



PI AF with Asset Analytics and PI Coresight for Business Process Improvement

Presented by **Greg Paulson**

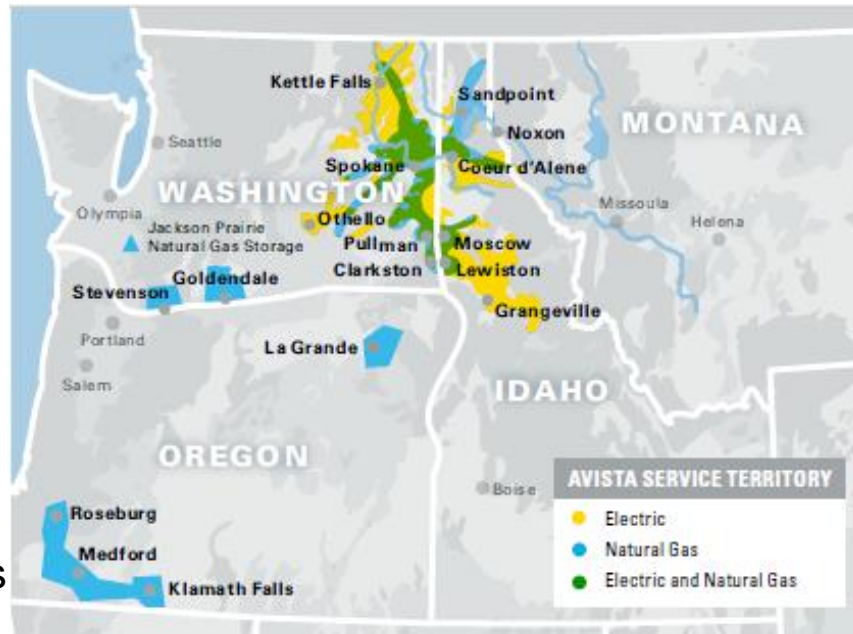


Agenda

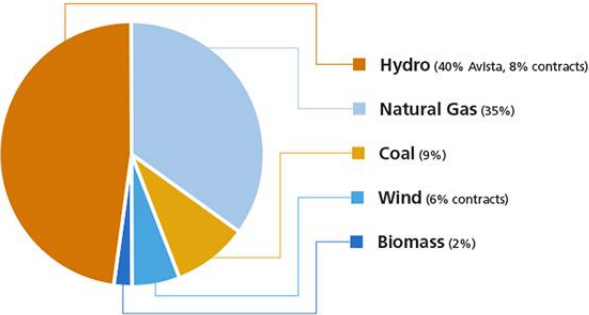
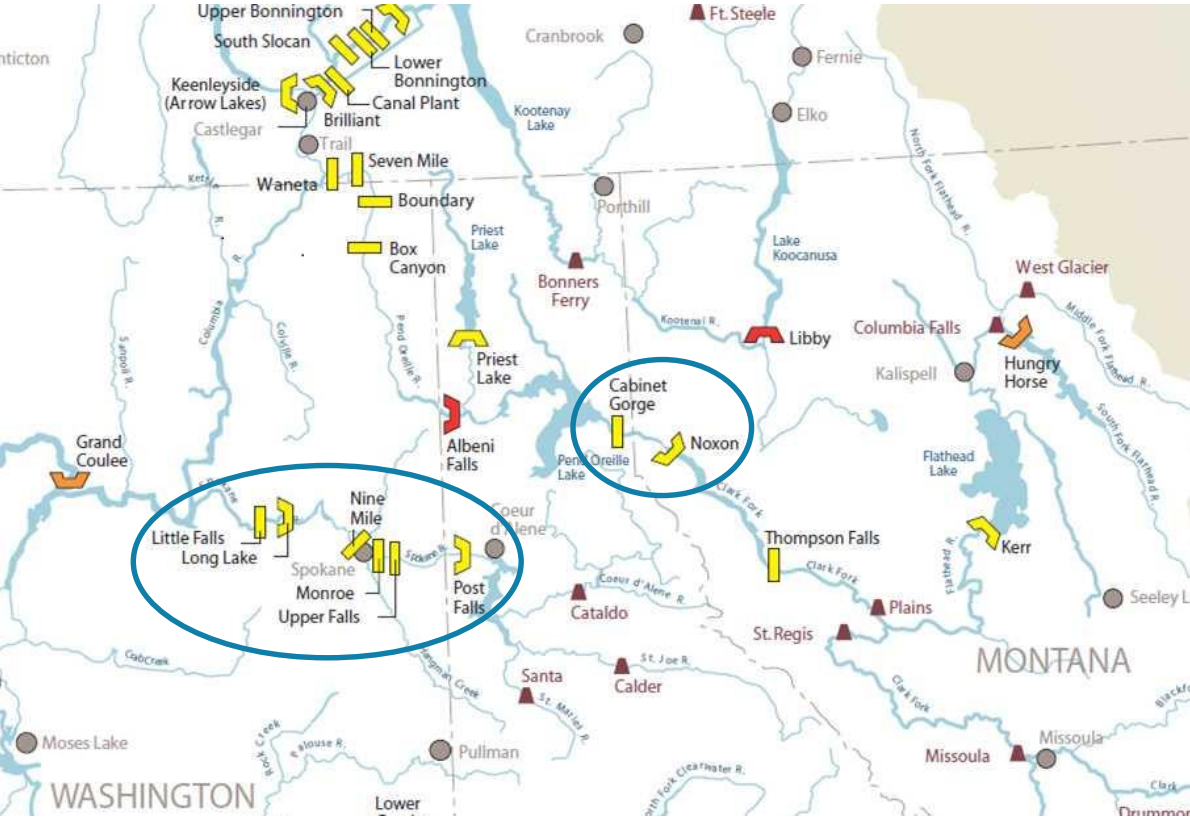
- Avista Overview
- Generation Data Collection
- Round 1 Solution - Excel with PI Datalink
- Round 2 Solution – AF and Coresight to the Rescue
- People, Process, and Technology
- Results
- Future Plans

