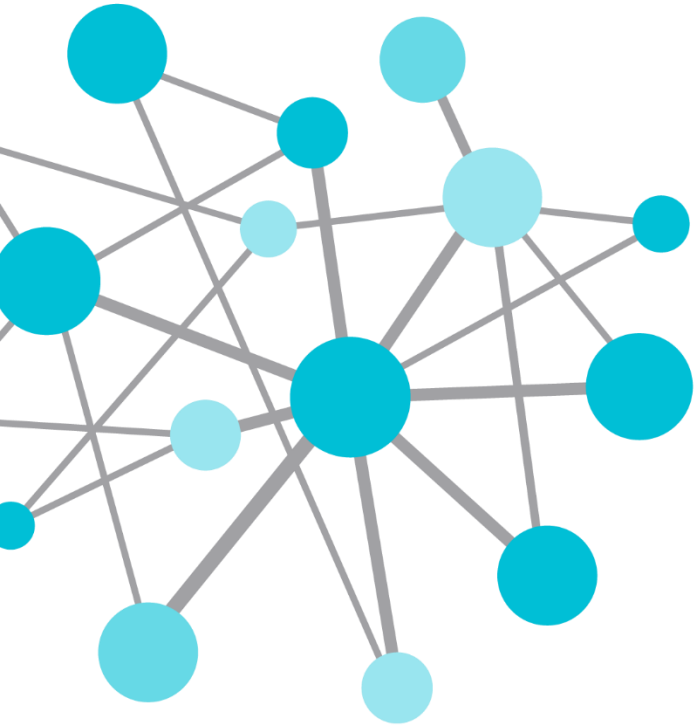

Using the PI System to Improve Safety at Suncor's SAGD Operations

Presented by **Tripti Somani**

Tom Luo

SUNCOR

Agenda

- Suncor at a Glance
- History with the PI System
- Improving Safety and Performance
  - Observations wells monitoring for Steam-Assisted Gravity Drainage (SAGD) operations
  - Safety Interlock Bypass Monitoring and Reporting
- Concluding Remarks

About Suncor

Canada's Leading Integrated Energy Company

- HQ in Calgary
- 14,000 employees
- Global E&P ~170 kboe/d
- Oil Sands – ~499 kbbls/d
- 4 Refineries – 460k kbbls/d
- +1,500 Petro-Canada stations
- 6 wind farms – 255 MW
- 1 Ethanol Plant

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Our Journey from a “Historian” to an Infrastructure

- **First PI System installed in 2006 at Firebag SAGD**

- **Current installed base**
  - 4 sites/18 EA PI System servers, 2 non-EA sites/3 server w ~100k tags
  - PI-AF, PI Notification, PI ACE, and other advanced functionality
  - Remote asset surveillance and support of all PI installations (Managed PI)
- **EA Signed in late 2009 covering our In Situ operations**
- **EA Expanded in late 2012 to include Oil Sands (Mines, Extraction, Upgraders, E&U)**
- **Key areas of Use:**
  - Operations visibility and KPI
  - Energy and environmental regulatory reporting (WPT, MARP)
  - Plant & Asset performance and monitoring
  - **Assist in managing safety**

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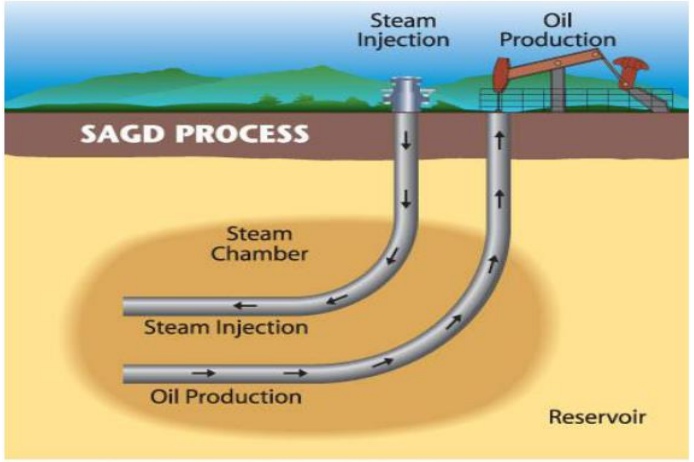
Steam-Assisted Gravity Drainage (SAGD)

- Approximately 80% of Canada's Oil Sands too deep to mine
- Two key SAGD facilities – Firebag & MacKay River
- Parallel pairs of horizontal wells are drilled:
  - one for steam injection
  - one for oil recovery
- Safety and Operational challenges:
  - Large numbers of assets and instrumentations
  - Complex logic and criteria
  - Process Changes



Source: Canadian Centre for Energy Information

Enhancing SAGD Operational Safety & Reservoir Monitoring & Optimization

"Any abnormal reservoir responses are captured automatically and alert the responsible parties immediately, so that prompt actions are taken place to ensure a safe operation."

