APA Group's Use of the PI System

APA Group

Presented by **Steve Nield – Enterprise Architect, APA Group**

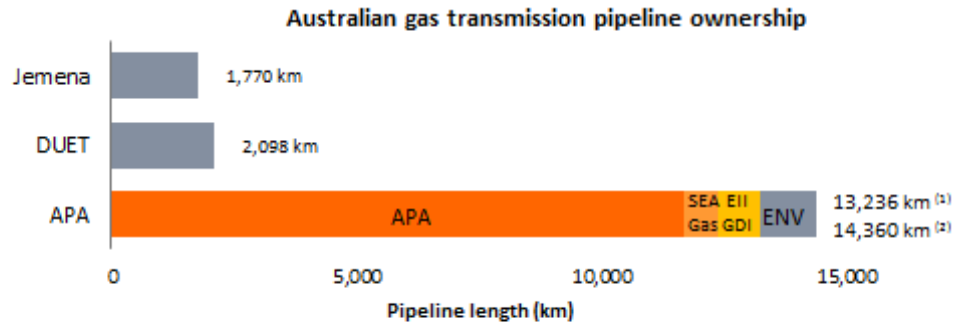
Andrew Todd – Green Technology Services

- About APA Group
- APA Group's Historian Roadmap
- Two examples
  - Reservoir Management System – Mondarra
  - Meter Data Management System – APA Grid
- Summary

About APA Group

APA is Australia's largest gas infrastructure business

- Gas transmission pipelines and storage
  - Owning and operating two thirds of Australia's onshore pipelines
  - Interconnected pipeline networks
  - Transporting approximately half the gas used domestically
- Gas distribution networks
  - Operating approximately a third of the nation's gas distribution networks
- Other related energy infrastructure
  - Developed and acquired complementary energy infrastructure



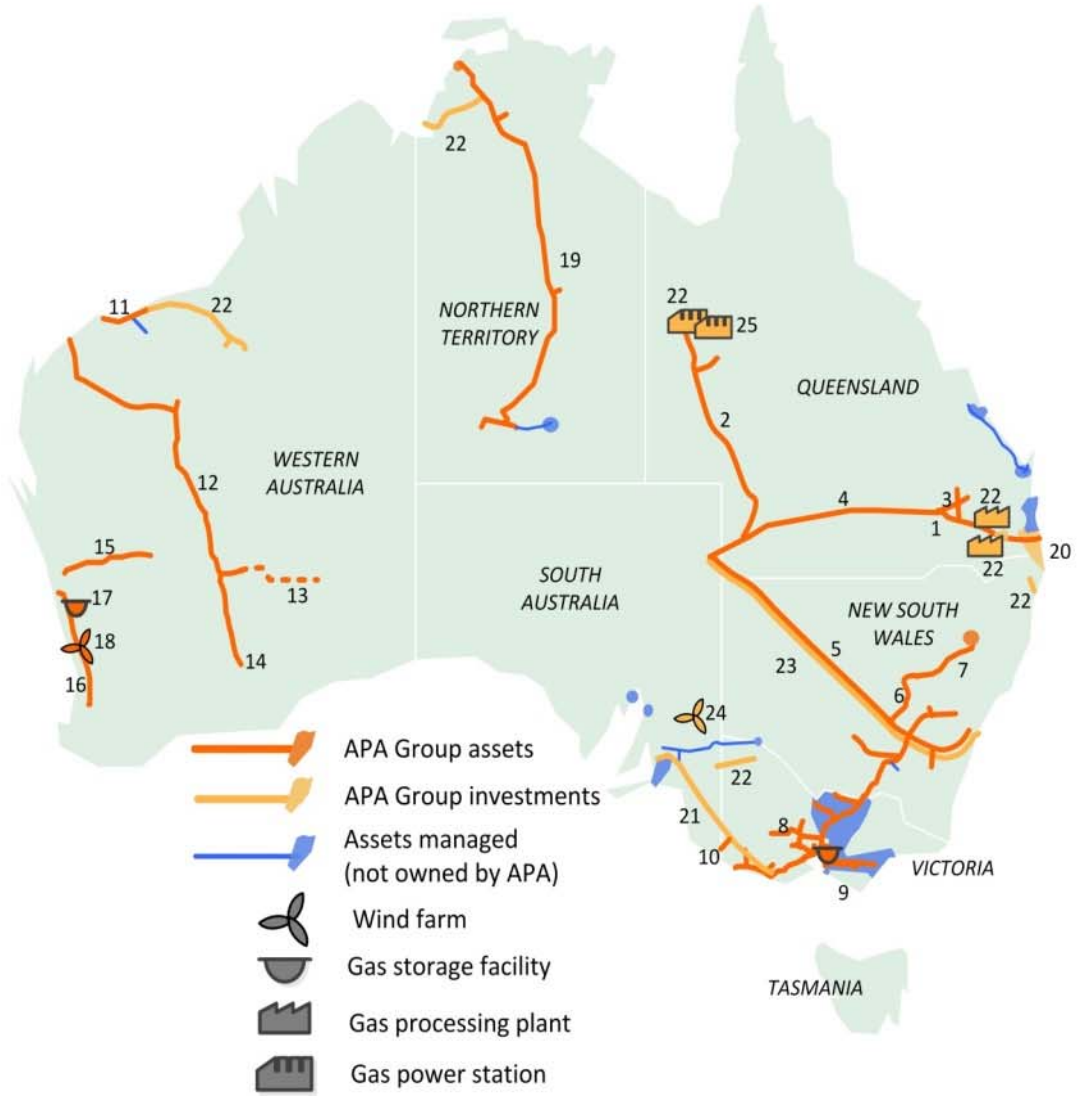
(1) APA pipelines and 100% of the pipelines which form part of its Energy Investments
(2) Pipelines operated by APA, including Envestra

Source: APA & AER State of the Energy Market 2013

APA (29 August 2014)	
Market capitalisation	A$6.6 billion USD 6.2bn; GBP 3.8bn; EUR 4.7bn; CHF 5.7bn S&P/ASX 50 MSCI All World Index; FTSE All World Index 836 million securities on issue
Assets owned/ operated	Over $12 billion **Gas transmission** 14,360 km transmission pipelines Underground and LNG gas storage **Gas distribution** 27,160 km gas network pipelines 1.3 million gas consumers **Other energy infrastructure** 430 MW power generation 239 km HV electricity transmission Gas processing plants
Employees	More than 1,600
Operator	Operator of APA's assets and investments

APA asset and investment portfolio

APA delivers half of Australia's domestic gas usage



APA Group assets and investments

Energy Infrastructure

Queensland
(1) Roma Brisbane Pipeline
(2) Carpentaria Gas Pipeline
(3) Berwyndale Wallumbilla Pipeline
(4) South West Queensland Pipeline

New South Wales
(5) Moomba Sydney Pipeline
(6) Central West Pipeline
(7) Central Ranges Pipeline

Victoria
(8) Victorian Transmission System
(9) Dandenong LNG facility

South Australia
(10) SESA Pipeline

Western Australia
(11) Pilbara Pipeline System
(12) Goldfields Gas Pipeline (88.2%)
(13) Eastern Goldfields Pipeline (under construction)
(14) Kalgoorlie Kambalda Pipeline
(15) Mid West Pipeline (50%)
(16) Parmelia Gas Pipeline
(17) Mondarra Gas Storage Facility
(18) Emu Downs wind farm

Northern Territory
(19) Amadeus Gas Pipeline

Energy Investments

(20) **GDI (EII) (20%)** Allgas
Gas distribution network in Queensland

(21) **SEA Gas Pipeline (50%)**

(22) **Energy Infrastructure Investments (19.9%)**
Gas pipelines, electricity transmission, gas-fired power stations and gas processing plants