Avista

- Investor Owned Utility founded in 1889.
- Annual Revenues of more than \$1.6 billion
- 680,000 electric and gas customers
- 30,000 square mile service territory
- 2,200 miles of transmission line
- 18,000 miles of distribution line
- 7,600 miles of natural gas distribution mains
- Headquartered in Spokane, Washington
- Nearly 1,500 employees work in four western states.



Avista – Hydro Generation



Generation Data Collection

- Each Plant Reports Hourly Output and Stream Conditions
- Input into Avista's Power Trading System
- Situational Awareness and Reporting

Element	Light Load						Heavy Load																		Light Load				DTD Total	MTD Total
	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00						
Noxon Forebay	29.03	29.15	29.32	29.45	29.55	29.63	29.61	29.5	29.44	29.32	29.21	29.11	28.96	28.88	28.85	28.82	28.77	28.66	28.51	28.41	28.3	28.25	28.35	28.45	695.53					
Noxon Discharge	1158	5059	62	62	713	9160	16059	24035	21575	23419	25127	21209	31596	27426	15466	16260	20498	23740	29425	26692	23064	19468	12808	633	394714					
Noxon Gen - 94592	8	-3	-2	-4	4	103	184	281	248	272	295	240	356	319	173	183	231	265	333	299	265	225	148	0	4423	9112				
Noxon 3hr Inflow	16582	14843	15197	14832	12759	12984	13636	14858	14628	13962	14326	12956	14745	16448	16717	15349	13976	14238	14882	15387	15162	14963	16575	15650	355655					
Cabinet Forebay	73.8	73.1	73.3	72.9	72.8	73.1	72.5	72.7	72.5	72.8	72.6	73.08	73.19	73.4	72.9	72.7	72.5	72.4	72.6	72.6	72.5	72.8	72.7	72.4	1747.87					
Cabinet Discharge	7846	7166	7110	7231	7692	8405	15509	27469	27441	25938	18080	18162	18225	20940	27736	27693	27752	27663	27345	27468	27440	26909	10535	8361	456116					
Cabinet Gen - 9459	59	54	53	53	57	66	110	196	196	184	131	135	133	152	198	199	198	197	195	195	197	188	79	64	3289	6060				
Cab Nat Inflow	16050	15150	15276	15523	15306	16564	14722	15335	15174	16431	15205	15542	15062	15550	14907	15053	14899	14783	15259	15024	15458	15902	15219	15170	368564					
Long Lake Forebay	29.15	29.2	29.24	29.28	29.31	29.32	29.36	29.4	29.44	29.48	29.51	29.54	29.57	29.61	29.65	29.68	29.71	29.75	29.79	29.82	29.86	29.9	29.93	29.97	709.47					
Long Lake Disch	11533	11533	11542	11538	11563	11554	11564	11567	11584	11609	11618	11633	11637	11631	11642	11641	11652	11656	11650	11656	11656	11692	11671	11676	278698					
Long Lake Gen - 94	79	81	81	83	80	81	80	83	79	82	82	80	81	83	80	82	82	80	82	82	80	82	81	83	1949	3879				
Long Lake 3hr Inflow	14028	14221	14224	14034	13660	13088	13096	13290	13876	13891	13716	13540	13357	13554	13749	13750	13565	13570	13765	13766	13766	13780	13785	13792	328863					
Little Falls Forebay	61.63	61.62	61.62	61.6	61.61	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.67	61.65	61.61	61.59	61.59	61.56	61.54	1478.49					
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Little Falls Gen - 94	27	26	27	27	28	27	27	27	27	27	27	27	28	27	27	27	26	27	27	27	28	27	27	26	648	1295				
Mid-C Capability	152	152	152	152	152	152	152	141	139	139	141	141	141	141	142	144	148	148	147	148	148	148	148	154	3522					

