



# ProcessPlugins HRSG Condition Monitor



Partner Organizations:

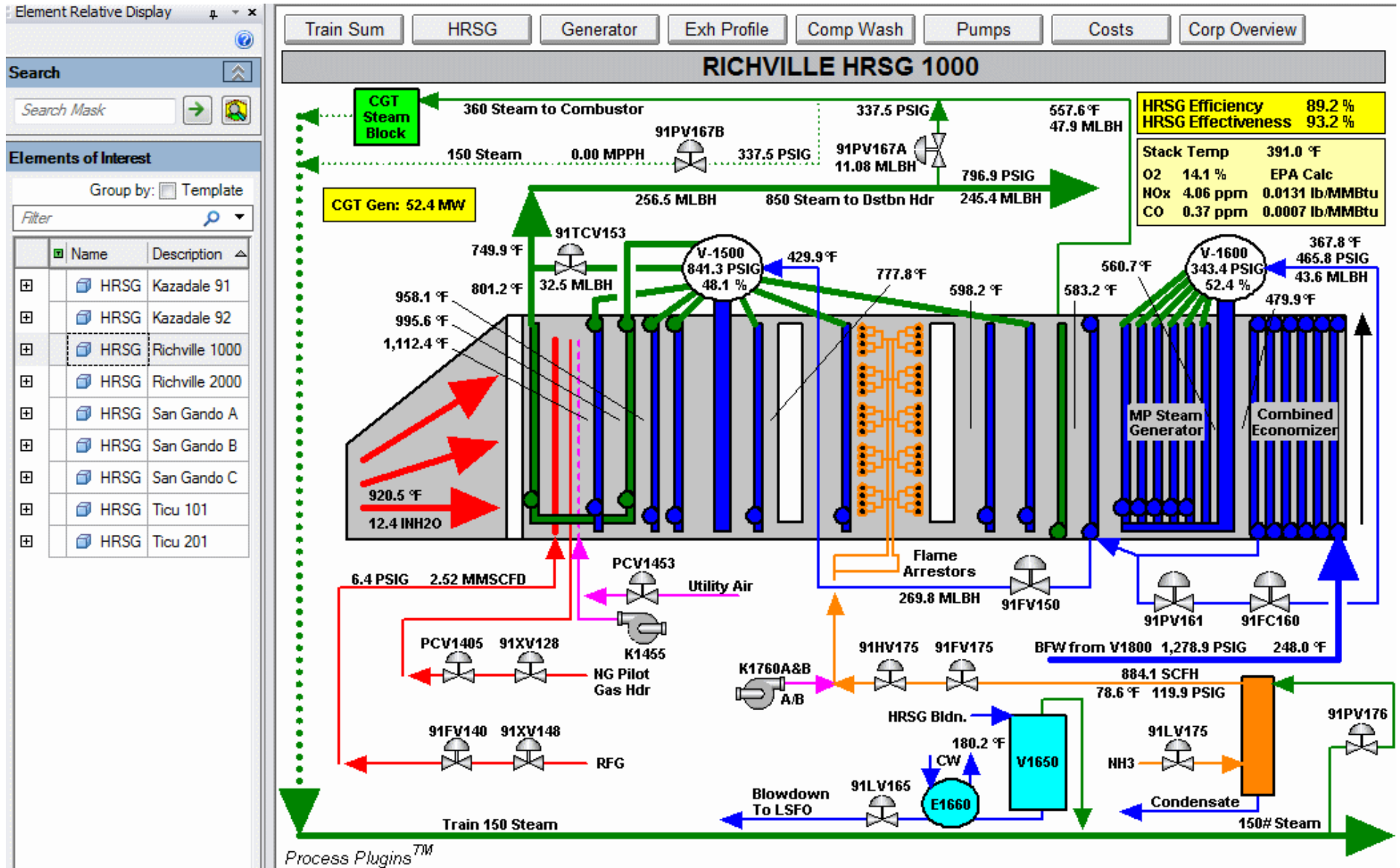


Process  
Innovations  
Inc.



# PROCESS PLUGINS™ HEAT RECOVERY STEAM GENERATOR (HRSG) PERFORMANCE & CONDITION MONITOR

The HRSG Condition Monitor provides real-time HRSG efficiency and effectiveness. This information can be useful in determining loss of HRSG efficiency or other problems. This tool makes it easy to identify problems with your HRSG performance early.



