

OSIsoft.
**T&D USERS
GROUP** 2014
The **Power** of **Data**
DECISION READY IN REAL-TIME



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Agenda

- Who is Salt River Project
- Current PI System Implementation
- Our AF Model
 - Creation / Design
 - Maintenance
 - Uses
- Lessons Learned
- Future Projects

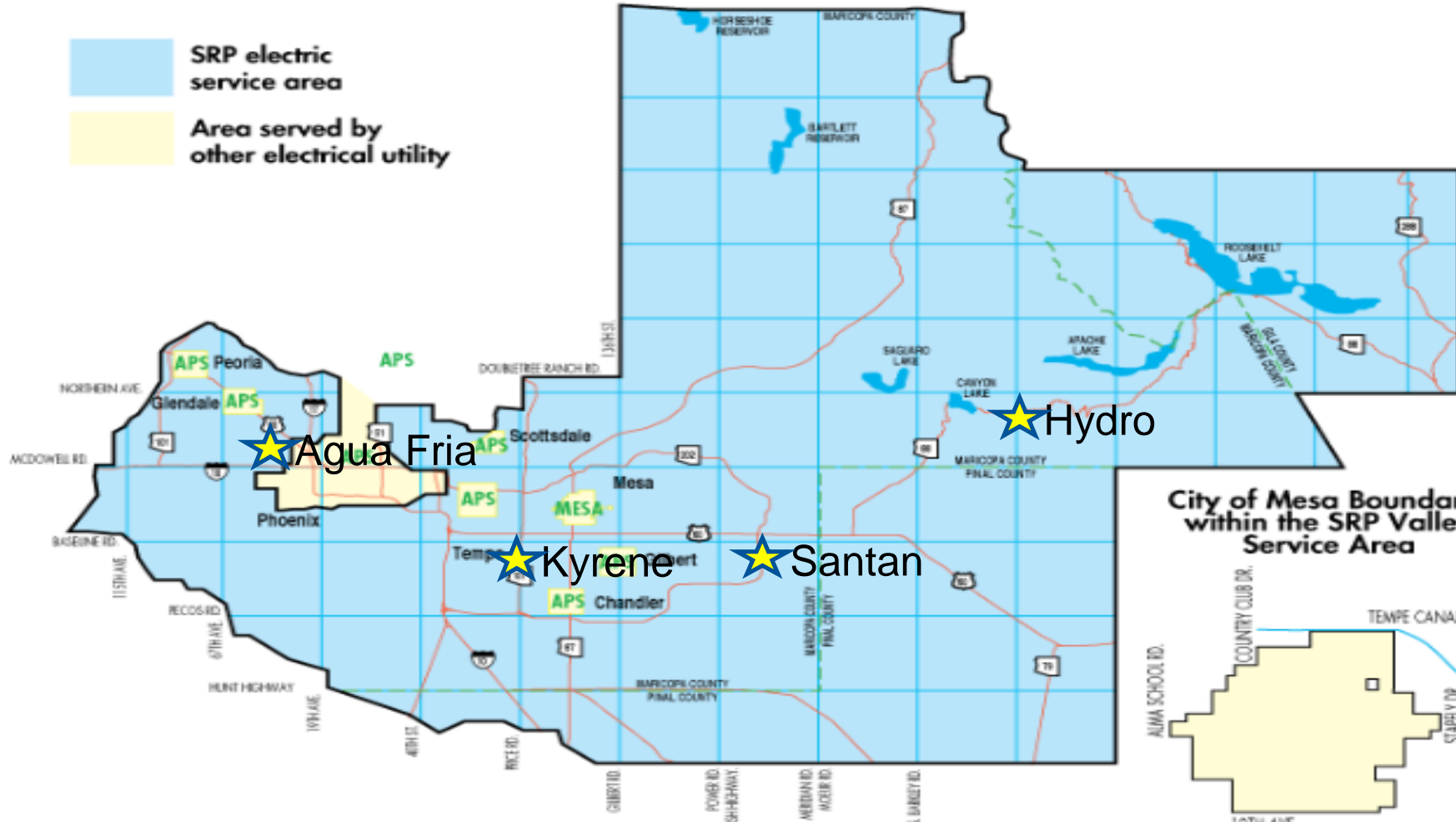
About SRP

- US Bureau of Reclamation Project
- Supply Water and Power to Salt River Valley and large portions of the Phoenix Metropolitan area
- Generation Resources
 - Gas, Coal, Nuclear, Hydro, Solar, Biomass, Wind, and Geothermal
- SRP Facts per end of FY13
 - ~975,000 Customers
 - Peak System Load ~7200 MW
 - 300+ Stations and RTU's

