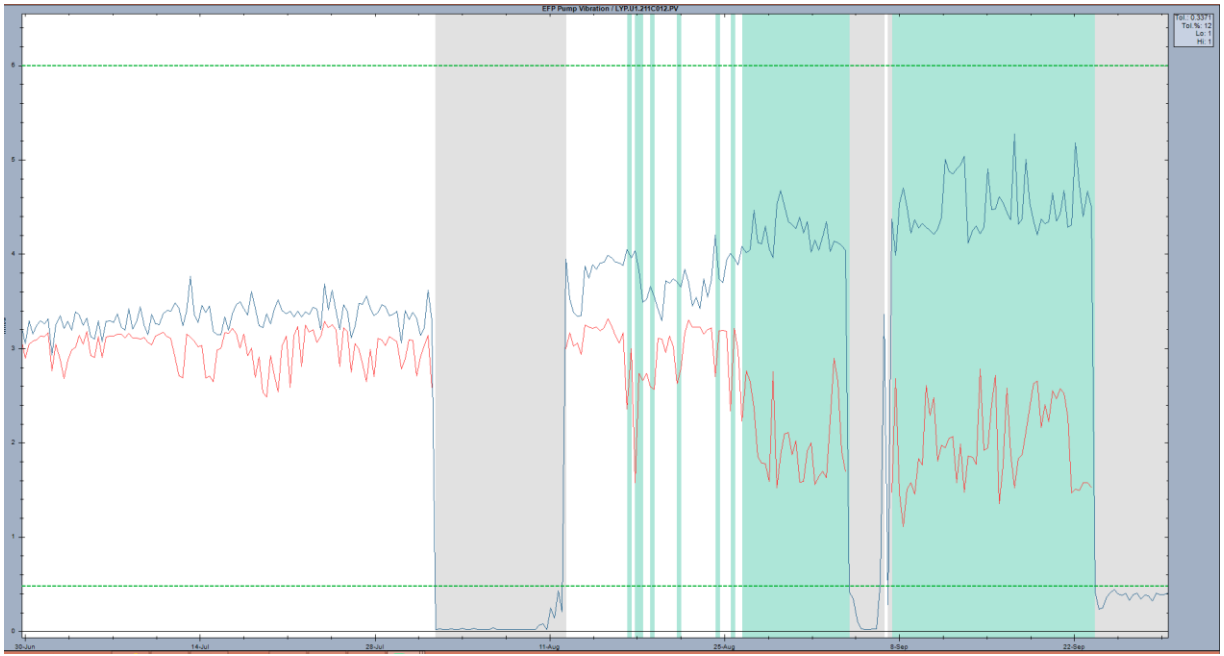
Meeting with Tim and Peter to communicate APR alarm. Please see attached alarm and performance data.

Tim to investigate reason for step change, indication at present is that the pump internal seals have wiped, increasing internal clearances and reducing pump performance.

Support Documentation:

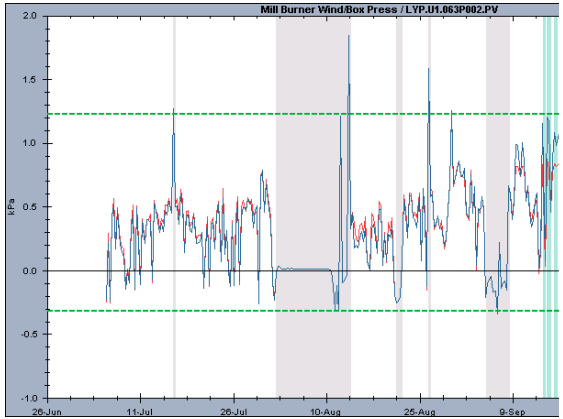
1-EFP-1

- 1-EFP-1 Alarm raised
- Initial Investigation
- Performance Monitoring via PI system
- Vibration increase and Performance loss confirmed
- Communication with site Engineer and Condition Monitoring Team
- Formal Communications with agreed actions
- ODC conducts further monitoring as agreed
- Site programs pump overhaul for next available maintenance opportunity

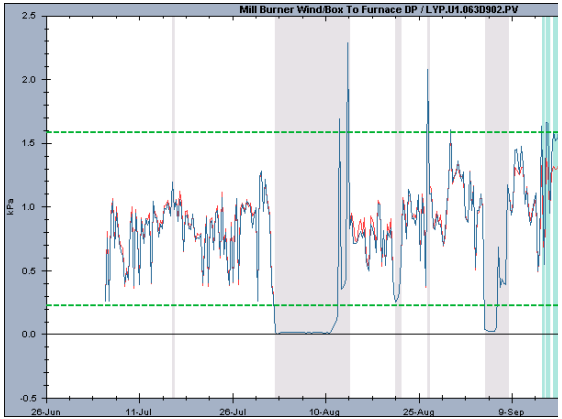


1-PFM-1 Expansion Joint Alarm

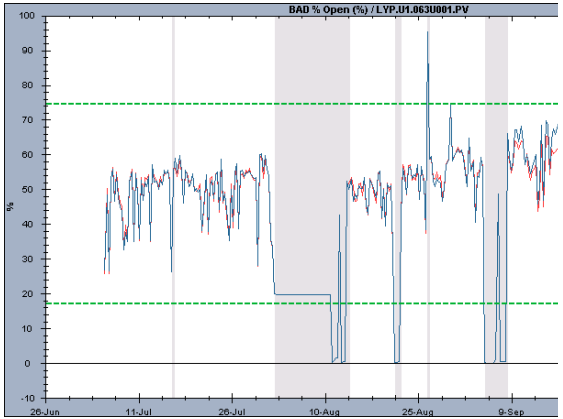
Alarm 1: Mill Burner Wind/Box Pressure is trending high (Tag: LYP.U1.063P002.PV)



Alarm 2: Mill Burner Wind/Box To Furnace DP is trending high (Tag: LYP.U1.063D902.PV)



Alarm 3: BAD % Open (%) (Tag: LYP.U1.063U001.PV) is also showing a considerable step change.