(23) **Ethane Pipeline Income Fund (6.1%)**

(24) **EII2 (20.2%)** North Brown Hill wind farm

(25) **Diamantina and Leichhardt Power Stations (50%)** Under development

Asset Management

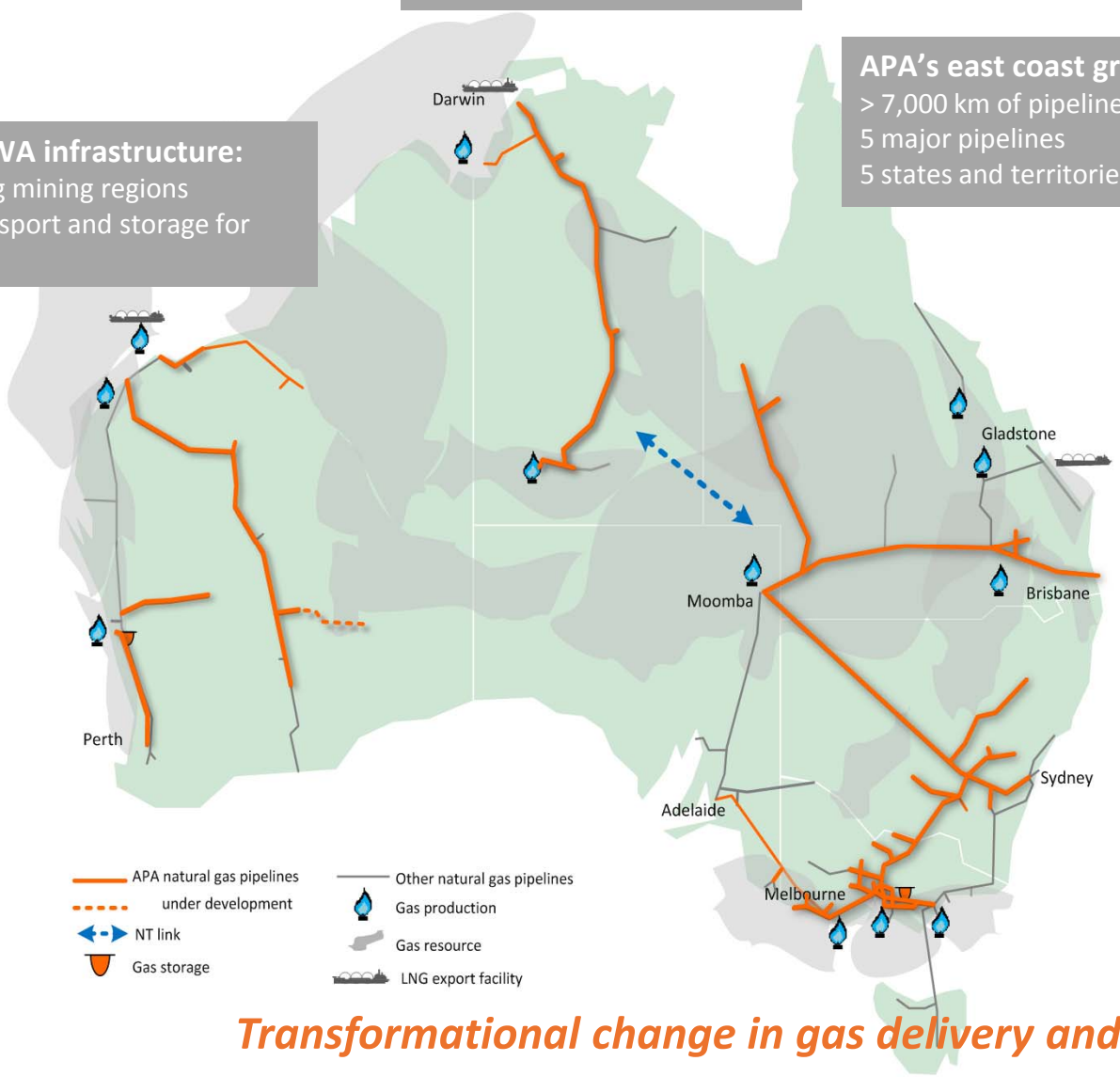
Commercial and/or operational services to:
- Envestra Limited
- GDI (EII) – Allgas (20.0%)
- Energy Infrastructure Investments (19.9%)
- Ethane Pipeline Income Fund (6.1%)
- SEA Gas Pipeline (50.0%)
- EII2 (20.2%)
- other third parties

Strategic development of pipeline grids

NT link to east coast grid:
Feasibility study

APA's east coast grid:
> 7,000 km of pipelines
5 major pipelines
5 states and territories

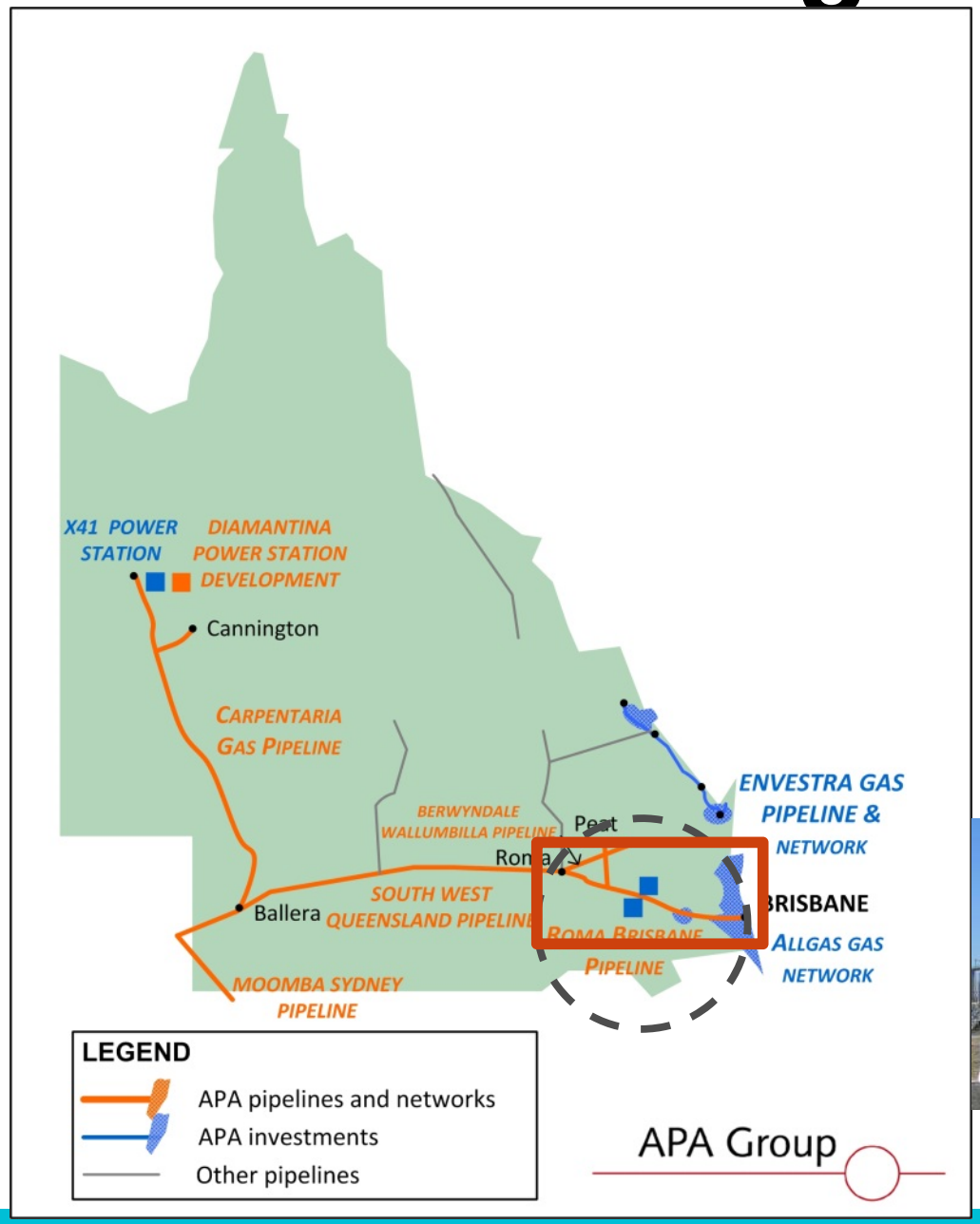
APA's WA infrastructure:
Servicing mining regions
Gas transport and storage for Perth



- East coast grid
  - Interconnected transmission pipelines operating as one system
  - Seamless service capability across 30 receipt points and 100 delivery points
  - Attractive growth and revenue opportunities
- West Australian infrastructure
  - Interconnected gas storage and transportation to Perth
  - Pipeline infrastructure serving mining regions
- NT link – APA feasibility study
  - Connecting APA's infrastructure to facilitate gas flow across regions