Manager Reservoir Management, Firebag

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Business Challenge

- Identify abnormal pressure, temperature and steam migration outside of the reservoir
- Real-time information for large number of wells and conditions

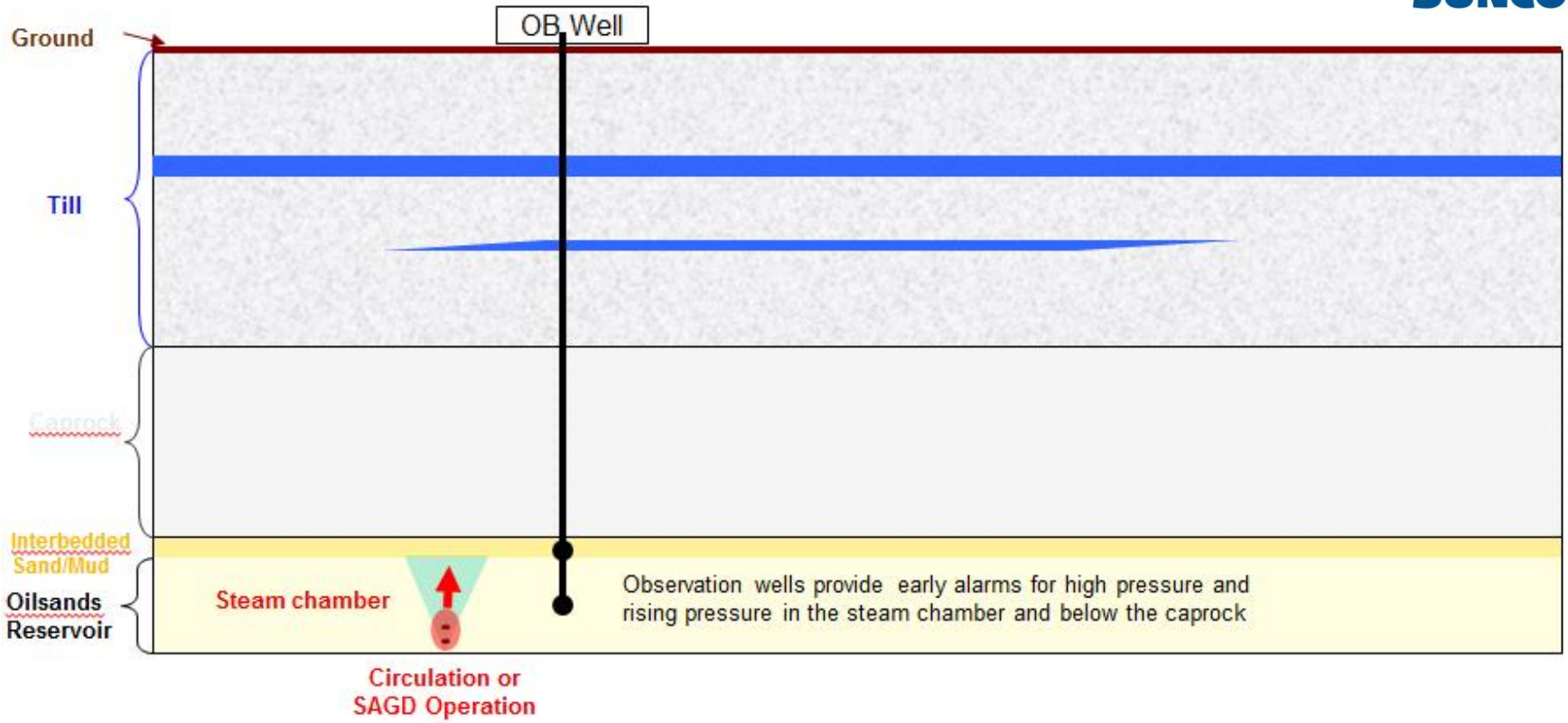
Solution

- Selected and installed the PI System as a real-time integration infrastructure
- PI System infrastructure key components - PI-AF, PI Notifications

Results and Benefits

- Enable enhanced safety, environment & production
- Assist in SAGD operations, & asset reliability & optimization
- Continuous improvement, and collaboration