Generation Data Collection – The Old Way

- Manual Input to Excel Spreadsheet running Macros
- Customized to each Plant
- Maintained by Chief Operator
 - On call after hours to fix when broken
- Stored in Multiple Locations on the Control Network
- Rework required to duplicate for Reporting



Business Process Improvement – Round 1 Solution

- Utilize PI as the System of Record
- Excel Workbooks utilizing PI Datalink
- Perform Calculations in Excel
- Technical and Operational Issues were Encountered
 - Active X Calendar Control
 - Non-Technical personnel
 - Low Bandwidth to Remote Plants
 - Change is Hard



Business Process Improvement – Round 2 Solution

- Establish Avista's Power Trading System as System of Record
- PI AF as means centralize calculations
- PI Coresight to Visualize Data

The screenshot displays the PI Coresight application interface. On the left is a tree view of assets, including 'Boulder Park', 'Cabinet Gorge', 'Long Lake', 'Nine Mile', 'Northeast', 'Noxon Rapids', 'Post Falls', 'Rathdrum CT', and 'Upper Falls'. The central pane shows a table of data points categorized by 'CFS and Elevation' and 'Daily'. The right-hand pane shows the properties for the selected 'Forebay Elevation' data point.

Name	Value
Forebay Elevation	2172.639892578125
Hourly Forebay Elevation	2172.389892578125
Hourly Spill CFS	0
Hourly Total CFS	8377
Hourly Turbine CFS	8377
Ice Gate CFS	0
Ice Gate Open	0
Spill CFS	0
Trash Gate CFS	0
Trash Gate Open	0
Turbine CFS	8285

Name	Value
08:00 CFS Average	16653.125
08:00 Daily Plant MWh Net	957
08:00 Daily Spill CFS	0
08:00 Daily Turbine CFS	133225
16:00 CFS Average	0
16:00 Daily Plant MWh Net	No Data
16:00 Daily Spill CFS	No Data
16:00 Daily Turbine CFS	No Data
24:00 CFS Average	0
24:00 Daily Plant MWh Net	No Data
24:00 Daily Spill CFS	No Data
24:00 Daily Turbine CFS	No Data

Properties for Forebay Elevation:

- Name: Forebay Elevation
- Description: Forebay Elevation
- Properties: <Home>
- Categories: CFS and Elevation
- Default UOM: <Home>
- Value Type: Double
- Value: 2172.639892578125
- Data Reference: PI Point

PI AF 2.5 and PI Coresight 2014 – Proof of Concept

- Formulas
- Timing Issues
 - Inconsistencies
- Coresight 2014 Issues

The screenshot shows a configuration window for a data source named 'Spill CFS'. The window has a 'Group by' section at the top right with checkboxes for 'Category' (checked) and 'Template' (unchecked). The main configuration area includes fields for Name, Description, Properties, Categories, Default UOM, Value Type, Value, and Data Reference. Below these fields is a 'Settings...' button and a text area containing a complex formula.