Transformational change in gas delivery and storage services

Understanding the scale



In QLD on the RBP we can deliver over 220 TJ/day

- over 275 LNG tankers driving into Brisbane

=

X 2,000

Compressors

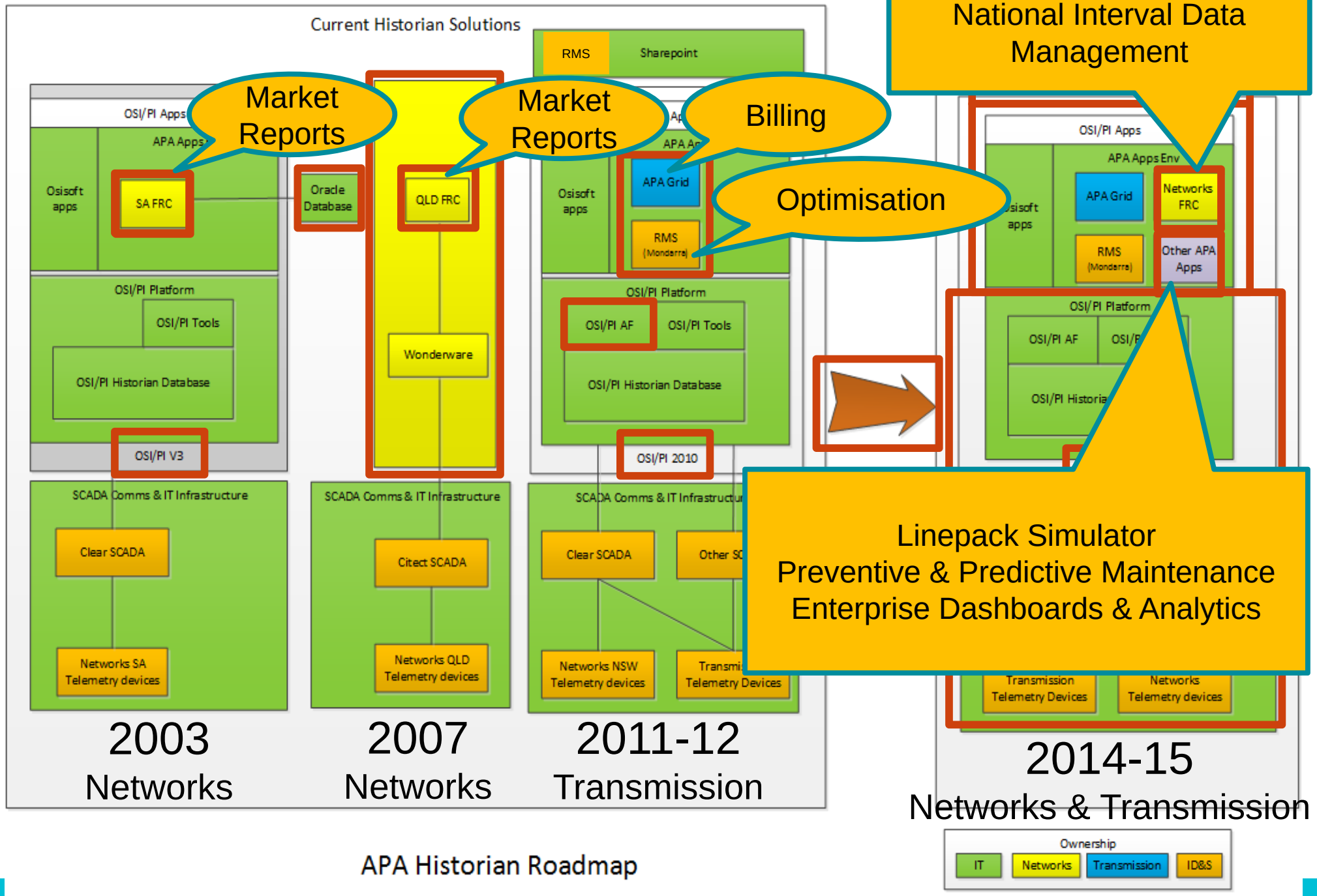
- Increase the throughput and capacity of pipelines
- 300 kW compressors at Iona
  9,860 KW units being installed at Moomba and Wallumbilla
- 87 compressor units
- Total horsepower of 244,000 kW


Ned's Creek compressor station, WA

Compressors

- Each Moomba compressor unit has the horsepower of 50 Falcons or Commodores per unit
- 3 new compressors at Moomba, has the combines horsepower of 150 Falcons or Commodores

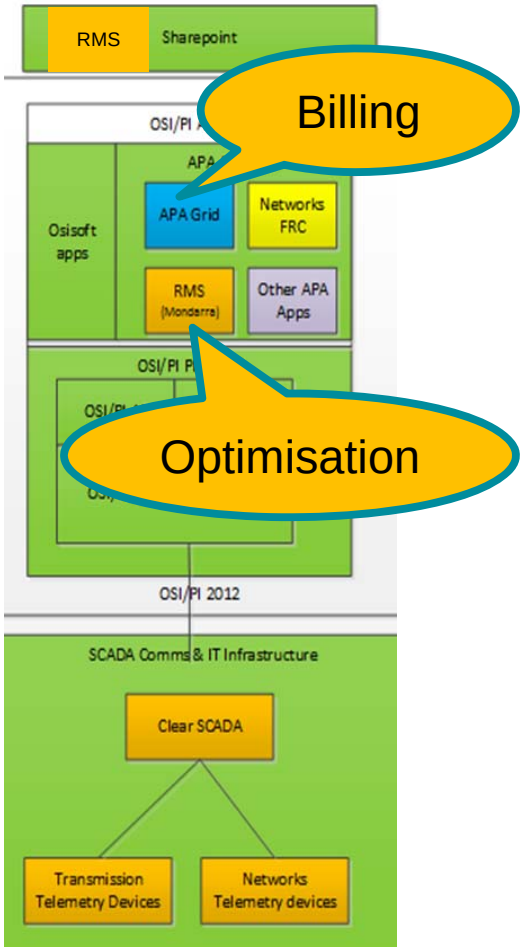
APA Group's Historian Roadmap



APA Historian Roadmap

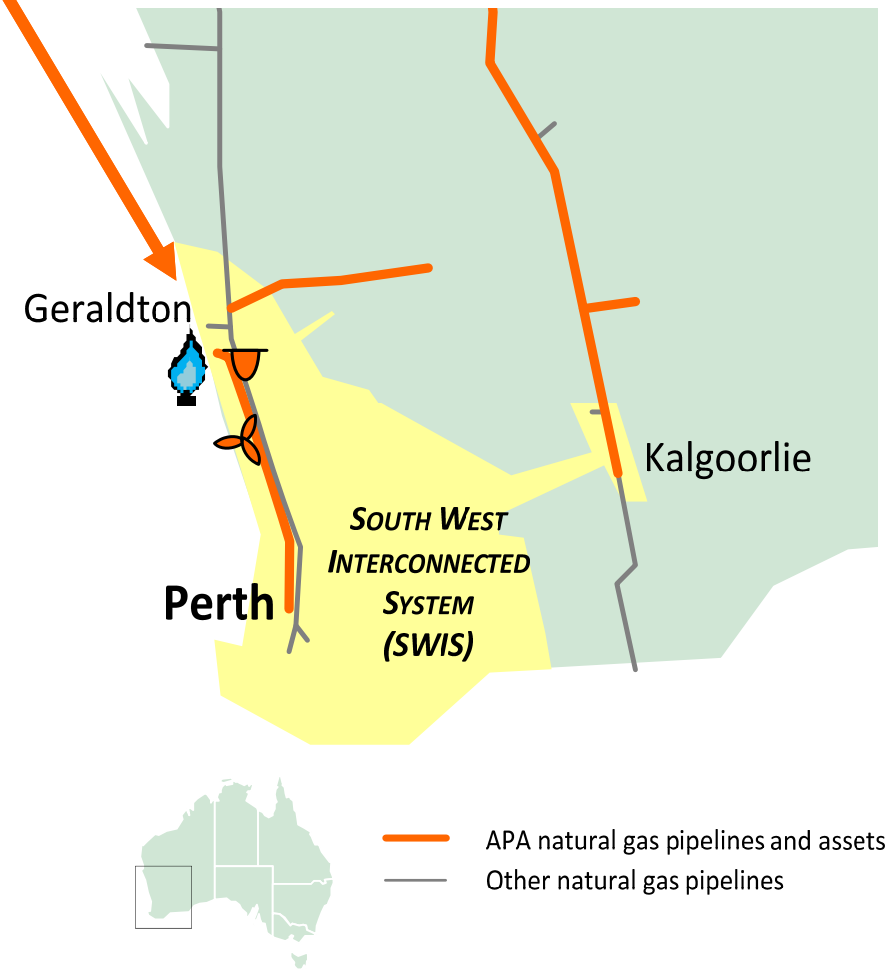
APA Group's Use of the PI System – Two examples

- Underground Gas Storage, Mondarra - Reservoir Management System
- Transmission - Meter Data Management – APA Grid System



