



ProcessPlugins Steam Turbine Performance



Partner Organizations:

PII Process
Innovations
Inc.



PROCESS PLUGINS™ STEAM TURBINE PERFORMANCE

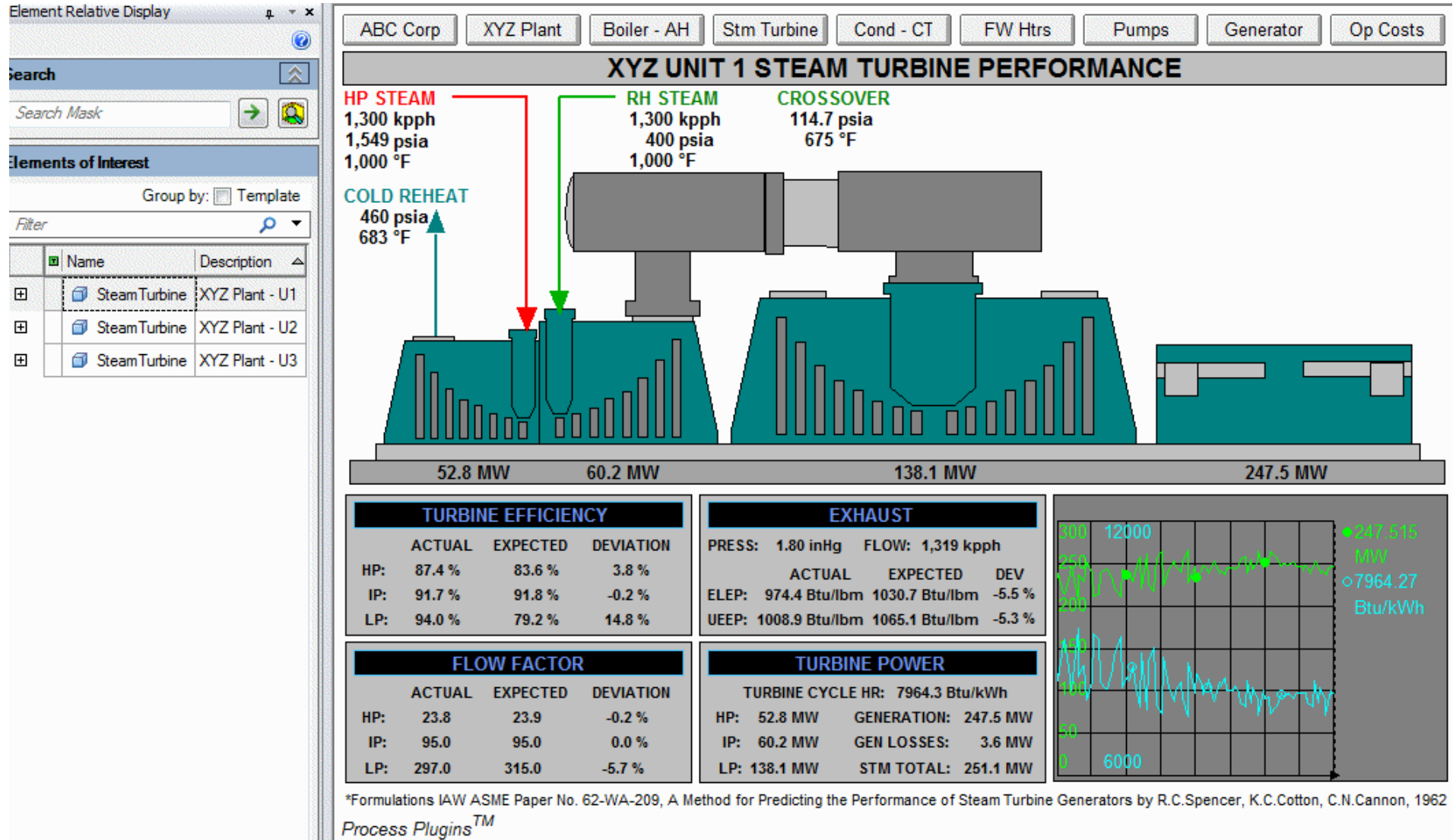
The Steam Turbine Performance module monitors and presents a real time graphic display of your Steam Turbine's key performance indicators. Formulations (also used by General Electric) are based upon ASME Paper No. 62-WA-209, A Method for Predicting the Performance of Steam Turbine Generators by R.C. Spencer, K.C. Cotton, C.N. Cannon, 1962. All formulations occur entirely within PI-AF, so that there is no hidden code. Real time calculations include:

- Actual and expected efficiencies of each individual steam turbine, including the low pressure steam turbine
- Actual and expected steam inlet flow factors of each individual steam turbine
- Actual and expected expansion line end point (ELEP) and used energy end point (UEEP).
- Steam power extracted from each individual turbine, and electrical and mechanical losses.