- Initial alarm raised in Predict it
- Acknowledged by the ODC
- ODC confirmed alarm with other plant and units

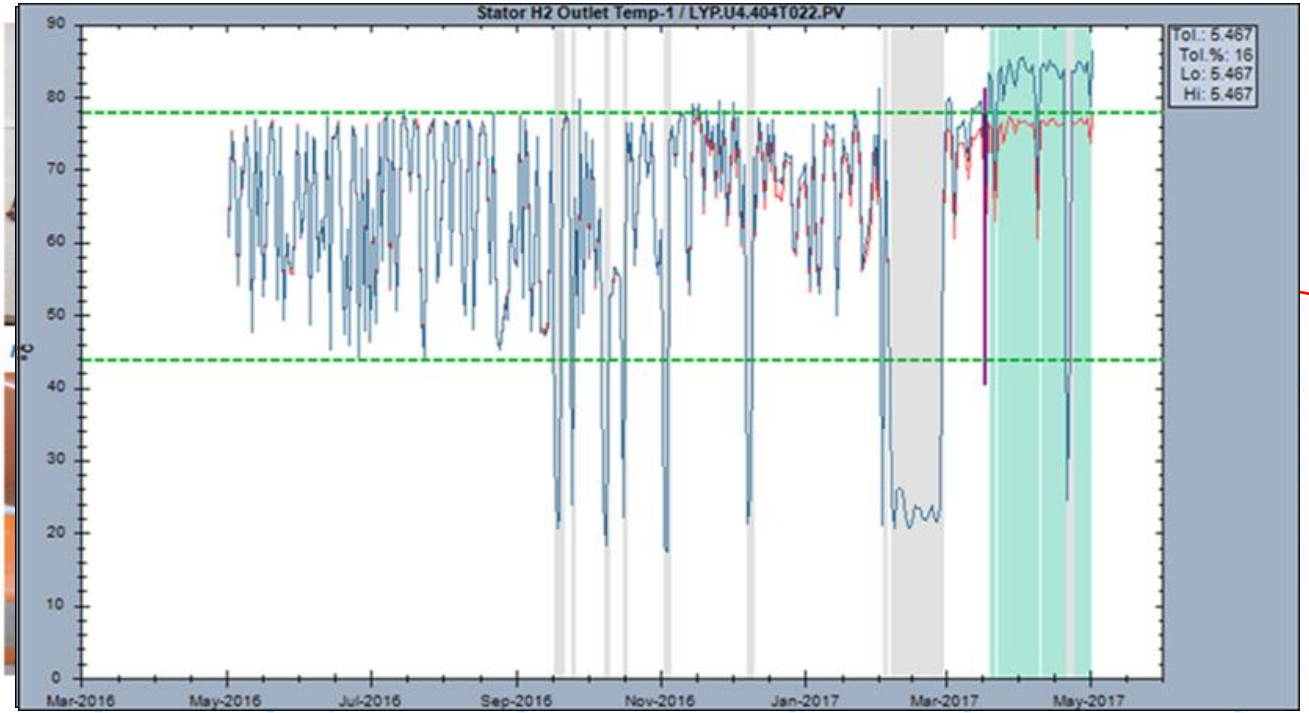
- Ticket raised and business unit notified by email and phone

1-PFM-1 Expansion Joint Alarm

- Responsible engineer confirmed the alarm and initiated inspection of the plant.
- Confirmed air leakage from the expansion joint
- Work order for inspection raised by business unit at the upcoming Outage – 3 weeks
- Inspection resulted in repair of expansion joint. Program to be replaced next outage.
- Adverted 2 day forced outage
- Est VR $417,200.00
- Learnings documented, to be evaluated on other sites

July 17 ODC: Significant Failure Avoided

- Loy Yang Station U4 Generator, 560MW, Hydrogen Cooled Stator



May 2017
Hydrogen Outlet #1 found to be above Predict It calculated expectation

July 2017
Hydrogen Outlet #1 temperature rises to the Predict It calculated expectation

Unit repaired in situ 4.5 weeks (estimated 12-14weeks)

Unit placed under close observation

Avoided loss of generation and comprehensive inspection actioned

Operational Diagnostic Centre

Set up of Advanced Pattern Recognition across 10,000MW
Centralised Diagnostic Centre to monitor AGL generation
Thermal, Hydro, Solar, Wind and Gas assets.

CHALLENGE

Provide advanced pattern Recognition diagnostics capabilities services to Group Operations BUs.

- Site engagement and buy in
- Model build expectations
- Alarm management

SOLUTION

Priority Model Build and Collaborative approach with site engineering team

- Predict It
- OSI PI
- Face to Face collaboration

RESULTS

Successful deployment of ODC and APR.

Site engineering engagement with engineering team ownership of the models

- Overall savings since installation of 18.7M
- Total set up cost $1.2M
- Annual running costs $620k
- Over 2700 models monitoring over 45k critical points every 5 minutes

AGL's Advance Pattern Recognition Implementation Journey

- Mark Faith
- MFaith@agl.com.au
- Manager ODC and Technology
- AGL

Questions

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

State your **name & company**

Please remember to…

Complete the Online Survey for this session

Merci

谢谢

Danke

Спасибо

Gracias

Thank You

감사합니다

ありがとう

Grazie

Obrigado

Optional: Click to add a takeaway you wish the audience to leave with.