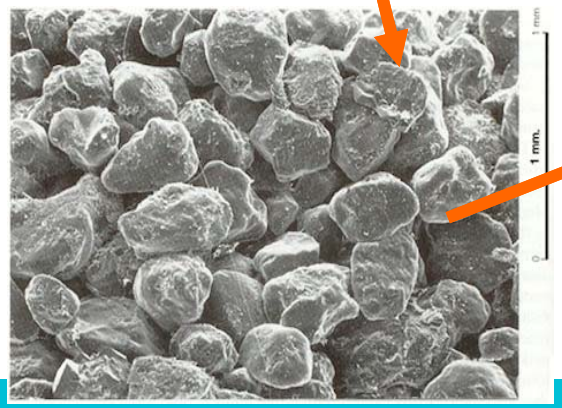
WA portfolio serving Perth and southwest regions

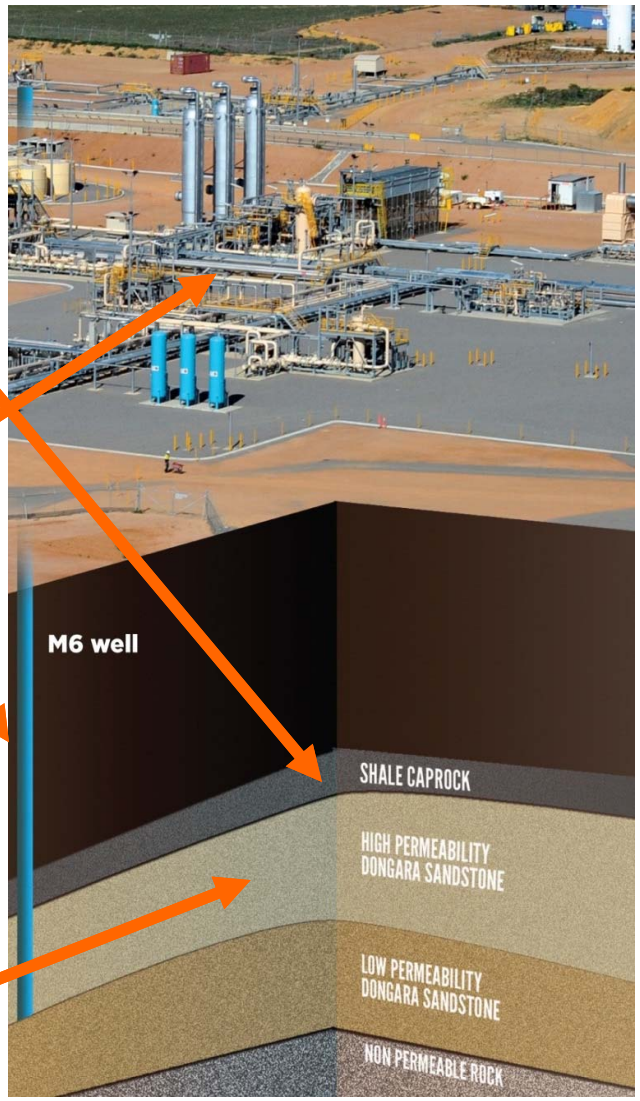
- Mondarra Gas Storage Facility providing gas supply security for Perth and the south west region
  - Expansion completed mid 2013
  - Connected to major pipelines
  - Providing services to four customers, including Synergy
  - Majority of capacity contracted – underpinned by 20 year contract with Synergy
- Providing flexible, integrated gas transport and storage services and competitive tariff structures



Underground gas storage

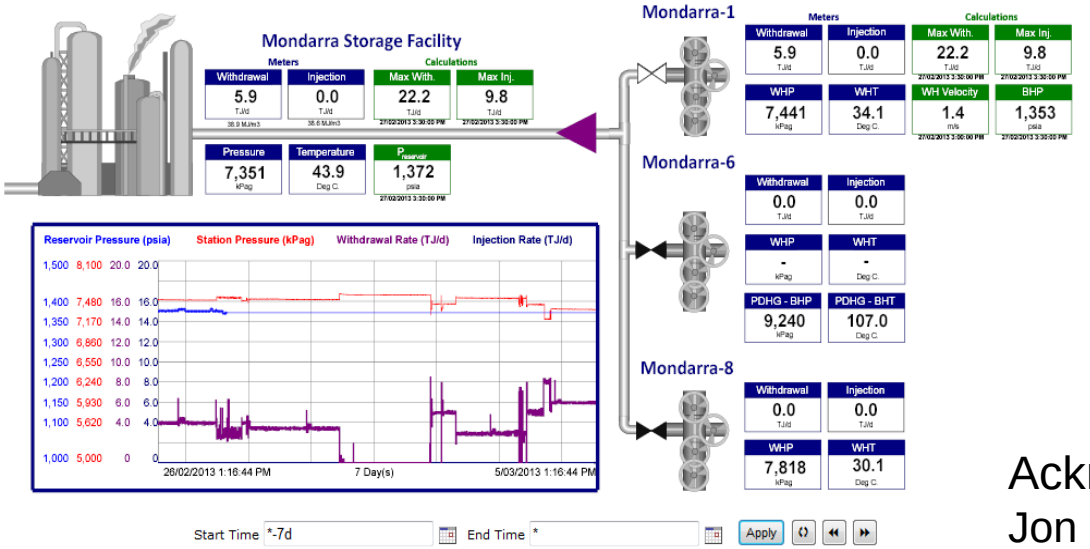
- Storage provided by the depleted gas reservoir
- Gas is stored in the porous rock – sandstone, limestone
- Gas is kept in place by impermeable cap rock – shale, clay
- Gas is re-injected into the porous rock – like a 'sponge absorbing water'
- Geological properties determine the characteristics of the reservoir
  - Porosity – the capacity of the rock to hold gas
  - Permeability – the ability of the rock to transmit gas
  - Integrity – the ability to contain the gas
- Surface facilities to inject and withdraw gas
  - Compression
  - Gas treatment





Reservoir Management System (RMS)

- Business Driver: Commercial & Operational optimisation
- RMS provides operational & commercial insight by performing reservoir and well calculations and visualising these in Sharepoint & reports
- The calculations are performed by
  - PI ACE custom code
  - PI ACE calling Petroleum Expert's application PROSPER via a web service
- Certain calculations are utilised for the day to day optimisation of the facility eg. prediction of the wells' flow capacity
- Users include the Subsurface Engineering Group and Control Room

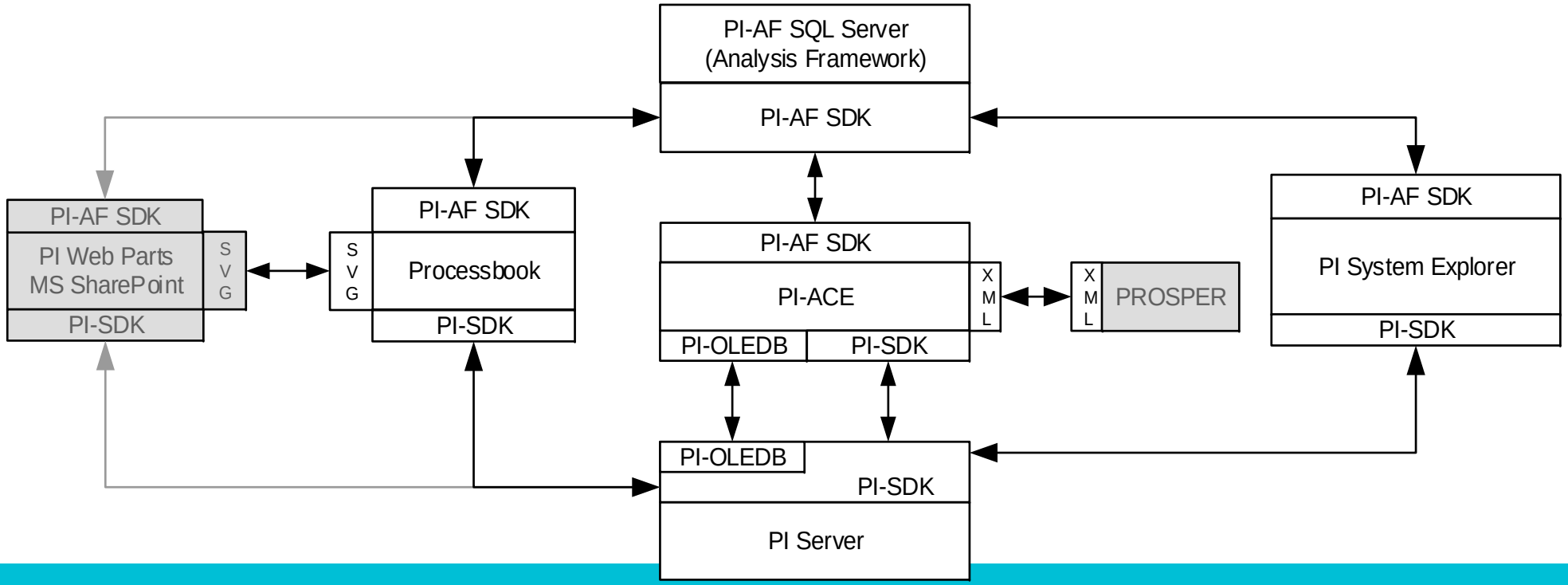


Acknowledgement:
Jon Serfaty – Reservoir Engineer, APA Group

RMS use of PI System

- RMS is composed of a number of components:
  - PI Webparts, & Sharepoint for visualisation & queries
  - PI Processbook
  - PI System Explorer
  - PI ACE
  - PI Server
  - PI AF Server
  - Petex PROSPER Server & Web-interface service