SRP Service and Generation Area

★ Navajo

SRP electric service area
Area served by other electrical utility



★ Coronado

★ Springerville

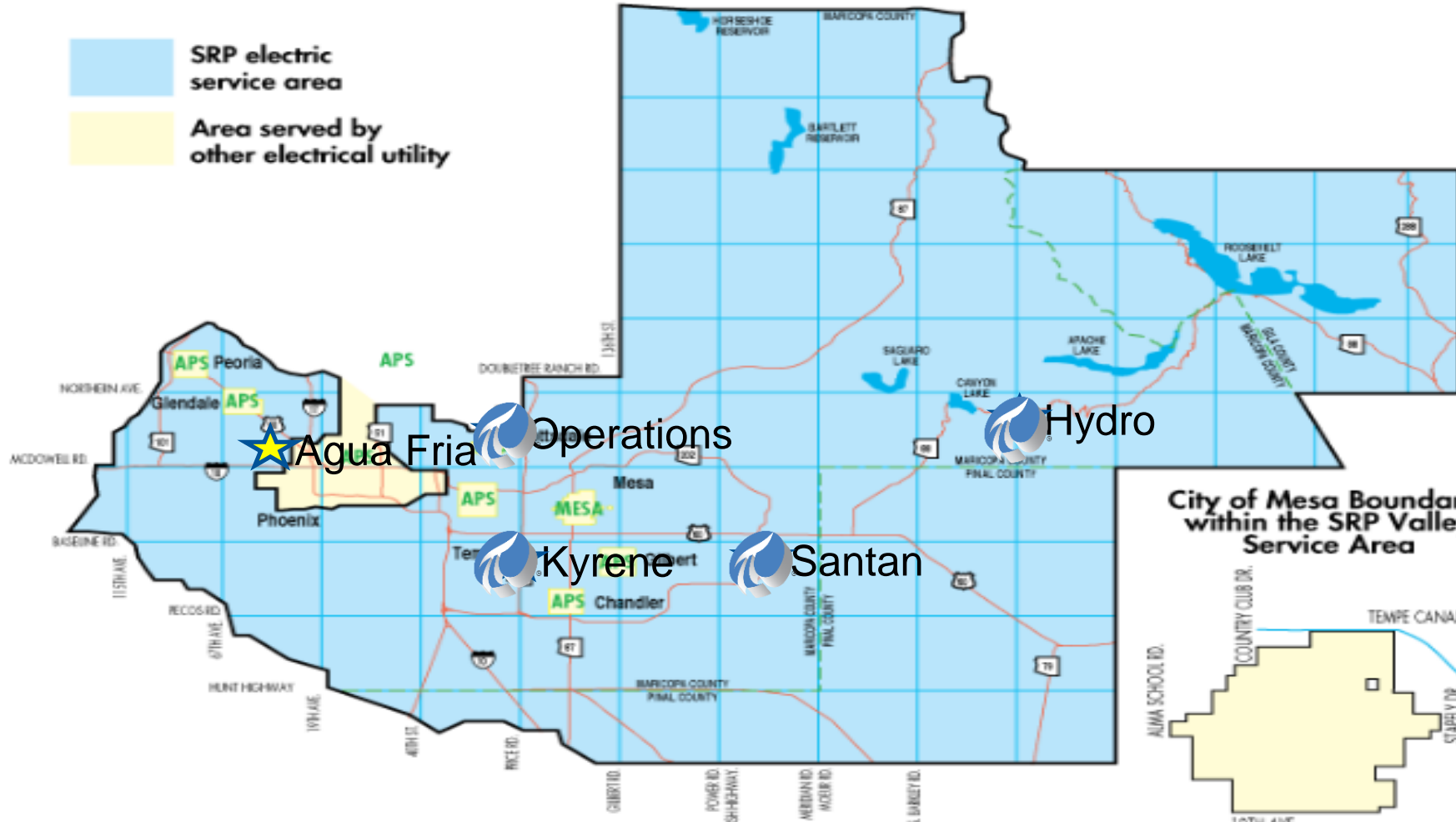
★ Mesquite

★ Desert Basin

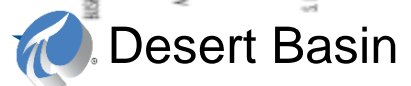
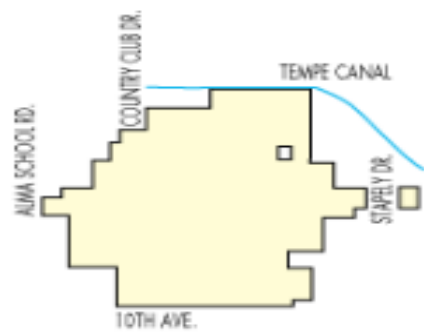
SRP PI System Installs



SRP electric service area
Area served by other electrical utility

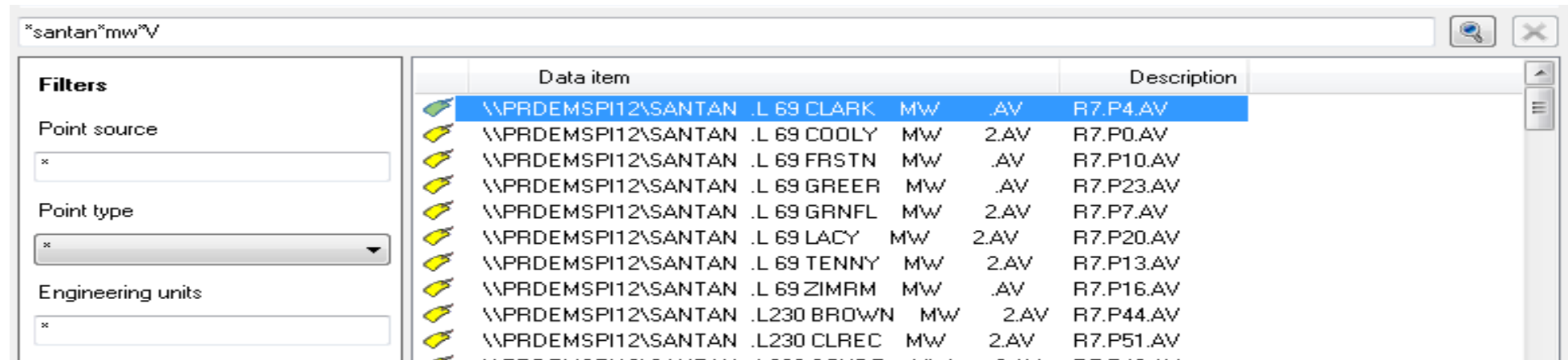


City of Mesa Boundary within the SRP Valley Service Area



PI Difficulties

- Organization
- Point Naming Conventions
 - SANTAN .U5 NET CMW .AV
 - EDC .USNTNG5 MW .AV



The screenshot shows a software window titled "*santan*mw*V". On the left, there is a "Filters" panel with three sections: "Point source" with a text input field containing "*", "Point type" with a dropdown menu containing "*", and "Engineering units" with a text input field containing "*". The main area is a table with two columns: "Data item" and "Description". The table contains ten rows of data, with the first row highlighted in blue.

Data item	Description
\\PRDEMSP12\SANTAN .L 69 CLARK MW .AV	R7.P4.AV
\\PRDEMSP12\SANTAN .L 69 COOLY MW 2.AV	R7.P0.AV
\\PRDEMSP12\SANTAN .L 69 FRSTN MW .AV	R7.P10.AV
\\PRDEMSP12\SANTAN .L 69 GREER MW .AV	R7.P23.AV
\\PRDEMSP12\SANTAN .L 69 GRNFL MW 2.AV	R7.P7.AV
\\PRDEMSP12\SANTAN .L 69 LACY MW 2.AV	R7.P20.AV
\\PRDEMSP12\SANTAN .L 69 TENNY MW 2.AV	R7.P13.AV
\\PRDEMSP12\SANTAN .L 69 ZIMRM MW .AV	R7.P16.AV
\\PRDEMSP12\SANTAN .L230 BROWN MW 2.AV	R7.P44.AV
\\PRDEMSP12\SANTAN .L230 CLREC MW 2.AV	R7.P51.AV