All steam turbine leakages are calculated and accounted for. The intermediate pressure turbine is corrected for N2 leakage when applicable.

The Process Plugins™ solution has the capability of monitoring an unlimited number of steam turbines, which can be added by the end user at any time in the future. Calculations are in accordance with ASME PTC 6/6s and utilize properties of water and steam calculated in accordance with the ASME 1997 formulations.

PROCESS PLUGINS™ STEAM TURBINE PI PROCESS BOOK – ELEMENT RELATIVE DISPLAY



Using the 'Element Relative Display' feature, one master Process Book display file may be used to consistently display the key performance indicators of each Steam Turbine by simply selecting the asset in the Element Relative pane (left side of display). With the 'Element Relative Display' feature, one master display file may be used for an unlimited number of similar assets. Corporate level summary "drill down" screens make navigation easy via PI Process Book, or Internet Explorer using PI Web Parts.

Flexibility of the OSIsoft AF structure allows for value substitution whenever certain instrumentation may be unavailable. This substitution can take a number of forms including real-time calculation of the expected value based upon surrounding instrumentation, manual input via AF, manual input to a PI tag based on operator rounds, or any combination of manual and calculated inputs.

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MORE ABOUT PROCESS PLUGINS™

OSIsoft's PI System continues to be the industry standard in data historians, which has been the core of its 21st century real-time infrastructure platform. And now this platform comes fully loaded with every feature necessary to support all of your needs for monitoring, modeling, diagnostics, or forecasting without the need for any 3rd party software. That's where the Process Plugins™ package comes in.

Process Plugins™ is not 3rd party software. The Process Plugins™ package customizes your OSIsoft platform for your plant. This is the only existing solution if you want:

1. No unnecessarily redundant PI tags
2. No 3rd party software
3. One Microsoft certified package with seamless integration of calculations and models
4. Web browser interface capability
5. Ability to drill down into calculations to see (or edit) exactly what they're doing
6. Direct Access to the PI Notification Systems

PI Analysis Framework (PI-AF)

The screenshot shows the PPI - PI System Explorer interface. The main window displays the 'Performance' element details for 'Efficiency'. The 'Performance' pane includes a table of metrics and a detailed view for the selected element.

Name	Value
Efficiency	91.98404 %
EfficiencyExp	86.43343 %
ELEP	1006.872 Btu/lbm
Power	116.2709 MW
UEEP	1016.245 Btu/lbm

The detailed view for 'Efficiency' shows the following fields:

- Name: Efficiency
- Description: (empty)
- Configuration Item:
- Categories: (empty)
- UOM: %
- Value Type: Single
- Value: 91.98404 %
- Data Reference: Formula

The formula for Efficiency is displayed as:

$$A = \dots; B = UEE; C = \dots; [100 * (A - B) / (A - C)]$$

The Process Plugins™ package resides primarily within OSIsoft’s PI Analysis Framework (PI-AF). Your plant customization exists in the form of *elements* which handle most of your basic performance calculations. Using PI System Explorer, system administrators can view, modify, or enhance elements as desired.

Element Formulas

Formula Configuration: (Efficiency)

Parameters

A=.\SteamInlet\PPISmEng_HPTIOutputH
B=UEEP
C=.\PPISmEng_HPSIOutputH

Default Values Allowed

Equations

100*(A-B)/(A-C)