- **PROSPER is a well performance, design and optimisation program** for modelling most types of well configurations found in the worldwide oil and gas industry today.
- PROSPER can assist the production or reservoir engineer to predict tubing and pipeline hydraulics and temperatures with accuracy and speed.
- Once a well system model has been tuned to real field data, PROSPER can be confidently used to model the well in different scenarios and to **make forward predictions of reservoir pressure based on surface production data**



RMS Calculations

Ref	Tag Name	Freq	Units	Type
CR-1	Well State	60s	N/A	Code
CR-2	Well Cumulative Inj Volume	24h[1]	MMscf	Code
CR-3	Well Cumulative Prod Volume	24h[1]	MMscf	Code
CR-4	Time Injection	60s	fraction	Code
CR-5	Time Production	60s	fraction	Code
CR-6	Well Head Velocity	60s	m/s	Code
CR-7	Pressure Change 1hr	15m	kPa/d	Code
CR-8	**Bottom Hole Pressure**	15m	psia	PROSPER
CR-9	**Reservoir Pressure**	15m	psia	PROSPER
CR-10	**Bottom Hole Velocity**	15s	m/s	Code
CR-11	**Predicted Injection Rate**	15m	TJ/d	PROSPER
CR-12	**Predicted Production Rate**	15m	TJ/d	PROSPER
CR-13	**Well Injection Potential**	15m	TJ/d	PROSPER
CR-14	**Well Production Potential**	15m	TJ/d	PROSPER
CR-15	Injection Performance (IP)	1hr	-	Code
CR-16	Production Performance (PP)	1hr	-	Code
CR-17	Injection Performance %	15m	%	Formula
CR-18	Production Performance %	15m	%	Formula

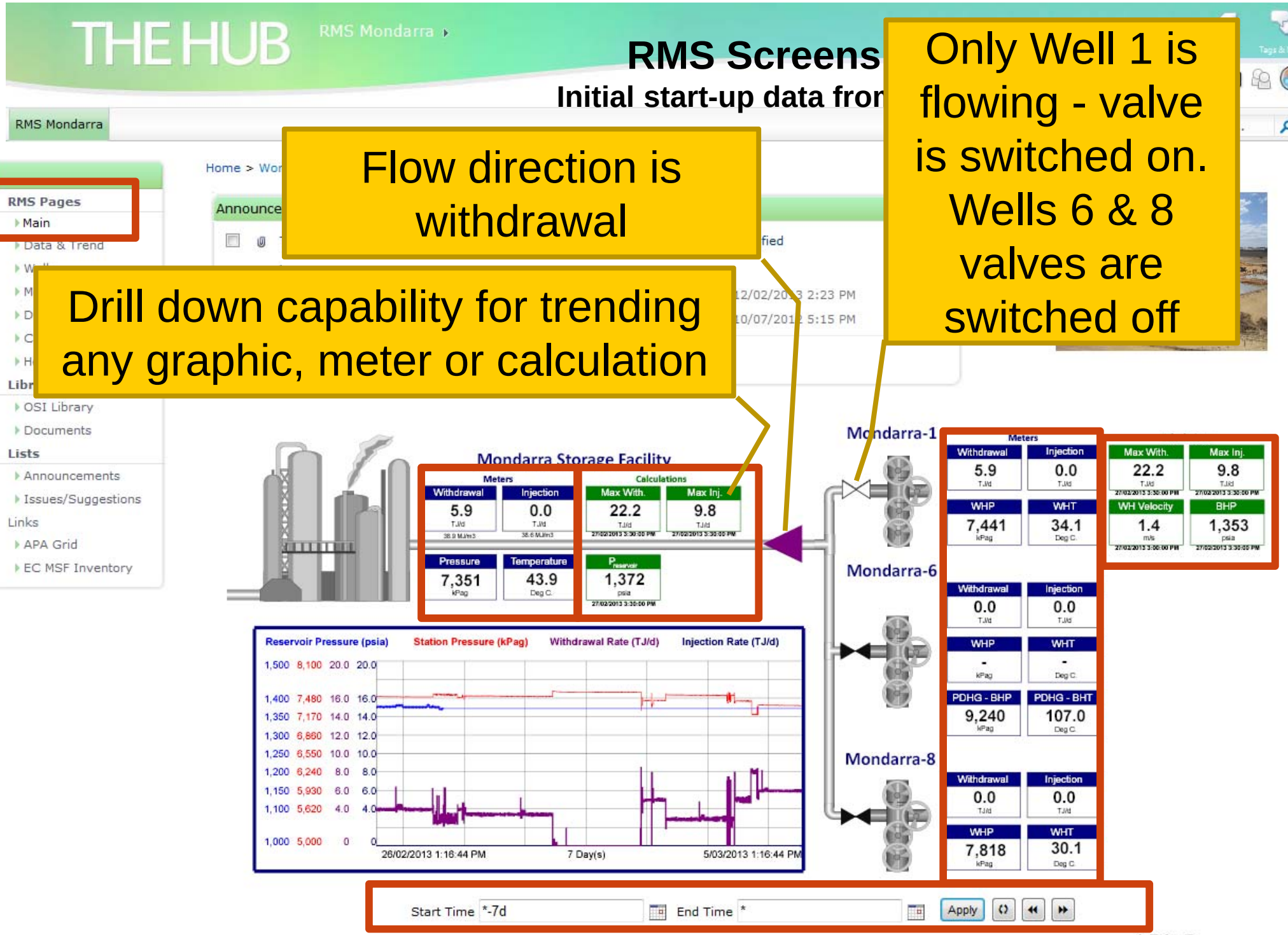
RMS Screens

Initial start-up data fro

Flow direction is withdrawal

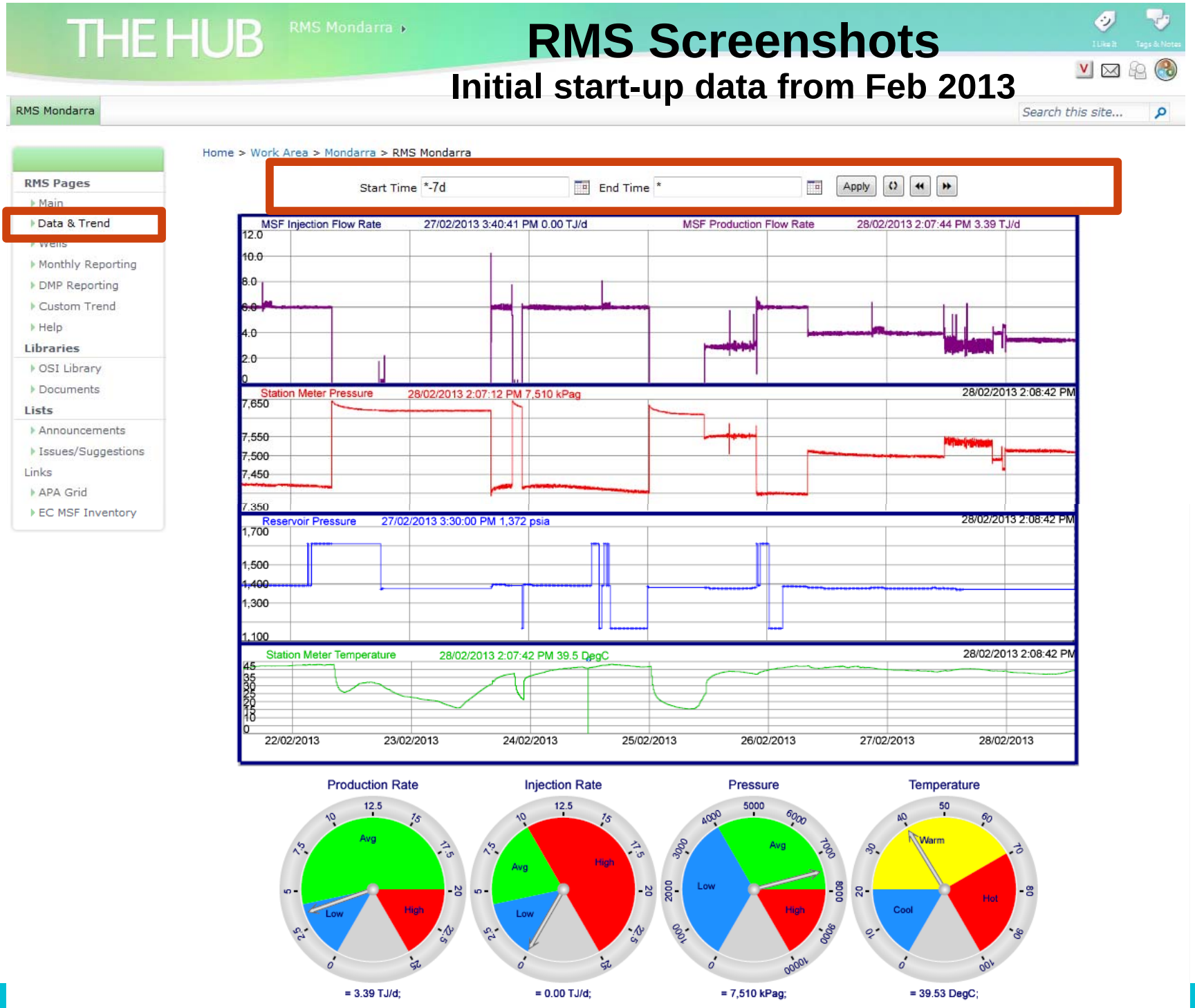
Only Well 1 is flowing - valve is switched on. Wells 6 & 8 valves are switched off