AF Hierarchy of Data

Elements

- Elements
 - AGC
 - Calculators and Displays
 - Generators
 - Transmission Stations
 - Foreign Stations
 - SRP Stations
 - 115kV
 - 230kV
 - Abel
 - Agua Fria
 - Breakers
 - Agua Fria Breaker 715
 - Agua Fria Breaker 718
 - Agua Fria Breaker 722
 - Agua Fria Breaker 725
 - Agua Fria Breaker 728
 - Agua Fria Breaker 732
 - Agua Fria Breaker 735
 - Agua Fria Breaker 738
 - Agua Fria Breaker 742
 - Agua Fria Breaker 745
 - Agua Fria Breaker 748

Agua Fria Breaker 735

General | Child Elements | **Attributes** | Ports | Analyses | Version

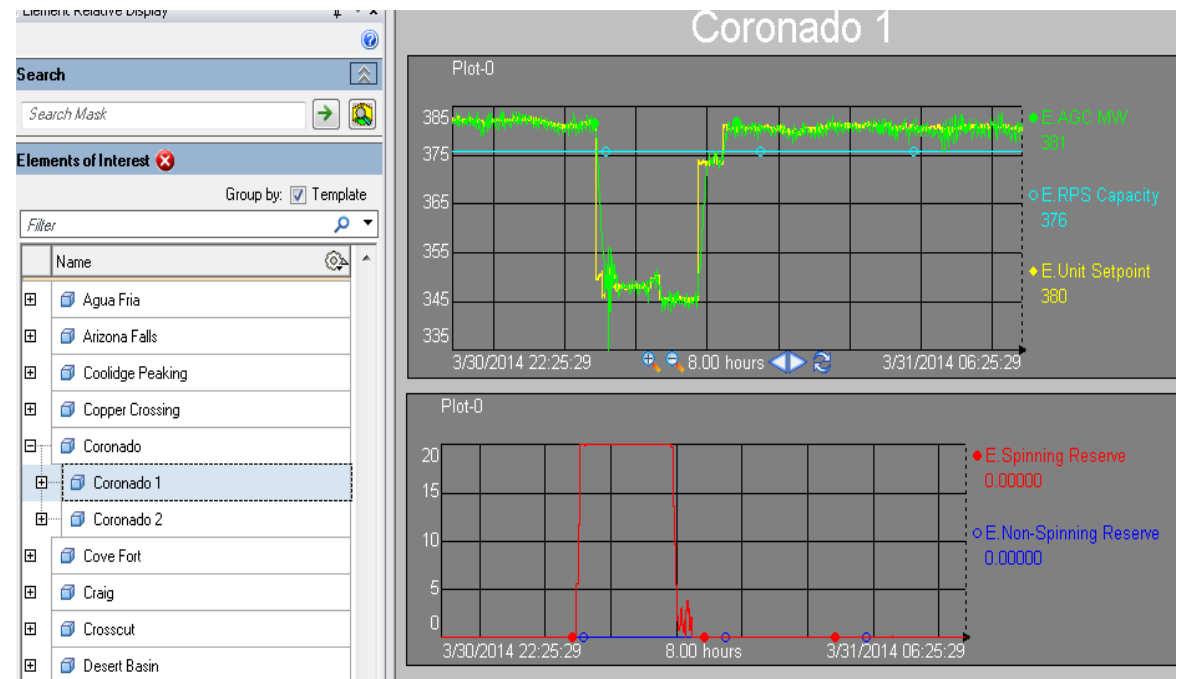
Filter

	Name	Value	Settings...
Category: <None>			
<input checked="" type="checkbox"/>	Operating Entity	0	
<input checked="" type="checkbox"/>	Operating Voltage (kV)	230	SELECT [No Units] FROM Voltage WHERE [W...
Category: Equipment Status			
<input checked="" type="checkbox"/>	Breaker Status	Close	\\PRDEMSP112\AGUAFRIA.B230 735 ST ...
<input checked="" type="checkbox"/>	Recloser Status	Out	\\PRDEMSP112\AGUAFRIA.B230 735 RS ...
<input checked="" type="checkbox"/>	Remote/Local Status	RMOT	\\PRDEMSP112\AGUAFRIA.B230 735 RL ...
Category: Power Characteristics			
<input checked="" type="checkbox"/>	A Phase Amps	PI Point not fo...	\\PRDEMSP112\AGUAFRIA.B230 AA ...
<input checked="" type="checkbox"/>	Amps	PI Point not fo...	\\PRDEMSP112\AGUAFRIA.B230 A .AV
<input checked="" type="checkbox"/>	B Phase Amps	PI Point not fo...	\\PRDEMSP112\AGUAFRIA.B230 BA ...