Group by: ☒ Category ☐ Template

Name: Spill CFS

Description: Spill CFS

Properties: <None>

Categories: CFS and Elevation

Default UOM: <None>

Value Type: Double

Value: 0

Data Reference: Formula

Settings...

A=\\h0168\Cabinet Gorge.Spillgate 1 CFS;B=\\h0168\Cabinet Gorge.Spillgate 2 CFS;C=\\h0168\Cabinet Gorge.Spillgate 3 CFS;D=\\h0168\Cabinet Gorge.Spillgate 4 CFS;E=\\h0168\Cabinet Gorge.Spillgate 5 CFS;F=\\h0168\Cabinet Gorge.Spillgate 6 CFS;G=\\h0168\Cabinet Gorge.Spillgate 7 CFS;H=\\h0168\Cabinet Gorge.Spillgate 8 CFS;I=\\h0168\Cabinet Gorge.Ice Gate CFS;J=\\h0168\Cabinet Gorge.Trash Gate CFS;[A+B+C+D+E+F+G+H+I+J]

PI AF 2.7 – Analyses Save the Day!

- Write to PI Tags from Analyses
- Control Timing

Scheduling: ☐ Event-Triggered ☒ Periodic Advanced...

Period: 01h 00m 00s Configure

Cabinet Gorge

General Child Elements Attributes Ports Analyses Version

Name	Backfilling
✓ f(x) Daily Net Calculations	✓
✓ f(x) Hourly CFS and Forebay Elevation	✓
✓ f(x) Hourly Meter Readings	✓
✓ f(x) Hourly Net Calculations	✓
✓ f(x) Ice and Trash Gate	✓

Name: Hourly Net Calculations

Description: Hourly Net Calculations

Categories: Loadsheets

Analysis Type: ☒ Expression ☐ Rollup ☐ Event Frame

Evaluate

Name	Expression	Value	Output Attribute
U1MWhInNet	<code>if TagVal('Unit 1 MWh In Meter Read','*') - TagVal('Unit 1 MWh In Meter Read','*-1h') >=0 then TagVal('Unit 1 MWh In Meter Read','*') - TagVal('Unit 1 MWh In Meter Read','*-1h') else if TagVal('Unit 1 MWh In Meter Read','*') > 99999 then (100000 - TagVal('Unit 1 MWh In Meter Read','*-1h') + TagVal('Unit 1 MWh In Meter Read','*')) else (100000 - TagVal('Unit 1 MWh In Meter Read','*-1h') + TagVal('Unit 1 MWh In Meter Read','*'))</code>		Hourly Unit 1 MWh In Net

PI AF 2.7 – Analyses Save the Day!

- Templates were the key

The screenshot displays the PI AF 2.7 software interface, specifically the 'Cabinet Gorge' analysis template. The interface is divided into several panes:

- Elements:** A tree view on the left showing the project hierarchy, including 'Generation', 'Line Segments', 'Assets', and 'Event Frames'. Under 'Assets', various units like 'Boulder Park', 'Cabinet Gorge Spillgate 1 CFS', and 'Long Lake' are listed.
- General:** A tab at the top of the main pane showing the 'Name' (MTD Net Calculations), 'Description' (MTD Net Calculations), 'Categories' (Loadsheets), and 'Analysis Type' (Expression).
- Analyses:** A table listing the analysis elements and their backfilling status.
- Expression:** A table showing the expressions for each analysis element.
- Functions:** A pane on the right showing a list of available functions for use in the expressions.