Proactive Reservoir Monitoring – The Role of Observation Wells



Legacy Monitoring System without PI AF

SQL Tables

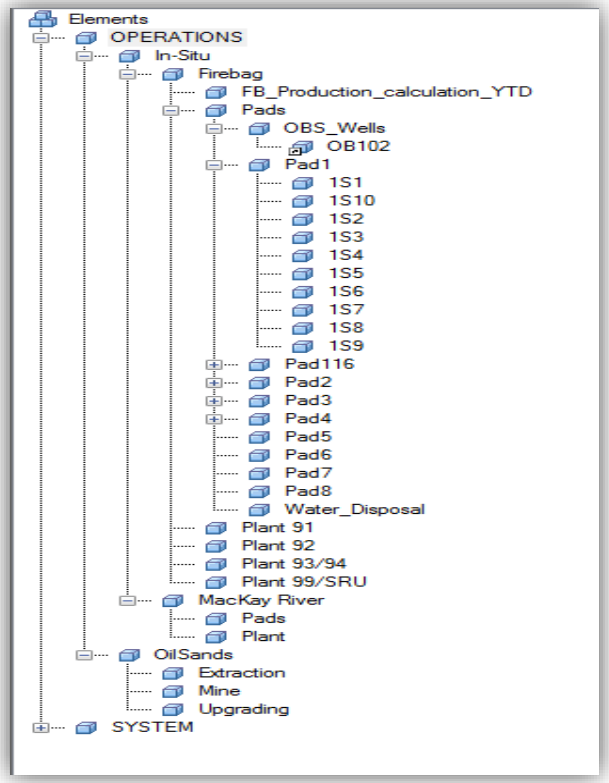
- dbo.Notification_Config
- dbo.Notification_Contacts
- dbo.Notification_Tag_Contacts
- dbo.Notification_Users

Challenges:

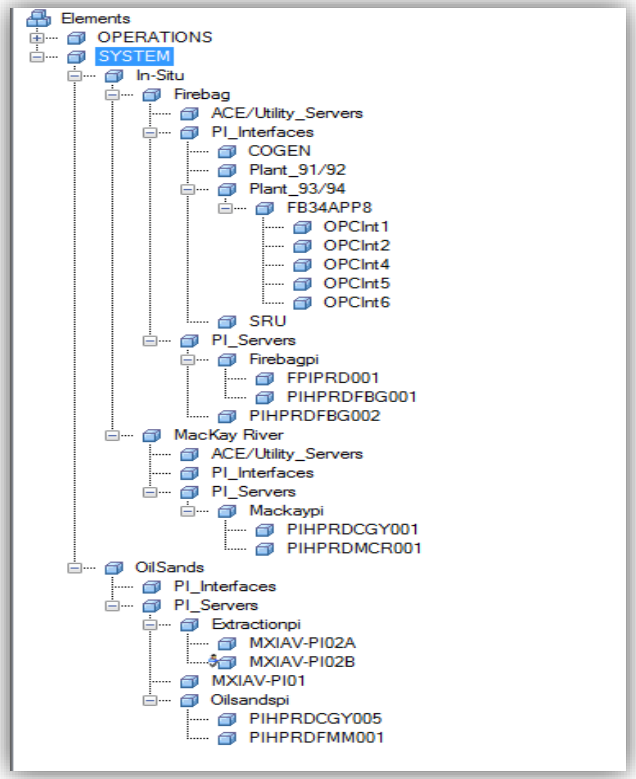
- Longer development time
- Unhandled exceptions trigger false alarms
- Challenge to manage business change requests