Drill down capability for trending any graphic, meter or calculation



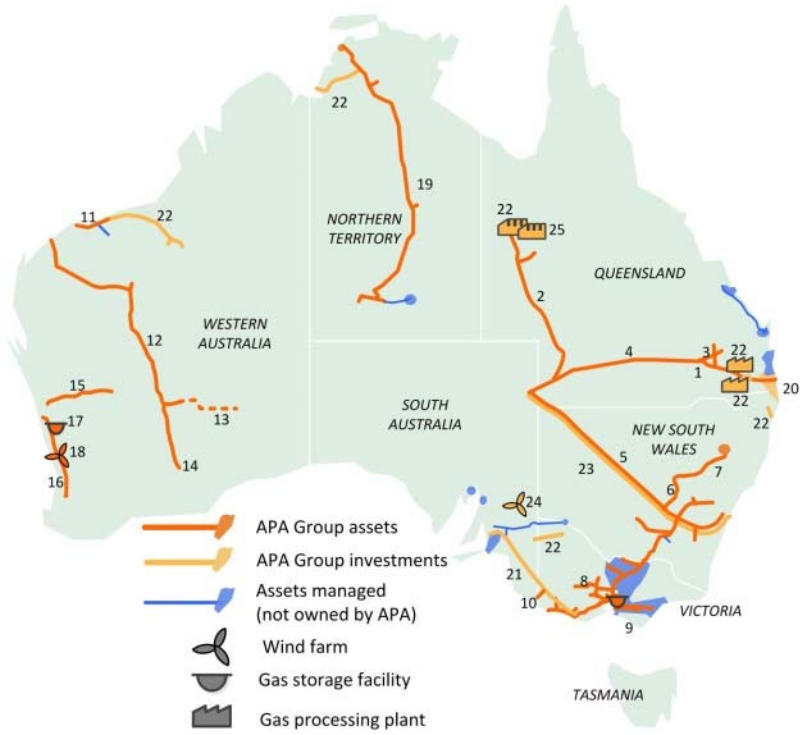
RMS Screenshots

Initial start-up data from Feb 2013



Transmission - Meter Data Management System - APA GRID

- Business Driver:
  - Accurate, validated, auditable meter data for pipeline billing
- Background
  - Multiple SCADA systems/platforms
  - Disparate data across all states
  - No central enterprise historian
  - No consistency in data profiles from site to site
  - Significant billing project underway requiring reliable data source

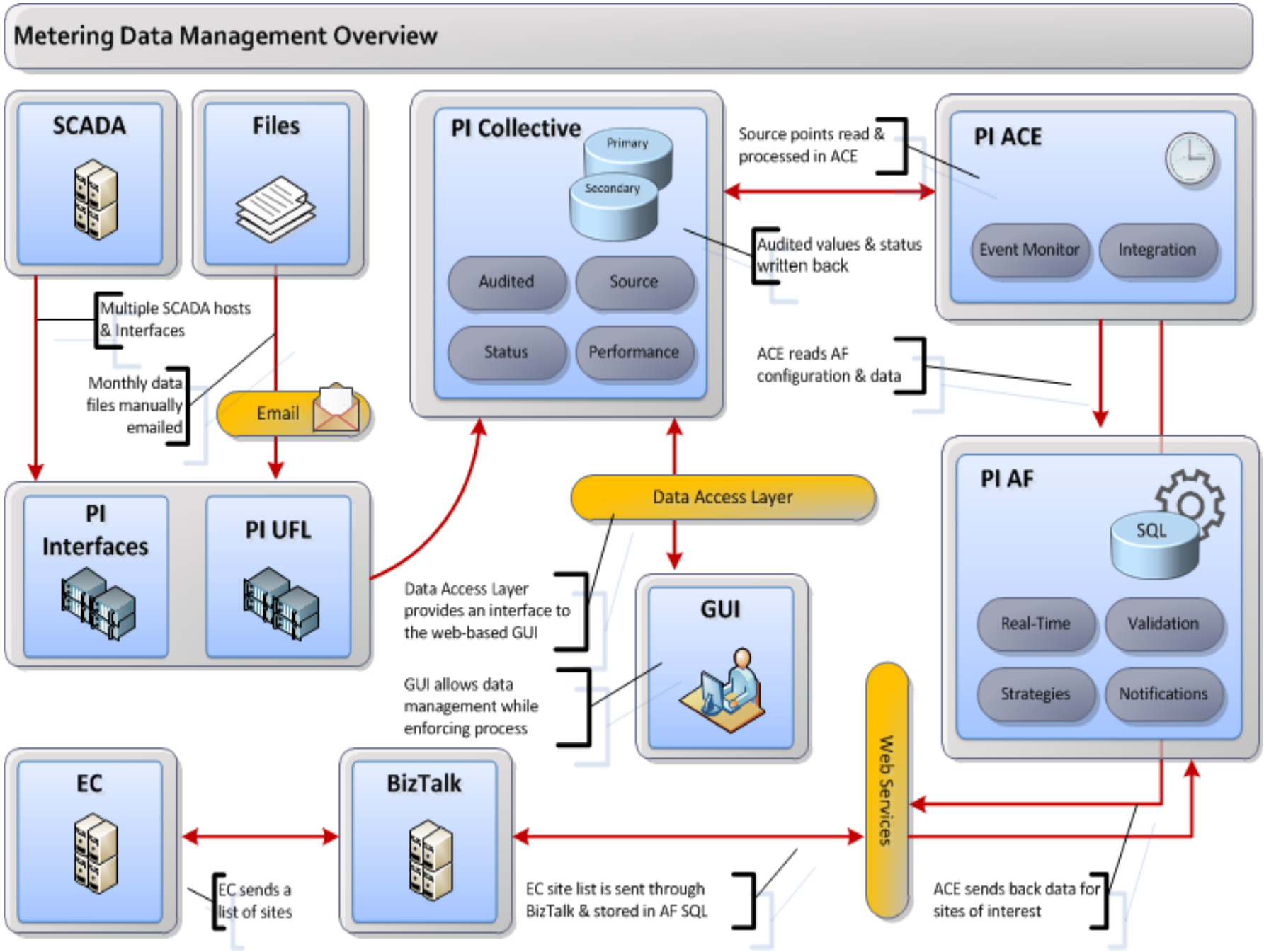


Transmission - Meter Data Management System Requirements

- Single, reliable source of actual (or estimated) operational data; validated and auditable; integrated with Energy Components
- High-level requirement summary:
  - Real-time data collection from multiple sources
  - File-based data integration via email
  - Interpretation of different data profiles to determine ‘correct’ end of gas period values
  - Implement estimation ‘rules’
  - Auto-validate data and flag exceptions
  - Allow users to review and revise data
  - Enforce consistent process
  - Integrate data through existing middleware
  - Raise alerts on system KPIs