Analyses Table:

Name	Backfilling
f() Daily CFS	✓
f() Daily Net Calculations	✓
f() Hourly CFS and Forebay Elevation	✓
f() Hourly Meter Readings	✓
f() Hourly Net Calculations	✓
f() Ice and Trash Gate	✓
f() MTD Net Calculations	✓

Expression Table:

Name	Expression	Value	Output Attribute
U1MhInNetCalc	if (Hour('**') = 0 and Day('**') = 1) then TagVal('Unit 1 MWh In Meter Re		Map
if (Hour('**') = 0 and Day('**') = 1) then TagVal('Unit 1 MWh In Meter Read', '**') - TagVal('Unit 1 MWh In Meter Read', BOM('** - 1mo')) else TagVal('Unit 1 MWh In Meter Read', '**') - TagVal('Unit 1 MWh In Meter Read', BOM('**'))			
U1MhInlet	if U1MhInNetCalc >= 0 then U1MhInNetCalc else if TagVal('Unit 1 MWh In		Hourly Unit 1 Month to Date MWh In
U1MhOutletCalc	if (Hour('**') = 0 and Day('**') = 1) then TagVal('Unit 1 MWh Out Meter R		Map
U1MhOutlet	if U1MhOutletCalc >= 0 then U1MhOutletCalc else if TagVal('Unit 1 MWh		Hourly Unit 1 Month to Date MWh Out
U2MhInNetCalc	if (Hour('**') = 0 and Day('**') = 1) then TagVal('Unit 2 MWh In Meter Re		Map
U2MhInlet	if U2MhInNetCalc >= 0 then U2MhInNetCalc else if TagVal('Unit 2 MWh In		Hourly Unit 2 Month to Date MWh In
U2MhOutletCalc	if (Hour('**') = 0 and Day('**') = 1) then TagVal('Unit 2 MWh Out Meter R		Map
U2MhOutlet	if U2MhOutletCalc >= 0 then U2MhOutletCalc else if TagVal('Unit 2 MWh		Hourly Unit 2 Month to Date MWh Out
U3MhInNetCalc	if (Hour('**') = 0 and Day('**') = 1) then TagVal('Unit 3 MWh In Meter Re		Map
U3MhInlet	if U3MhInNetCalc >= 0 then U3MhInNetCalc else if TagVal('Unit 3 MWh In		Hourly Unit 3 Month to Date MWh In
U3MhOutletCalc	if (Hour('**') = 0 and Day('**') = 1) then TagVal('Unit 3 MWh Out Meter R		Map
U3MhOutlet	if U3MhOutletCalc >= 0 then U3MhOutletCalc else if TagVal('Unit 3 MWh		Hourly Unit 3 Month to Date MWh Out
U4MhInNetCalc	if (Hour('**') = 0 and Day('**') = 1) then TagVal('Unit 4 MWh In Meter Re		Map
U4MhInlet	if U4MhInNetCalc >= 0 then U4MhInNetCalc else if TagVal('Unit 4 MWh In		Hourly Unit 4 Month to Date MWh In
U4MhOutletCalc	if (Hour('**') = 0 and Day('**') = 1) then TagVal('Unit 4 MWh Out Meter R		Map

Functions:

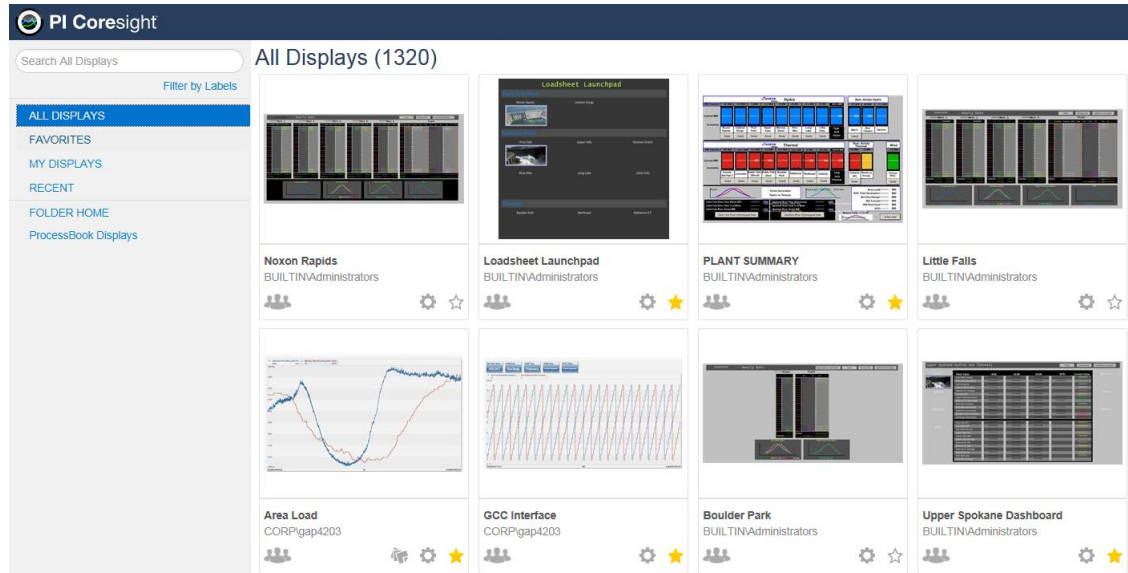
Insert functions into the expression

All

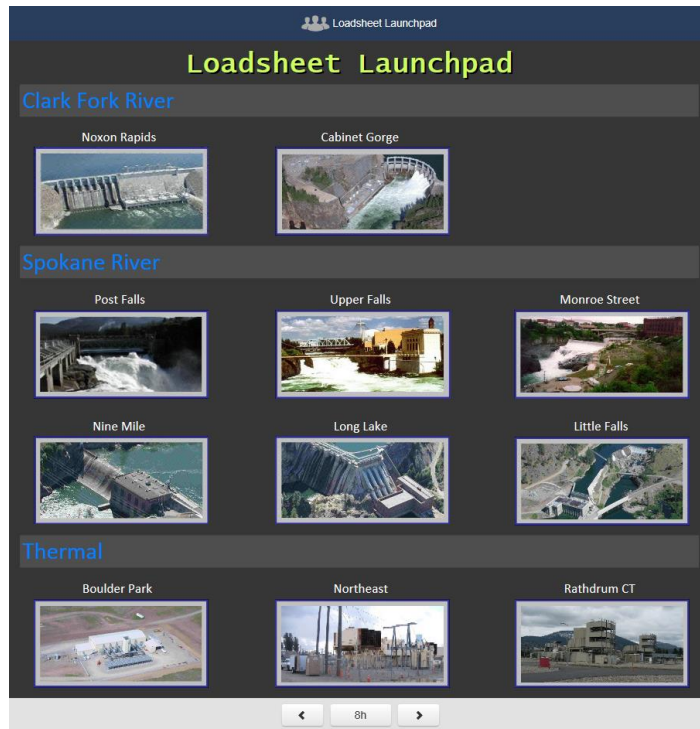
TagAvg
TagBad
TagDesc
TagEU
TagExDesc
TagMax
TagMean
TagMin
TagName
TagNum
TagSource
TagSpan
TagTot
TagType
TagTypVal
TagVal
TagZero
Tan
Tanh
Text
Then
TimeEq
TimeGE
TimeGT
TimeLE
TimeLT
TimeStamp(attribute x)
Returns the time stamp for a single time-stamped value.
Example: TimeStamp(PrevVal('sinusoid', '')) *Returns the time stamp of the most recent PI archive event for sinusoid.
Attributes

PI Coresight 2015 - Centralized Control of Displays

- Accessible to All
- Lower Bandwidth Requirements
- Element Relative
 - Reuse Displays