Synchronization of Object Models

Production Model



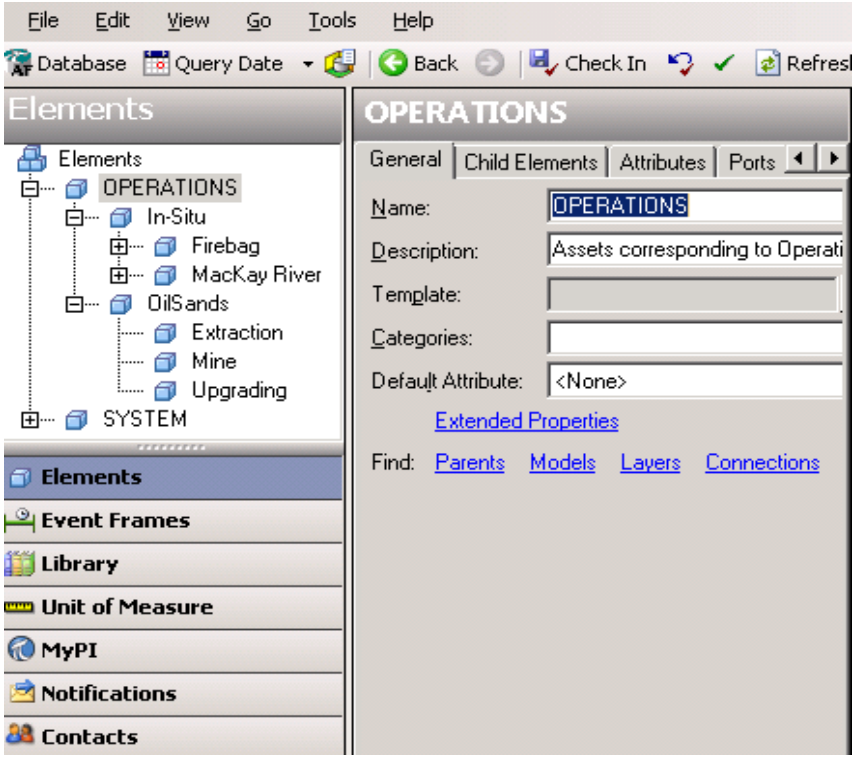
System Model



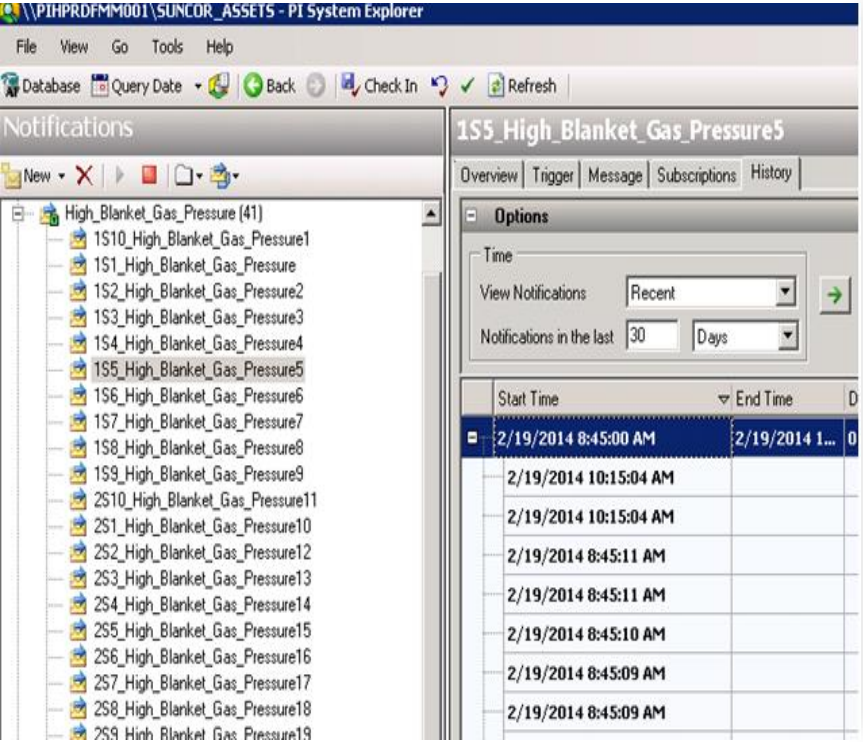
PI AF and PI Notifications

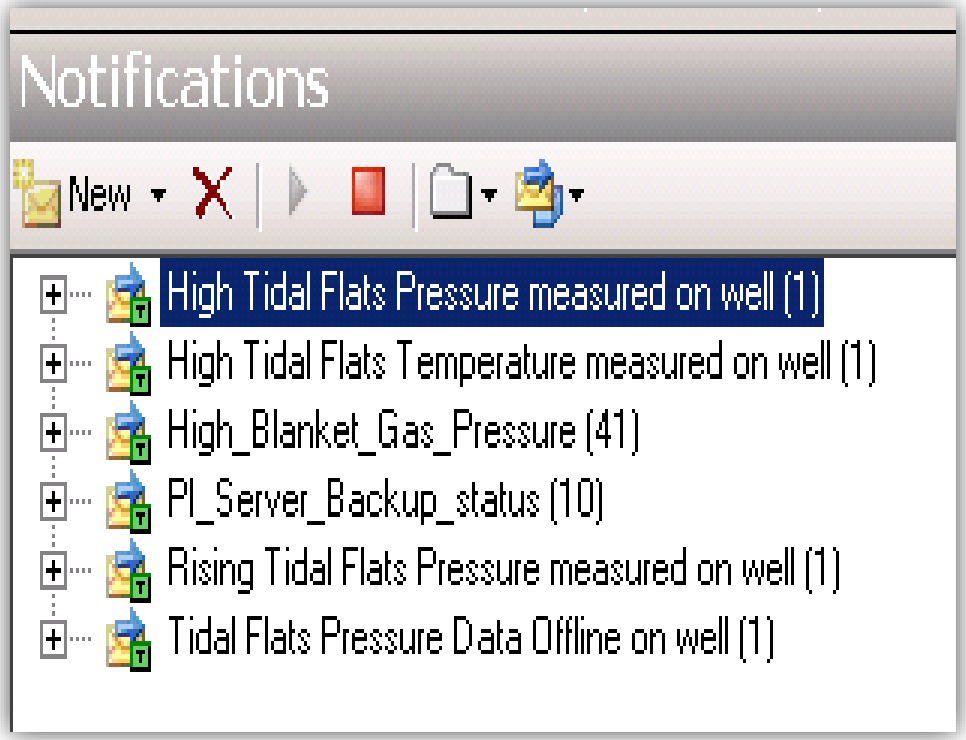
- **Ease of use**
  - Templates to set up new notifications
  - Support & development
- **Better Exceptions handling**
- **Highly reliable than custom code**
- **No False Alarms**
- **Historize notifications**

High or lower levels alarms available on DCS.