Transmission - Meter Data Management System Solution

- Redundant PI interfaces to multiple SCADA system sources
- PI UFL for file-based data delivered via email
- Primary/secondary PI collective for archive, ACE and AF
- Multiple non-prod environments (15 servers in total)
- PI AF used to build a pipeline model combining live data with configuration
- PI ACE modules used to implement processing, validation, delivery
- GUI built in ASP.NET together with a VB.NET data access layer
- PI data integrated with EC via BizTalk

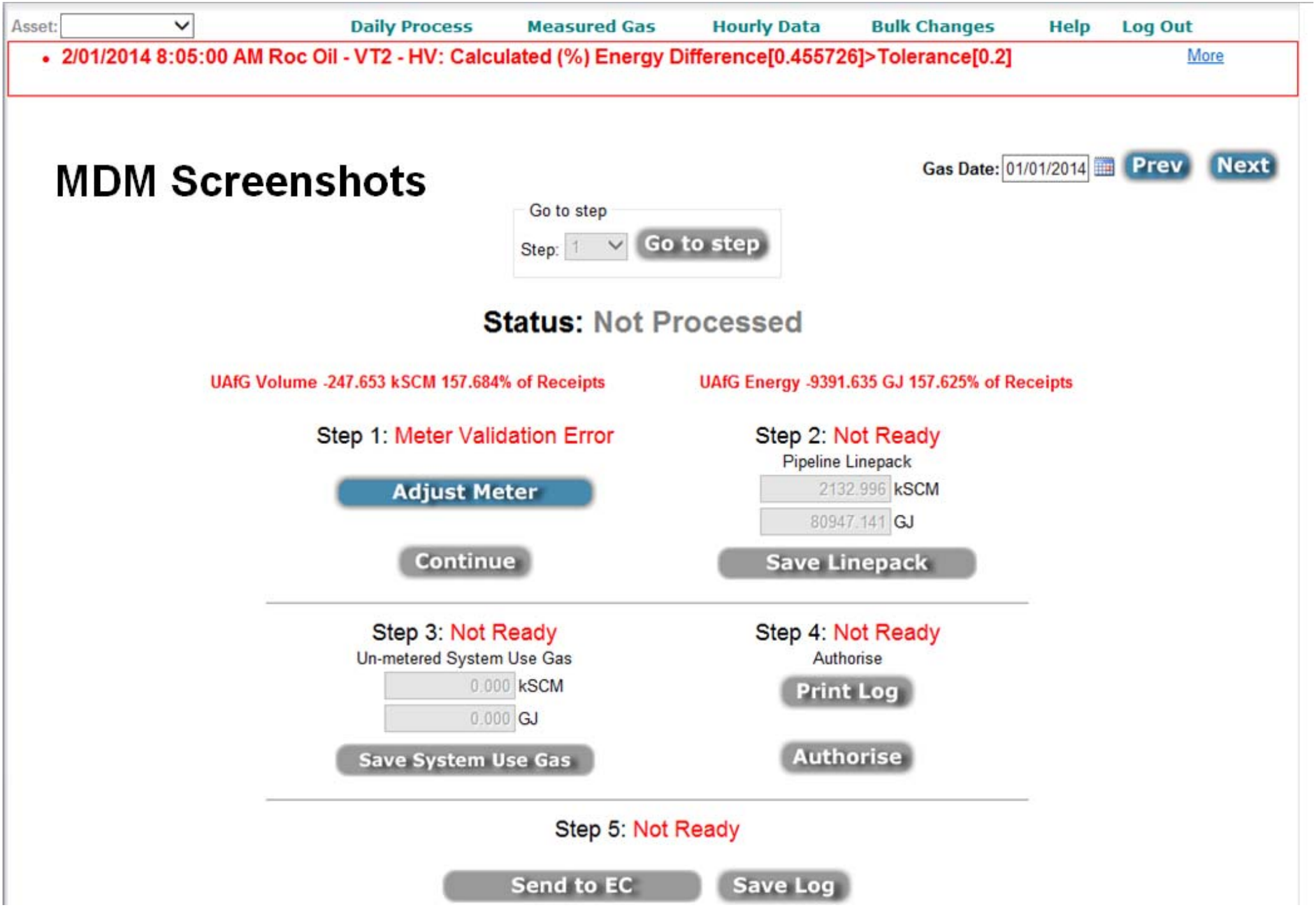


Transmission - Meter Data Management System Some Design Principles

- Implementation of national tag naming standards in PI
- Preservation of ‘raw’ source data
- Concept of Audited Value and Record points
- Enforcing data quality and process

Transmission - Meter Data Management System Some Interesting Problems

- Different data profiles made it hard to determine the ‘correct’ value to represent a gas period
- Numerous different site configurations need to be permitted
- Any gaps in missing data needed to be filled in with estimates
- Data sent to EC needed to be auditable
- Data must be validated
- Users need to manage data but also follow process
- Need to deliver new and modified data for sites of interest



Asset: Daily Process Measured Gas Hourly Data Bulk Changes Help Log Out

MDM Screenshots

Gas Date: 05/05/2012 Prev Next

Location

Type: (•) All ( ) Error

Location: Prev Next

	Previous	Current	Adjustment	UOM
Volume:		424.043		kSCM
Energy:		15648.609		GJ

SCADA Reading

SCADA Type	Run 1	Run 2	Station	
Volume Accumulator	923.102	70042.578	NA	kSCM
Energy Accumulator	34017.238	581901.688	NA	GJ
Volume Yesterday	0.000	424.043	424.043	Actual
Energy Yesterday	0.000	15648.609	15648.609	Actual
Heating Value	36.891	36.903	36.897	MJ/m3
Heating Value Source	Actual	Actual	Actual	
Active	True	True	True	
Substituted Volume				kSCM
Substituted Energy				GJ
Substituted Heating Value				MJ/m3

Calculate

Audit Log Hourly Data Save

Asset: | Daily Process | Measured Gas | Hourly Data | Bulk Changes | Help | Log Out