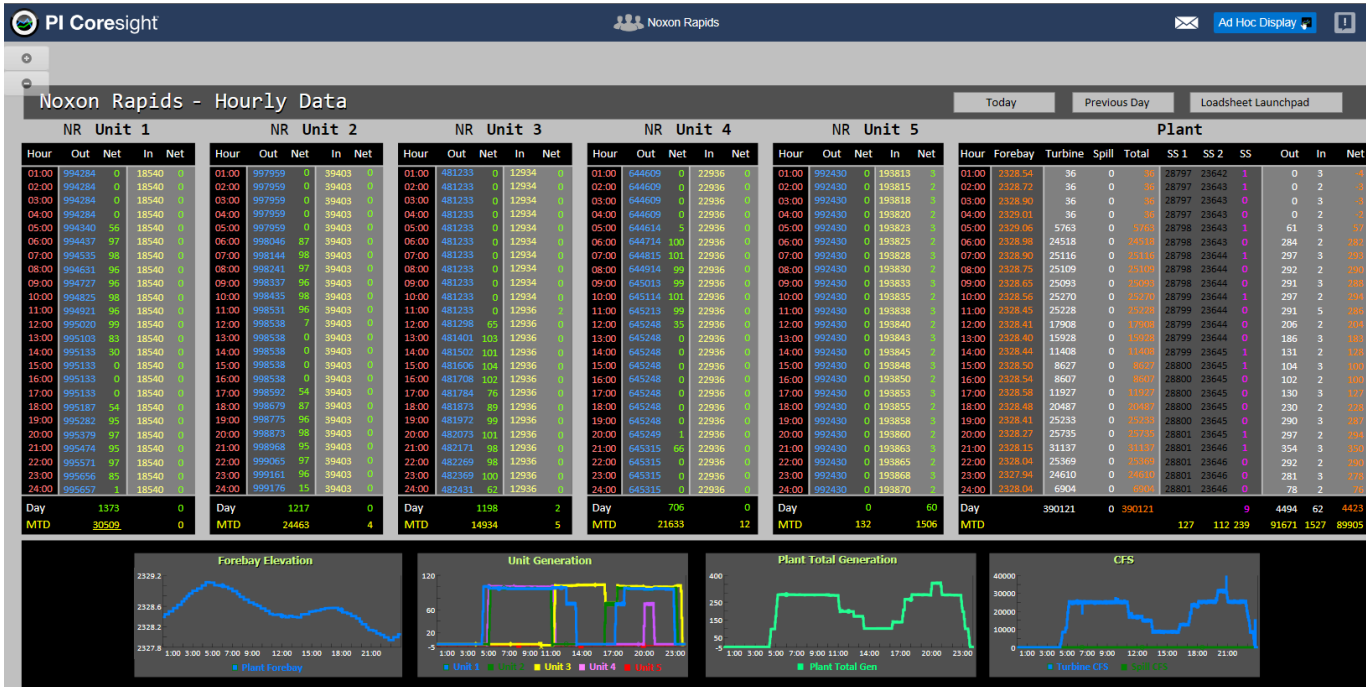


PI Coresight 2015 – Control Loading of Asset via URL



<https://servername/Coresight/#/PBDisplay/Loadsheets/Plant%20Displays/Noxon%20Rapids?CurrentElement=\\servername\\Avista\\Loadsheets\\Assets\\Noxon%20Rapids>

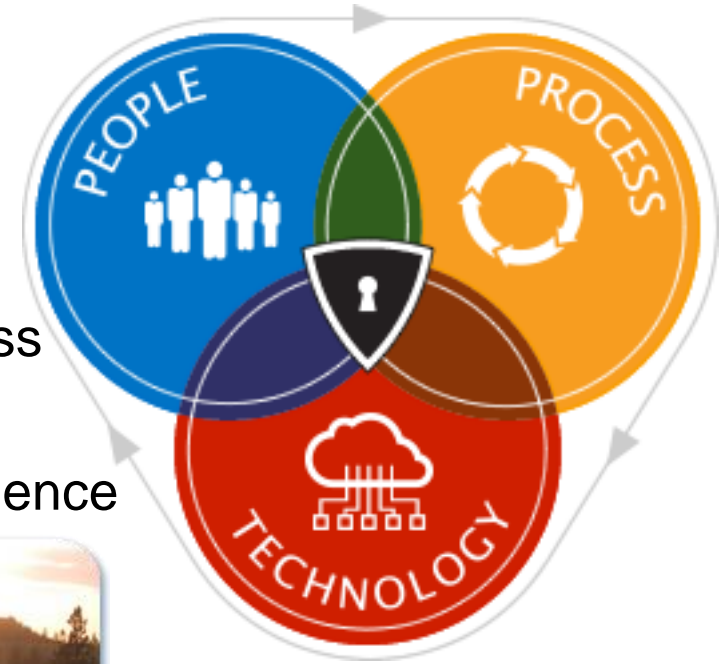
PI Coresight 2015 – Control Start and End Times