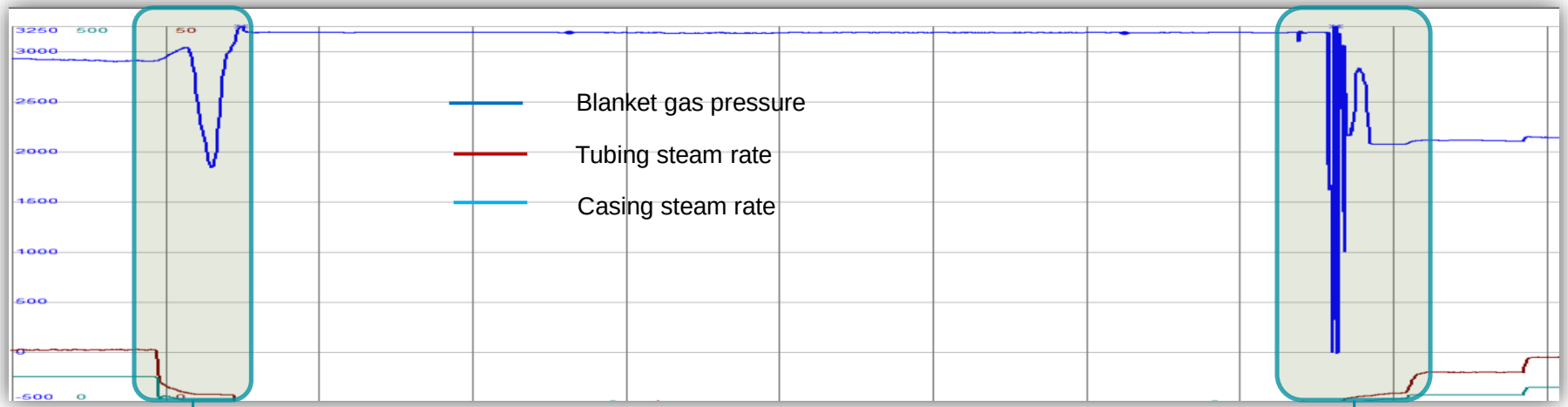


PI AF and PI Notifications





High Blanket Gas Pressure



Blanket gas pressure increased

Alert type: High Blanket Gas Pressure

Investigation

Reservoir Engineer called the field to get the confirmation that there was a hydrate/freezing in the pipeline which caused the blanket gas pressure to increase.

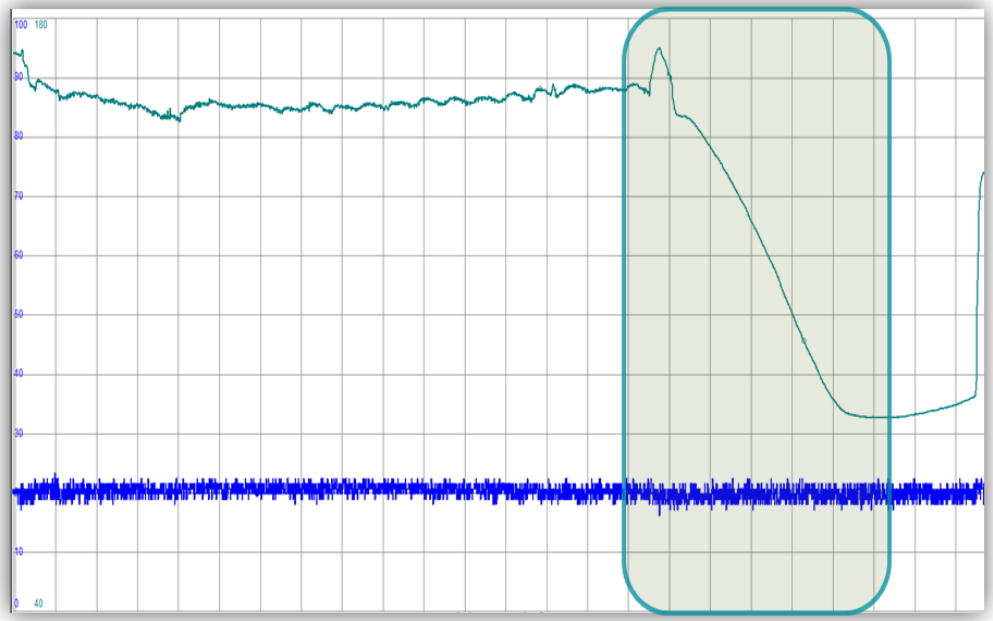
End of alarm status

High Blanket Gas Pressure Alarm Ended.