Display Simplification

- Converted nearly 100 displays to 1 Element Relative Display

AGUA FRIA CT GEN - MSS	5/24/2011 11:44
AGUA FRIA STEAM GEN - MSS	7/7/2011 11:43
AGUAFRIA GTS	7/15/2013 10:50
AGUAFRIA2	5/24/2011 11:45
AGUAFRIA3	5/24/2011 11:45
ARLINGTON VALLEY GEN	4/4/2011 08:51
Coolidge Generation	9/14/2011 11:53
Coolidge Peaking Generating Station	8/19/2011 10:18
copper crossing net	8/22/2011 15:57
Coronado Generation	2/5/2012 12:30
Coronado Generation2	9/15/2011 14:13
CORONADO GEN-MSS	10/25/2010 02:27
Craig net generation	5/24/2011 11:46
Desert Basin CT Generation	2/12/2010 07:45
DESERT BASIN	2/16/2006 10:56
DESERT BASINquad	2/12/2010 12:33
Display1	8/9/2006 14:52
Display2	1/21/2009 12:26
FALLS HYDRO OUTPUT	9/20/2010 11:20
FALLS HYDRO	5/19/2004 08:11



Maintenance

- PI AF SDK Application
- Reads in list of PI tags
- Parses tags for element information
- Validates or creates elements in AF database

Maintenance

The screenshot shows a software window titled "PI to AF" with a subtitle "PI to AF (TGO_OPS Database)". The interface includes a "Browse..." button next to a text field containing the file path "C:\PITest\PITagList.csv". On the left side, there are three buttons: "Verify Tags", "Import Selected", and "Add Station". The central area contains a list of six transmission stations, each with a checked checkbox:

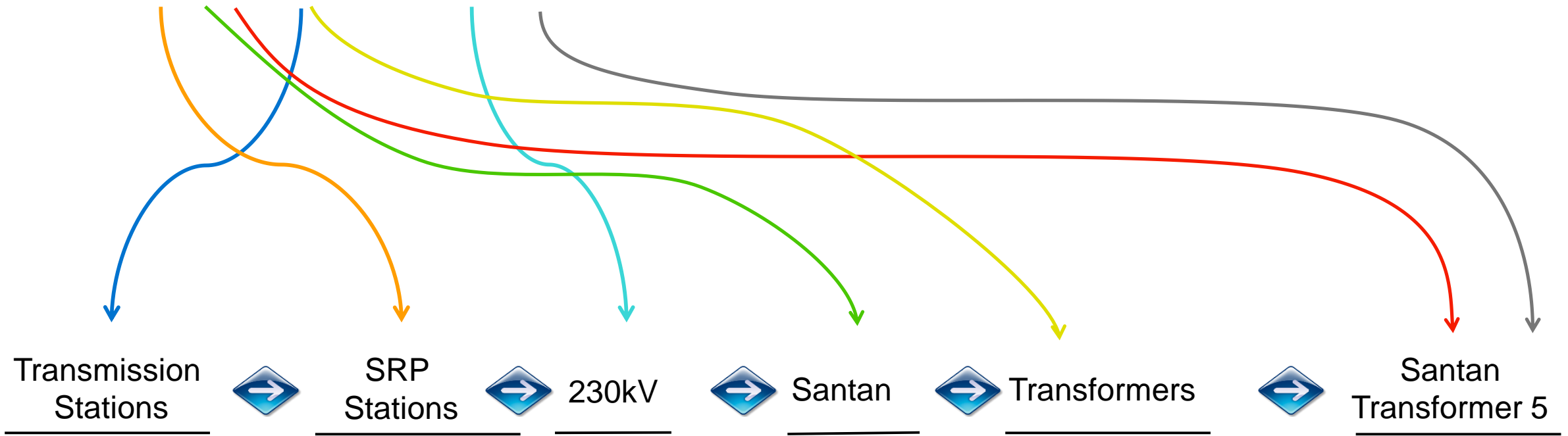
- Transmission Stations/Foreign Stations/WALC/[161kV]/[Headgate Rock (WALC)]/[Transformers]/[Headgate Rock Transformer 7]
- Transmission Stations/Foreign Stations/WALC/[161kV]/[Headgate Rock (WALC)]/[Transformers]/[Headgate Rock Transformer 10]
- Transmission Stations/Foreign Stations/WALC/[161kV]/[Kofa (WALC)]/[Transformers]/[Kofa Transformer 1]
- Transmission Stations/Foreign Stations/APS/115kV/Adams (APS)/Buses/[Adams Bus M-Bus]
- Transmission Stations/SRP Stations/115kV/Asarco/Buses/[Asarco Bus Voltage NW]
- Transmission Stations/Foreign Stations/SWTC/115kV/[Bicknell (SWTC)]/[Buses]/[Bicknell Bus -Bus]