Result

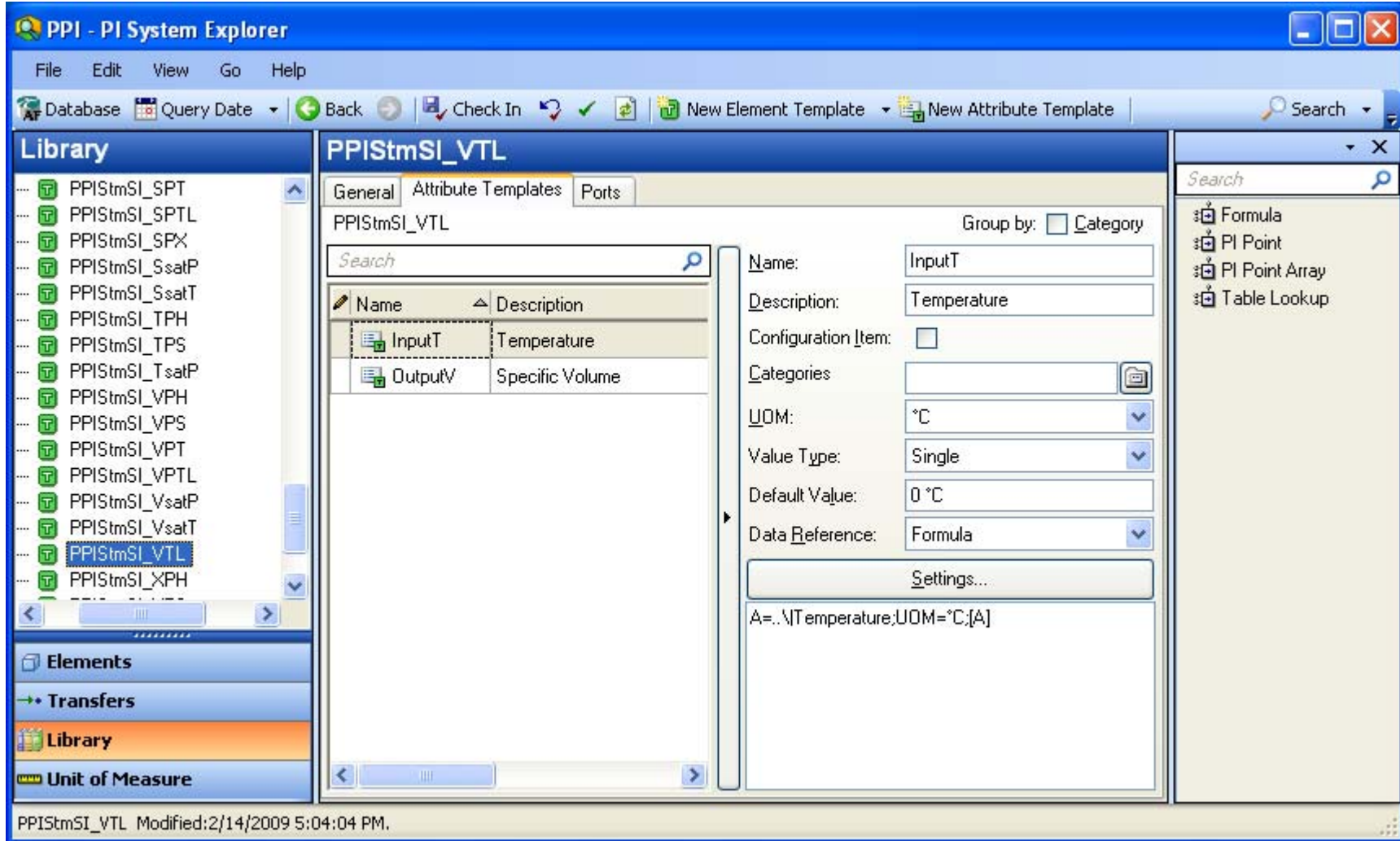
Unit of Measure: <Default> [%] Minimum: Maximum:

Evaluate 91.9840558039119

OK **Cancel**

Fundamental performance calculations exist as formulas within elements. Some routines utilize OS/soft's PI Advanced Computing Engine (PI ACE), which delivers results back to an element.

Element Templates



The Process Plugins™ package comes with a complete set of “Drag & Drop” Element Templates for use in PI-AF.

Lookup Tables

The screenshot displays the PPI - PI System Explorer interface. The left pane shows a library of tables, with 'PPI_IndStd_GESTmTurbLastStg' selected. The right pane shows the 'Table' tab for this table, displaying a data grid with two columns: 'LastStgBucketLen' and 'ExhaustAreaPerPlane'. The data points are as follows:

LastStgBucketLen	ExhaustAreaPerPlane
14.3	16.3
16.5	20.7
17	19.3
20	26.2
23	32.9
26	41.1
30	55.6
33.5	66.1
35	84
38	95.3
43	123.8
52	172.4
*	

The status bar at the bottom indicates: PPI_IndStd_GESTmTurbLastStg Modified:3/14/2009 10:31:43 AM. Version: 1/1/1970 12:00:00 AM, Revision 1

The Process Plugins™ package comes with both industry standard and site specific tables which are used by elements for lookup functions as well as interpolation.