Low Flow alerts on ESPs (electric submersible pump)

A Low Flow event was detected in one of the pumps based on wellhead temperature fall off

- Lost production
- Potentially fail of an ESP, around $0.5 million at risk
- 130+ wells at Firebag



Using the PI System to Monitor Critical Interlock Bypasses and Equipment Trips

It is very important to continuously monitor and audit safety critical bypasses as bypasses compromise the protection functions that are designed to protect human Health & Safety and the Environment.

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Business Challenge

- Thousands of bypass tags
- Custom logic and reporting requirements
- Multiple points can be used to monitor one bypass

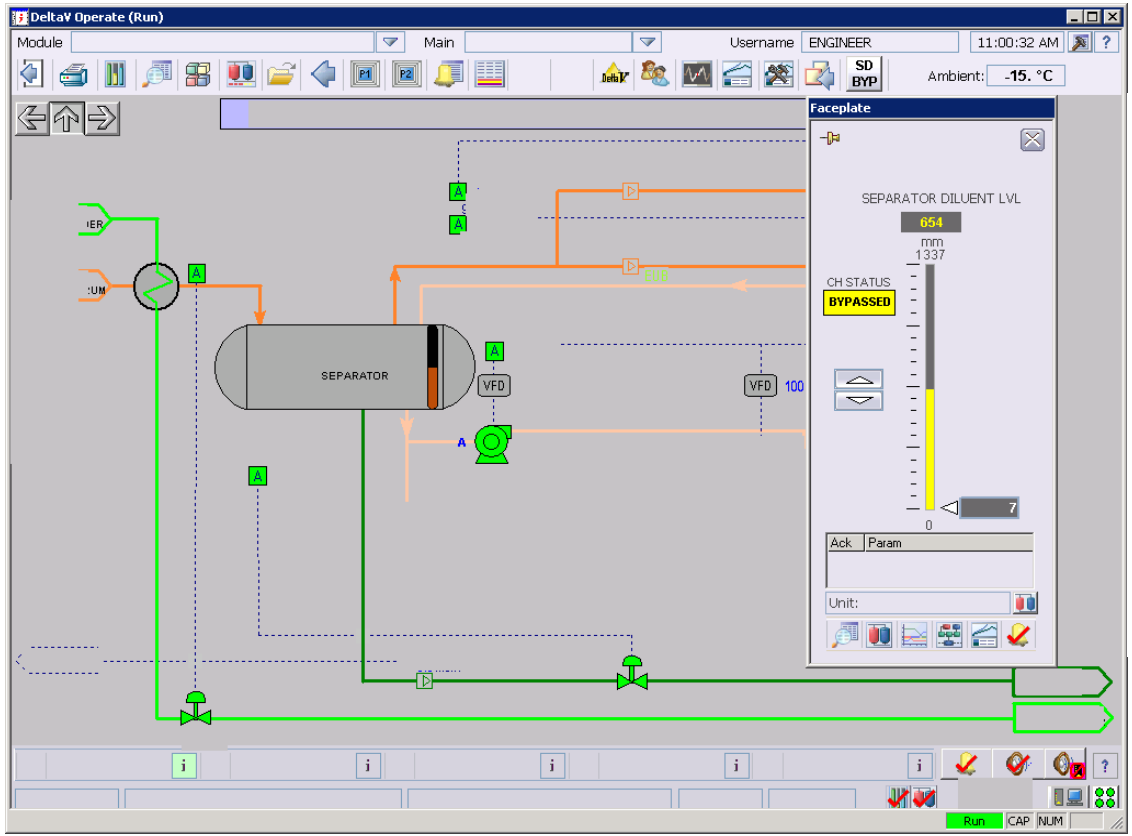
Solution

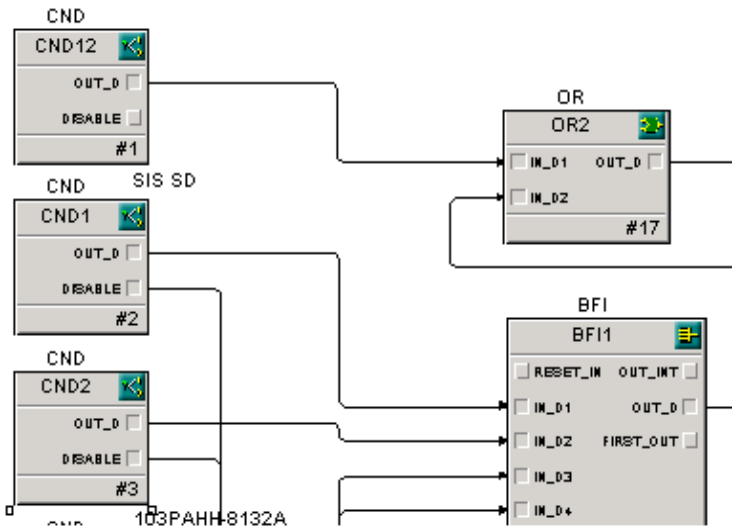
- Monitor, report, and audit safety critical bypasses through
  - PI Data Access Server,
  - PI JDBC
  - ETL and BI