On the right side, there are three buttons: "Select All", "Deselect All", and "Add Station". At the bottom left, there is a "Tags Verified" label next to a progress bar.

Example

PI Tag:

SANTAN .T 69/230 5 MW 2.AV



Example

Elements

- Elements
 - AGC
 - Displays
 - Generators
 - Transmission Stations
 - Foreign Stations
 - SRP Stations
 - 115kV
 - 230kV
 - Abel
 - Agua Fria
 - [...]
 - Rudd Receiving
 - Santan
 - Breakers
 - Buses
 - Circuit Switchers
 - Disconnects
 - Lines
 - Transformers
 - Santan Transformer 3
 - Santan Transformer 4
 - Santan Transformer 5
 - Schrader
 - Pringle
 - Quail

		MV	5.229651927948 Mvar
		MV, High Side	Tag not found
		MW	63.986328125 MW
		MW, High Side	Tag not found
		MW TTC	Tag not found
		MW TTC DIF	Tag not found
		MW TTC LIM	Tag not found
		Out Watt Hours (QWH)	Tag not found

Value Type: Double

Value: 63.986328125 MW

Data Reference: PI Point

Settings...

\\PRDEMSP12\SANTAN .T 69/230 5 MW 2.AV

Transmission
Stations



SRP
Stations



230kV



Santan

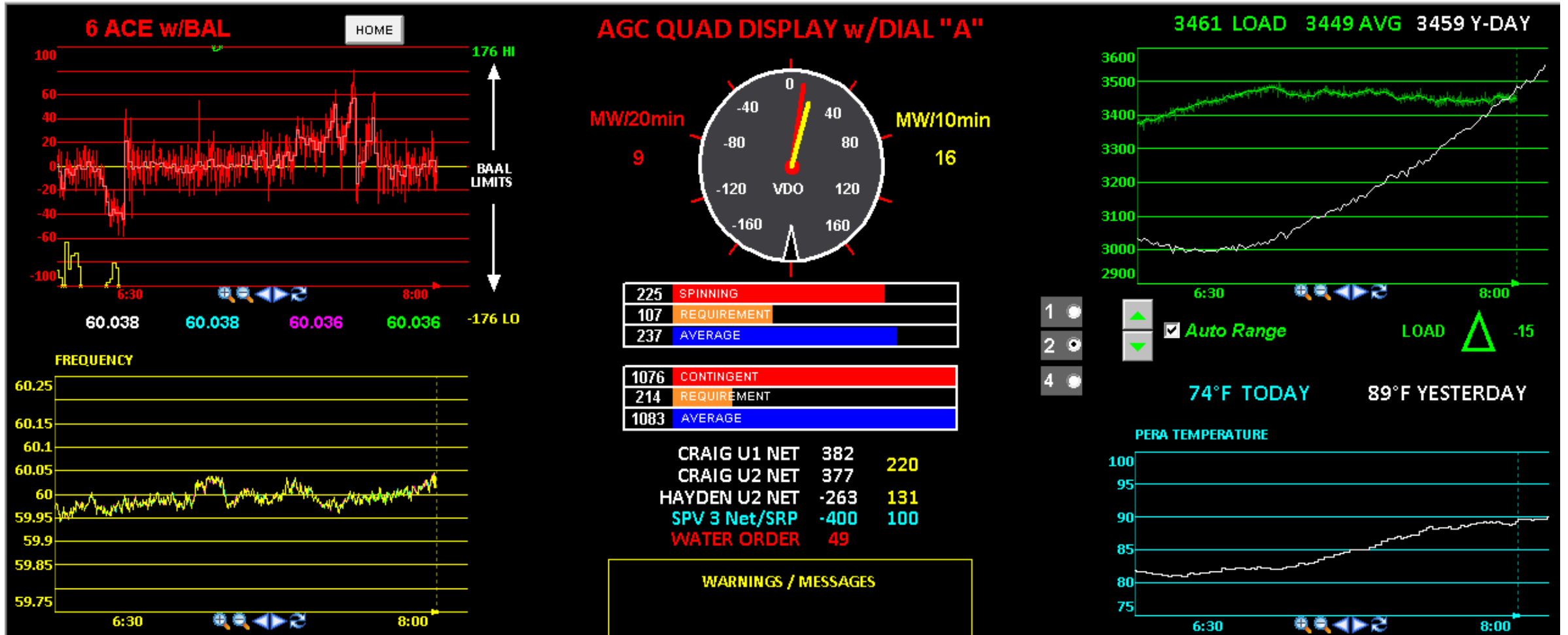


Transformers



Santan
Transformer 5

Analytics and Event Frames for Operations



Analytics and Event Frames for Operations

- Monitor errors in ACE and Load via Event Frame Generation Analyses
- Notify Dispatchers of the source of telemetry errors

The screenshot displays the PI System Explorer interface. The left pane shows a tree view of system elements, with 'Actual Interchange' expanded to show 'APS Tie Lines'. The right pane shows the configuration for the 'Agua Fria - El Sol 230kV Tie Line' under the 'Analyses' tab. A table lists several event frame templates, all with green checkmarks in the 'Backfilling' column. Below the table, the 'Event Frame Template' is set to 'Complete Tie Line Telemetry Failure'. A table at the bottom shows the 'StartTrigger' and 'EndTrigger' expressions.