Data Storage

The screenshot displays the PPI - PI System Explorer application. The main window is titled "PPI - PI System Explorer" and features a menu bar (File, Edit, View, Go, Help) and a toolbar with icons for Database, Query Date, Back, Check In, New Element, and New Attribute. A search bar is located in the top right corner.

The interface is divided into several panes:

- Elements:** A tree view on the left showing a hierarchy of elements. The selected path is: PumpPerformance > SteamTurbinePerformance > HPTurbine > Performance > PPI_WriteToPI5.
- PPI_WriteToPI5 Properties:** A central pane with tabs for General, Child Elements, Attributes, Ports, and Version. The "Attributes" tab is active, showing a table of attributes for the selected element.
- Attribute Table:** A table with columns "Name" and "Value". The "PIPoint" attribute is selected and highlighted in blue.
- Configuration Panel:** A panel on the right for configuring the selected attribute. It includes fields for Name (PIPoint), Description, Configuration Item, Categories, UOM (<None>), Value Type (Single), Value (91.98405 %), and Data Reference (PI Point). A "Settings..." button is also present.
- Search Panel:** A search bar on the far right with a list of search results, including "PPI_DrawPlot", "PPI_DrawPolar", "PPI_Iterate", "PPI_WriteTable...", "PPI_WriteToPI", "PPICombustorDy...", "PPIHum_DPtoSH", "PPIHum_RHtoSH", "PPIHum_SHtoRH", "PPIHum_SHtoWB", "PPIHum_WBtoSH", "PPINotifications", "PPIStmEng_HPS", "PPIStmEng_HPT", "PPIStmEng_HPX", "PPIStmEng_HsatP", "PPIStmEng_HsatT", "PPIStmEng_HTL", "PPIStmEng_PsatT", and "PPIStmEng_SPH".

The status bar at the bottom of the window displays "PIPoint".

Key resultant data generated by Process Plugins™ modules are stored in the OSIsoft PI historian. Process Plugins™ modules do NOT store redundant or unnecessary data, but only a handful of PI tags for key results.

Units of Measure

The screenshot shows the 'ProcessPlugins1 - PI System Explorer' application window. The main area is divided into two panes. The left pane, titled 'Unit of Measure', contains a search bar and a list of classes including Moles, Partition, Power (selected), Pressure, Specific Volume, Temperature, Temperature (Delta), Time, Velocity, Viscosity, Volume, Volume Flow Rate, and Volumetric Heating Value. Below this are sections for Elements, Transfers, Library, and Unit of Measure. The right pane, titled 'Power', contains a search bar and a table of power units.

Name	Abbrevi...	Class	Canonical	R.
Btu/h	Btu/h	Power	0.29307107017222 W	0...
Cal/s	Cal/s	Power	4.1868 W	4...
HP	HP	Power	745.699871582 W	7...
J/s	J/s	Power	1 W	1...
kBtu/h	kBtu/h	Power	293.07107017222 W	1...
kVA	kVA	Power	1000 W	1...
kVAR	kVAR	Power	1000 W	1...
kW	kW	Power	1000 W	1...
MJ/h	MJ/h	Power	277.777777777778 W	2...
MMBtu/d	MMBtu/d	Power	12211.2945905092 W	4...
MMBtu/h	MMBtu/h	Power	293071.07017222 W	1...
MMBtu/min	MMBtu/min	Power	17584264.2103332 W	6...
MMcal/h	MMcal/h	Power	1163 W	1...
MVA	MVA	Power	1000000 W	1...
MVAR	MVAR	Power	1000000 W	1...
MW	MW	Power	1000000 W	1...
VA	VA	Power	1 W	1...
VAR	VAR	Power	1 W	1...
W	W	Power	1 W	1...

Unit-of-Measure Database on PROCESSPLUGINS (33 Classes, 218 UOMs) Modified:7/2/2008 10:40:56 AM.

The Process Plugins™ package includes a complete set of engineering units utilized by the utility industry for use with the PI AF Unit of Measure (UOM) system. PI-AF automatically performs unit conversions on demand and delivers results in either the U.S. English or S.I. engineering unit systems.



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