Results and Benefits

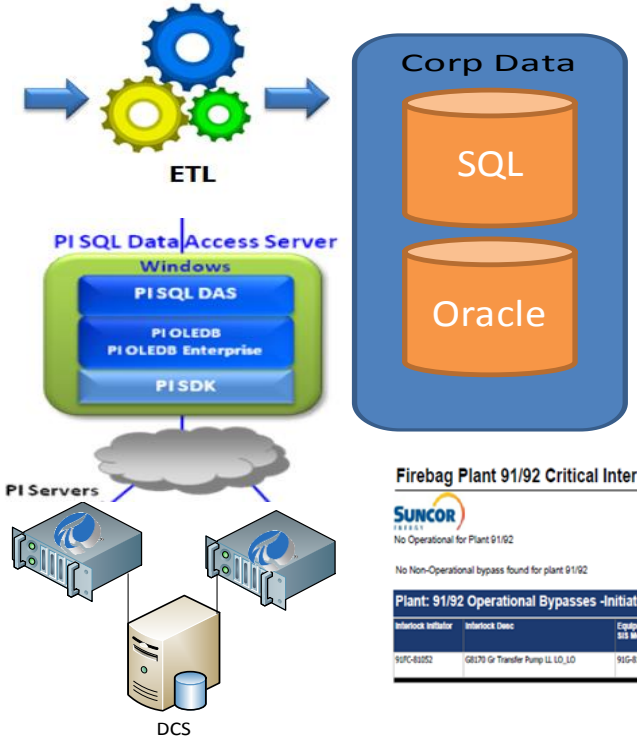
- Improved governance of critical interlock bypass
- Ability to track bypass history for audit purposes
- Enable risk mitigation planning (responsible groups, bypass duration)

Example - Bypass in Control System

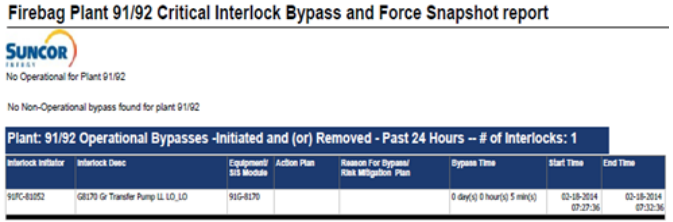




Data Flow for the Bypass & Equipment Trips Monitoring



DCS -> PI System -> PI JDBC -> SQL -> Business Intelligence Tools



Firebag Plant 91/92 Critical Interlock Bypass and Force Snapshot report

SUNCOR ENERGY

No Operational for Plant 91/92

No Non-Operational bypass found for plant 91/92

Plant: 91/92 Operational Bypasses -Initiated and (or) Removed - Past 24 Hours -- # of Interlocks: 1

Interlock Initiator	Interlock Desc	Equipment/ SIS Module	Action Plan	Reason For Bypass/ Risk Mitigation Plan	Bypass Time	Start Time	End Time
91FC-81052	GB170 Gr Transfer Pump LL LO_LO	91G-8170			0 day(s) 0 hour(s) 5 min(s)	02-18-2014 07:27:36	02-18-2014 07:32:36

Extract history from PI Archive into SQL

jdbc:pisql://localhost/Data source=FIREBAGPI; Integrated Security=SSPI; command timeout = 1200;

JDBC driver*: com.osisoft.jdbc.Driver*

SQL

```
SELECT tag,time as tag_time,value as tag_value,status from PIARCHIVE..PICOMP2
where tag  in
(     AI-9150/BP_ACK.CV',
'     I-9151/BP_ACK.CV',
'     I-9152/BP_ACK.CV',
'     I-9153/BP_ACK.CV',
'     I-9157/BP_ACK.CV',
'     I-9159/BP_ACK.CV',
'     I-9161/BP_ACK.CV',
'     I-9163/BP_ACK.CV',
'     I-9165/BP_ACK.CV',
```

Firebag Plant 91/92 Critical Interlock Bypass and Force Snapshot report

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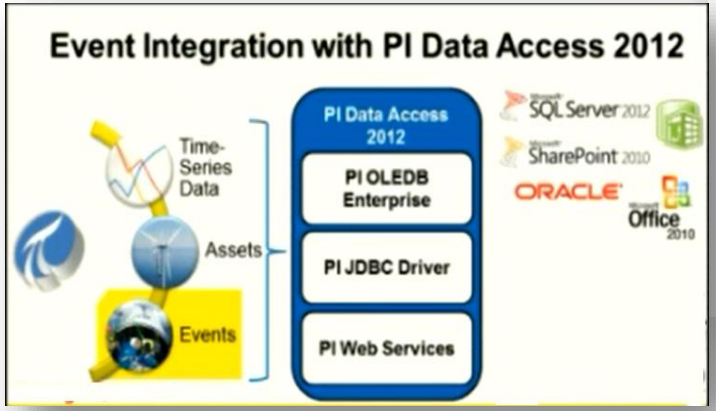
Interlock Initiator	Interlock Desc	Equipment/ SIS Module	Action Plan	Reason For Bypass/ Risk Mitigation Plan	Bypass Time	Start Time	End Time
91FC-81052	G8170 Gr Transfer Pump LL LO_LO	91G-8170			0 day(s) 0 hour(s) 5 min(s)	02-18-2014 07:27:36	02-18-2014 07:32:36