Name	Backfilling
Complete Tie Line Telemetry Failure	✓
Tie Line Alternate Read Failure	✓
Tie Line Error	✓
Tie Line Primary Read Failure	✓
Tie Line Telemetry Mismatch	✓

Name	Expression
StartTrigger	'Quality, ALT'<>0 and 'Quality, Primary'<>0
EndTrigger	'Quality, ALT'= 0 or 'Quality, Primary'=0

Telemetry Error Event Frames

\\SRPPOB2\TGO_OPS - PI System Explorer

File Edit View Go Tools Help

Database Query Date Back Check In Refresh New Event Frame

Event Frames

- Event Frame Searches
 - Event Frame Search 1
- Generator Runs
- Generator Trips
- Line Faults
- Path 50/54 Violation
- Tie Line Telemetry
 - Alternate Tie Line Telemetry Failure - Cove Fort - Tushar Tie Lin
 - Alternate Tie Line Telemetry Failure - Hassayampa - Arlington V
 - Alternate Tie Line Telemetry Failure - Springerville 4 345kV Tie L
 - Alternate Tie Line Telemetry Failure - Springerville 4 345kV Tie L
 - Alternate Tie Line Telemetry Failure - Springerville 4 345kV Tie L
 - Alternate Tie Line Telemetry Failure - Springerville 4 345kV Tie L
 - Alternate Tie Line Telemetry Failure - West Wing - Agua Fria 23
 - Alternate Tie Line Telemetry Failure - West Wing - Agua Fria 23
 - Alternate Tie Line Telemetry Failure - West Wing - Deer Valley 2
 - Complete Tie Line Telemetry Failure - West Wing - Agua Fria 23
 - Complete Tie Line Telemetry Failure - West Wing - Agua Fria 23
 - Complete Tie Line Telemetry Failure - West Wing - Deer Valley 2
 - Primary Tie Line Telemetry Failure - Coronado - Springerville 34