MDM Screenshots

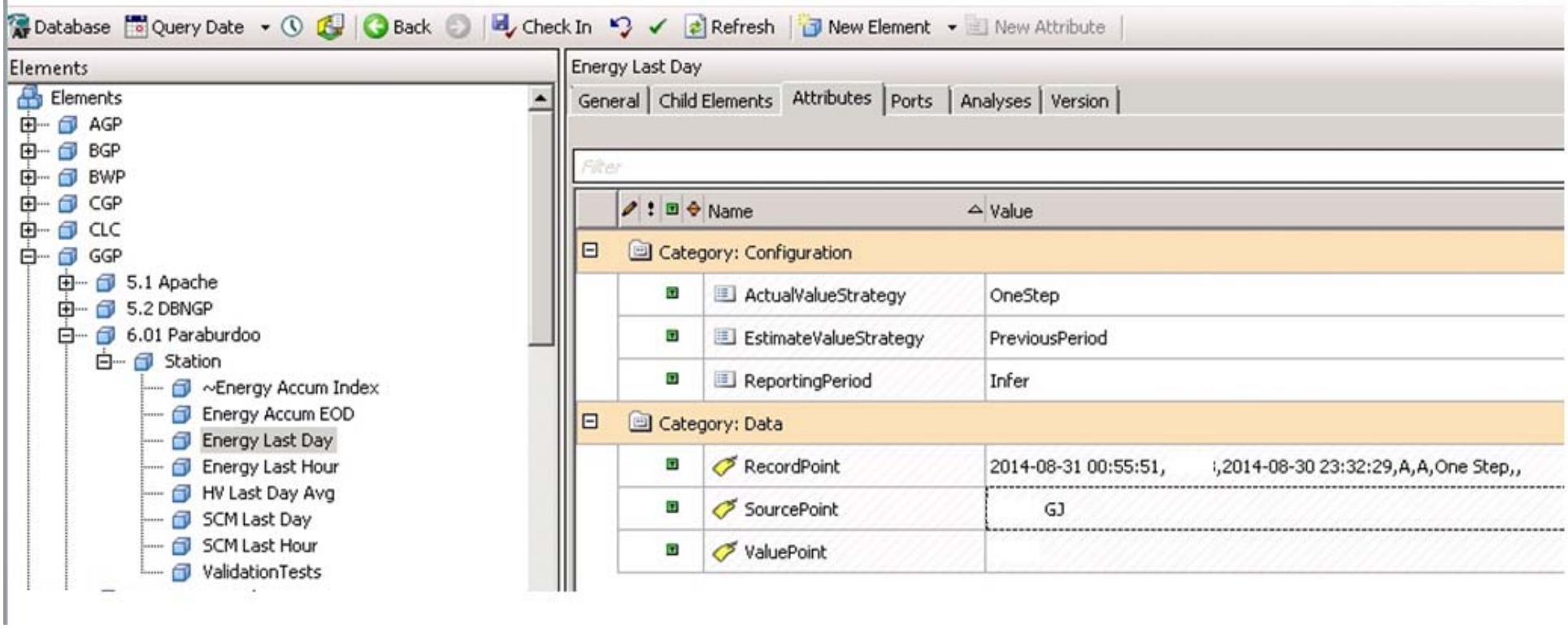
Gas Date: 05/05/2012 Prev Next

Location: Prev Next

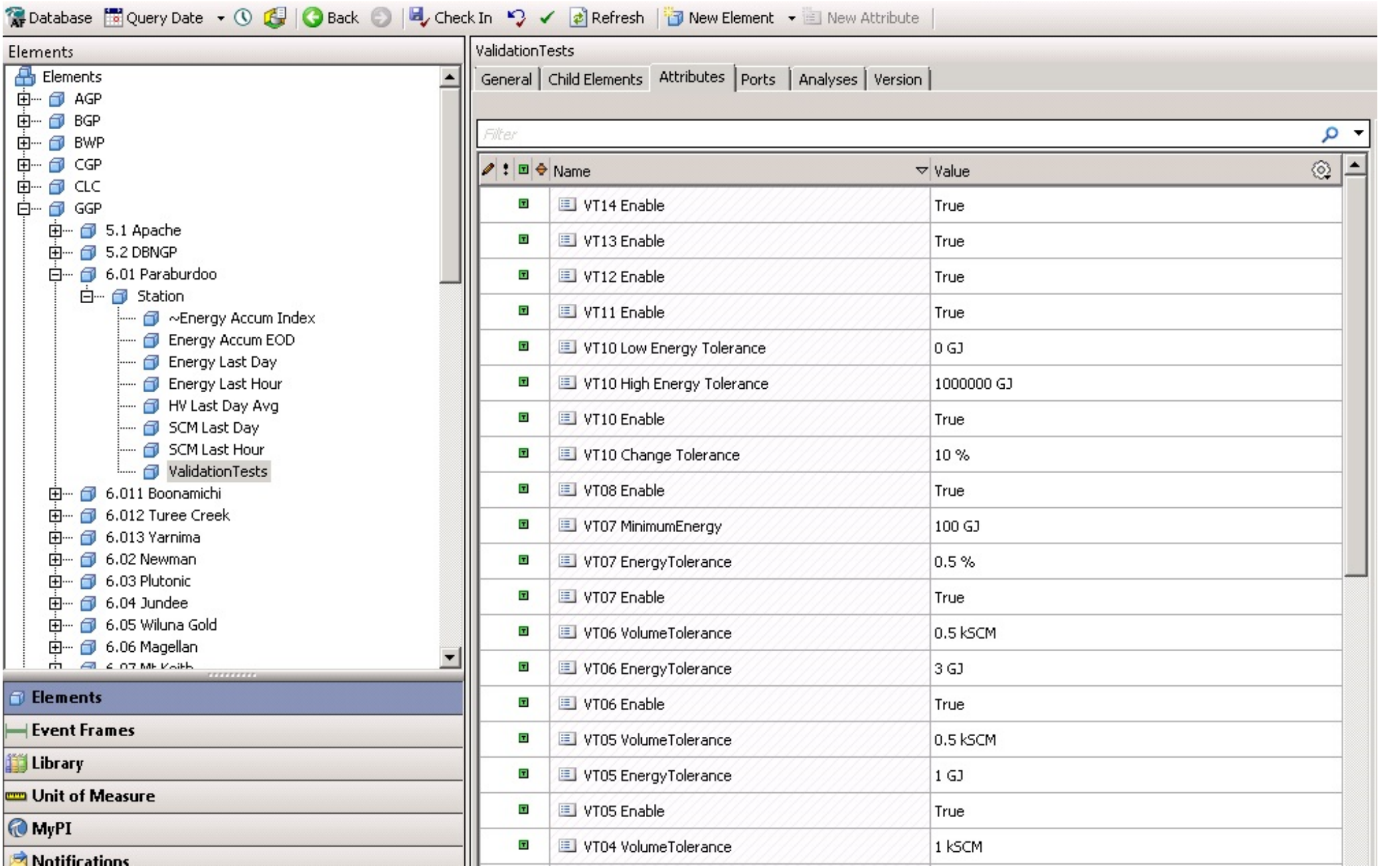
QSN				
	Station			
DateTime	Energy		Volume	
5/05/2012 9:00:00 AM	612.244	A	16.594	A
5/05/2012 10:00:00 AM	651.917	A	17.672	A
5/05/2012 11:00:00 AM	652.893	A	17.695	A
5/05/2012 12:00:00 PM	653.564	A	17.711	A
5/05/2012 1:00:00 PM	653.870	A	17.711	A
5/05/2012 2:00:00 PM	654.419	A	17.727	A
5/05/2012 3:00:00 PM	653.809	A	17.727	A
5/05/2012 4:00:00 PM	653.503	A	17.711	A
5/05/2012 5:00:00 PM	653.625	A	17.711	A
5/05/2012 6:00:00 PM	654.846	A	17.750	A
5/05/2012 7:00:00 PM	654.968	A	17.742	A
5/05/2012 8:00:00 PM	654.114	A	17.727	A
5/05/2012 9:00:00 PM	653.931	A	17.727	A
5/05/2012 10:00:00 PM	653.748	A	17.719	A
5/05/2012 11:00:00 PM	653.748	A	17.719	A
6/05/2012 12:00:00 AM	654.297	A	17.734	A
6/05/2012 1:00:00 AM	653.809	A	17.734	A
6/05/2012 2:00:00 AM	653.809	A	17.719	A
6/05/2012 3:00:00 AM	654.175	A	17.719	A
6/05/2012 4:00:00 AM	653.076	A	17.703	A
6/05/2012 5:00:00 AM	653.625	A	17.703	A
6/05/2012 6:00:00 AM	653.870	A	17.703	A
6/05/2012 7:00:00 AM	654.480	A	17.727	A
6/05/2012 8:00:00 AM	652.344	A	17.672	A
Totals	15648.684		424.057	
EOGD Totals	15648.609		424.043	
Difference	-0.075		-0.014	

View Run Data | Apportion | Save

Example AF Structure



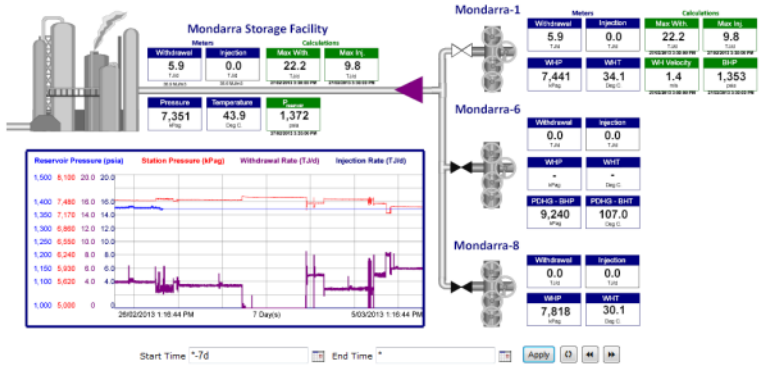
Example AF Structure



APA Group's Use of the PI System

1. Reservoir Management System (RMS) - provides operational & commercial insight by performing reservoir and well calculations and visualising these in Sharepoint

2. Meter Data Management (MDM) – provides validated single source of truth for pipeline meter data used for billing customers



APA Group

Business Challenge

- RMS
  - Need to understand operational characteristics 2700m underground
  - Need to optimise commercial use of storage asset
- MDM
  - Bring together data from disparate sources
  - Automate data estimation and validation
  - Allow user data management
  - Integrate with Billing software

Solution

- RMS
  - Use of PI ACE and 3rd party app to calculate well bottom metrics and provide usage forecasts
  - Visualisation in Sharepoint
- MDM
  - PI System interfacing with all APA SCADA systems
  - PI AF defining object model
  - PI ACE providing data processing and validation

Results and Benefits

- RMS
  - Provides operational dashboards, regulator reporting and ad-hoc query facilities
  - Provides forecasting capability for commercial insight
- MDM
  - Highly configurable and expandable model
  - Data quality enforced
  - Reliable data delivery

Contact Details

- Steve Nield
  - Steve.Nield@apa.com.au
  - Enterprise Architect
  - APA Group
- Andrew Todd
  - Andrew.Todd@gtsgroup.com.au
  - Partner
  - Green Technology Services
- Jon Serfaty
  - Jon.Serfaty@apa.com.au
  - Reservoir Engineer
  - APA Group

THANK YOU

Brought to you by OSIsoft.