Equipment Trip Report

To be replaced with Event Frames to understand Downtime and Overall Equipment Effectiveness

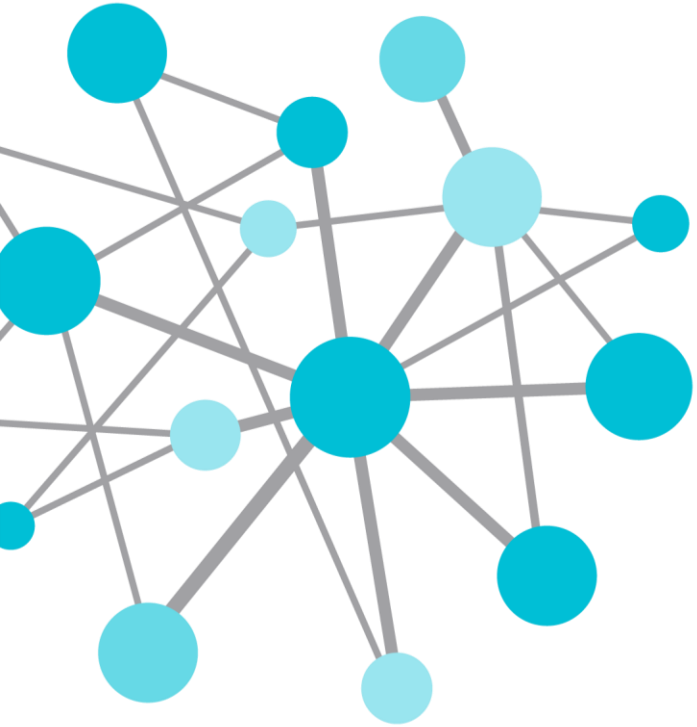


Plant	Equipment	Stop Time	Start Time	Down Time
	EM-650	3/11/2014 9:18:11 PM	continue...	9 hour(s) 41 min(s) 49 sec(s)
	G-321	3/11/2014 9:53:39 PM	3/11/2014 11:08:19 PM	1 hour(s) 14 min(s) 40 sec(s)
	G-371	3/11/2014 9:54:48 PM	3/11/2014 11:09:38 PM	1 hour(s) 14 min(s) 50 sec(s)
	G-714	3/11/2014 7:42:32 AM	3/11/2014 7:43:12 AM	0 hour(s) 0 min(s) 40 sec(s)
		3/11/2014 10:50:23 AM	3/11/2014 11:14:53 AM	0 hour(s) 24 min(s) 30 sec(s)
		3/11/2014 12:38:23 PM	3/11/2014 1:09:53 PM	0 hour(s) 31 min(s) 30 sec(s)
		3/11/2014 1:10:13 PM	3/11/2014 1:24:32 PM	0 hour(s) 14 min(s) 19 sec(s)
		3/11/2014 3:32:32 PM	3/11/2014 4:21:51 PM	0 hour(s) 49 min(s) 19 sec(s)
	NS-570	3/11/2014 4:17:02 PM	3/11/2014 4:17:12 PM	0 hour(s) 0 min(s) 10 sec(s)
	NS-6002	3/12/2014 5:05:29 AM	continue...	1 hour(s) 54 min(s) 31 sec(s)
	NS-6002	3/12/2014 5:05:46 AM	continue...	1 hour(s) 54 min(s) 14 sec(s)
	NS-793	3/12/2014 1:59:12 AM	continue...	5 hour(s) 0 min(s) 48 sec(s)
	NS-794	3/11/2014 10:53:28 AM	continue...	20 hour(s) 6 min(s) 32 sec(s)

# of Pumps Down: 9 **Total Down Time: 1 day(s) 19 hour(s) 7 min(s) 52 sec(s)**

Closing Comments

1. Increased data availability to users through PI System
2. Assist in following operations strategy and optimize production
3. Enhanced decision making & collaboration
4. PI AF enabled us to meet rapid business growth
5. Increasing PI System installations with the EA
6. What is next?
   - PI Event Frames and PI Analytics
   - Migrate custom alerts to PI AF
7. **Use of PI system to assist in improving safety**



THANK YOU

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