Tie Line Telemetry

Filter

Name	8 [7.02:27:20]	Duration	Start Time	End Time
Alternate Tie Line Telemetry Failure - Cove Fort - Tushar Tie Line		0:01:10	8/28/2014 09:46:15	8/28/2014 09:47:25
Alternate Tie Line Telemetry Failure - Hassayampa - Arlington Valley Solar 500kW Tie ...		0:01:10	9/4/2014 09:57:55	9/4/2014 09:59:05
Alternate Tie Line Telemetry Failure - Springerville 4 345kV Tie Line		0:04:00	8/30/2014 13:44:10	8/30/2014 13:48:10
Alternate Tie Line Telemetry Failure - Springerville 4 345kV Tie Line		0:01:15	9/3/2014 12:03:15	9/3/2014 12:04:30
Alternate Tie Line Telemetry Failure - Springerville 4 345kV Tie Line		0:02:50	9/3/2014 13:42:25	9/3/2014 13:45:15
Alternate Tie Line Telemetry Failure - West Wing - Agua Fria 230kV Tie Line		0:48:45	9/3/2014 07:49:30	9/3/2014 08:38:15
Alternate Tie Line Telemetry Failure - West Wing - Agua Fria 230kV Tie Line		0:14:45	9/3/2014 08:23:30	9/3/2014 08:38:15
Alternate Tie Line Telemetry Failure - West Wing - Deer Valley 230kV Tie Line		0:37:25	9/3/2014 11:24:40	9/3/2014 12:02:05
Complete Tie Line Telemetry Failure - West Wing - Agua Fria 230kV Tie Line		0:48:45	9/3/2014 07:49:30	9/3/2014 08:38:15
Complete Tie Line Telemetry Failure - West Wing - Agua Fria 230kV Tie Line		0:14:45	9/3/2014 08:23:30	9/3/2014 08:38:15
Complete Tie Line Telemetry Failure - West Wing - Deer Valley 230kV Tie Line		0:37:25	9/3/2014 11:24:40	9/3/2014 12:02:05

\SRPPOB27\TGO_OPS - PI System Explorer
 File Edit View Go Tools Help
 Database Query Date Back Refresh New Element

Elements
 Elements
 AGC
 Calculators and Displays
 MSSC Calculator
 Path 50-54 Operating Agreement
 Generation
 Paths
 Path 50
 Path 54
 Transmission Lines
 Generators
 Agua Fria
 Arizona Falls
 Coolidge Peaking
 Copper Crossing
 Coronado
 Cove Fort
 Craig
 Crosscut
 Desert Basin
 Dry Lake
 Foreign Generation
 Four Corners
 Hayden
 Hoover
 Horse Mesa
 Hudson Ranch
 Kyrene
 Mesquite
 Mormon Flat
 Navajo
 Palo Verde
 Queen Creek Solar
 Roosevelt
 Santan
 Snowflake
 South Con
 Springerville
 Stewart Mountain
 Tri-Cities
 Transmission Stations
 Element Searches

Path 54
 General Child Elements Attributes Ports Analyses Version

Name	Backfilling
100% of Limit Violation Flag	✓
90% of Limit	
90% of Limit Difference	
90% of Limit Violation Flag	
95% of Limit	
95% of Limit Difference	
95% of Limit Violation Flag	
Active Limit	
Active Limit Difference	✓
Active Limit Violation Flag	
APS_Gen_Calcs	✓
Event Generator	✓
Export	✓
IOS Condition	
Shares	✓
SRP_Gen_Calcs	!

Name: IOS Condition
 Description:
 Categories:
 Analysis Type: Expression Rollup Event Frame Generation

Name	Expression	Value	Output Attribute
Variable1	<pre> if('Lines Out of Service_output' = 0) then ("All Lines In Service") else (if('Lines Out of Service_output' >= 2) then ("N-2") else (if('Four Corners - Moenkopi 500kV Status' = 0) then ("Four Corners - Moenkopi IOS") else (if('Cholla - Pinnacle Peak 345kV Status' = 0) then ("Cholla - Pinnacle Peak IOS") else (if('Cholla - Preacher Canyon 345kV Status' = 0) then ("Cholla - Preacher Canyon IOS") else (if('Coronado - Springerville 500kV Line Status' = 0) then ("Coronado - Springerville IOS") else (if('Cholla - Saguaro 500kV Line Status' = 0) then ("Cholla - Saguaro IOS") else (if('Coronado - Sugarloaf 500kV Line Status' = 0) then ("Coronado - Sugarloaf IOS") else (if('Coronado - Silverking 500kV Line Status' = 0) then ("Coronado - Silverking IOS") else ("Oops")))))))) </pre>		IOS Condition

Evaluate

Lessons Learned

- AF Element Template Organization
- Methods to create database from existing PI tags
- Verify usability using the client tools!

Potential Future Projects

- Implementation of Coresight for use with Notifications
- Database creation for the distribution side
- Event Frame creation for disturbances
- Log generation based on event frames