<https://servername/Coresight/#/PBDisplayName/Loadsheets/Plant%20Displays/Noxon%20Rapids?CurrentElement=\\servername\\Avista\\Loadsheets\\Assets\\Noxon%20Rapids&StartTime=y-1s&EndTime=t-1s>

People, Process, and Technology

- Involve the End Users in the Solution
 - Travel to the End Users
- Use Technology as a Tool to Drive Process
- Easy Access to Report Issues
- Resolve Issues quickly to maintain confidence



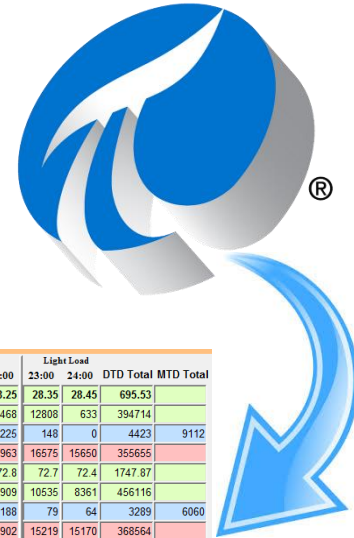
Results

- Consistent Defined Process
- Easy Access to the Data for everyone
- Chief Operators reduce overtime/deployed to higher value tasks
- Soft savings estimated at \$11,000/mo



Future Plans

- Integrate from PI to Power Scheduling System
 - Reduce Input Error
- Leverage AF Framework
 - Other Plants
 - Environmental Compliance



Element	Light Load						Heavy Load																Light Load		DTD	Total	MTD	Total
	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00				
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Little Falls Disch	11591	11595	11600	11603	11621	11616	11620	11620	11649	11656	11640	11640	11770	11685	11685	11685	11749	11713	11712	11718	11723	11728	11737	11736	280092			
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Mid C Capability	152	152	152	152	152	152	152	141	139	139	141	141	141	141	142	144	148	148	147	148	148	148	148	154	3522			

PI AF with Asset Analytics and PI Coresight for Business Process Improvement

COMPANY and GOAL

Avista constantly seeks to improve existing processes through its Business Process Improvement Program



CHALLENGE

Plant operational data only available at the generation site and not standardized between plants

- Manual processes
- Inconsistency
- Poor use of resources

SOLUTION

Centralize all calculations in Asset Framework and deliver to users in Coresight

- Asset Framework Analyses are key to consistent calculations
- Coresight is the best delivery mechanism for multiple users

RESULTS

Reduced overtime maintaining Excel macros and a consistent process for Operators at all plants

- Process is the same at each plant
- Coresight provides easy access
- Chief Operators time is allocated to higher value tasks – Soft savings estimated at \$11,000/mo

Contact Information

Speaker's Name

greg.paulson@avistacorp.com

System Operations Engineer

Avista



Questions

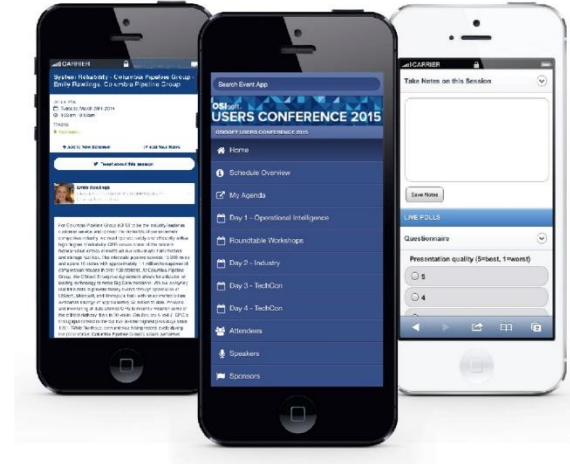
Please wait for the
microphone before asking
your questions



State your
name & company

Please don't forget to...

Complete the Online Survey
for this session



감사합니다

谢谢

Danke

Merci

Gracias

Thank You

ありがとう

Спасибо

Obrigado