Element Relative Display

Search: Search Mask

Elements of Interest

Group by: Template

Filter

Name	Description
HRSG Kazadale 91	
HRSG Kazadale 92	
HRSG Richville 1000	
HRSG Richville 2000	
HRSG San Gando A	
HRSG San Gando B	
HRSG San Gando C	
HRSG Ticu 101	
HRSG Ticu 201	

Using the 'Element Relative Display' feature, one master Process Book display file may be used to consistently display the key performance indicators of each HRSG by simply selecting the HRSG 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.

The Process Plugins™ solution has the capability of monitoring an unlimited number of assets, which could be added by the end user at any time in the future.

## **MORE ABOUT PROCESS PLUGINS™**

OSIsoft's PI System continues to be the industry standard in data historians, which has been the core of its 21<sup>st</sup> 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 3<sup>rd</sup> party software. That's where the Process Plugins™ package comes in.

Process Plugins™ is not 3<sup>rd</sup> 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 3<sup>rd</sup> 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

PI System Explorer

File Edit View Go Tools Help

Database Query Date Back Check In New Element New Attribute Search

### Elements

- Environment
- Forecast
- Fuel
- Train 1000
  - FWPumpA
  - FWPumpB
  - Gas Turbine
    - Compressor
    - Exhaust
    - FuelMixture
    - HeatRate
    - Output
      - PPI\_WriteToPI1
      - PPI\_WriteToPI2
  - Generator
    - HRSG
      - FlueGasEnthalpyIn
      - FlueGasEnthalpyOut
      - FlueGasEnthalpyRef
      - PPI\_WriteToPI1
      - PPI\_WriteToPI2
      - PPIStmEng\_HPTsuperHeat
      - PPIStmEng\_HTLfeed
      - PPIStmEng\_TsatPdrum
    - Stack
    - EPA

### HRSG

General Child Elements Attributes Ports Version

Filter

Name	Value
CTFuelEnergyInput	788.7235 MMBtu/h
CTGrossGeneration	58.68409 MW
CTHeatRate	13440.16 Btu/kWh
DBFuelFlowMass	11245.22 lb/h
DBFuelFlowVolume	4.744239 MMSCFD
DisplayHeader	RICHVILLE HRSG 1...
Effectiveness	90.45927 %
Efficiency	72.54671 %
FlueGasFlow	2290.252 kpph
FlueGasTempPinch	532.6586 °F
HeatInputDB	212.5514 MMBtu/h
HeatInputExhaust	588.4851 MMBtu/h
HeatInputTotal	801.0365 MMBtu/h

Group by:  Category

Name: Efficiency

Description: HRSG Efficiency

Configuration Item:

Categories:

UOM: %

Value Type: Single

Value: 72.54671 %

Data Reference: Formula

Settings...

A= \FlueGasEnthalpyIn|Result Enthalpy;UOM=Btu/lbm;B= \FlueGasEnthalpyOut|Result Enthalpy;UOM=Btu/lbm;C= \FlueGasEnthalpyRef|Result Enthalpy;UOM=Btu/lbm;[100\*(A-B)/(A-C)];UOM=%

Efficiency

The Process Plugins™ package resides primarily within OSIsoft's PI Asset 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

The screenshot shows a 'Formula Configuration' dialog box for an 'Efficiency' element. It is divided into two main sections: 'Parameters' and 'Equations'. The 'Parameters' section contains three entries: 'A=.\\FlueGasEnthalpyIn|ResultEnthalpy;UOM=Btu/lb', 'B=.\\FlueGasEnthalpyOut|ResultEnthalpy;UOM=Btu/lb', and 'C=.\\FlueGasEnthalpyRef|ResultEnthalpy;UOM=Btu/lb'. Each entry has a yellow star icon to its right, and there are 'X' and 'XX' icons below the list. The 'Equations' section contains the formula '100\*(A-B)/(A-C)' with a yellow star icon to its right, and 'X', 'XX', and arrow icons below it. At the bottom, there is a 'Result' section with a 'Unit of Measure' dropdown set to '%', and 'Minimum' and 'Maximum' input fields. An 'Evaluate' button is next to a text box displaying the value '72.607313165307 %'. 'OK' and 'Cancel' buttons are at the very bottom.

Formula Configuration:(Efficiency)

Parameters

A=.\\FlueGasEnthalpyIn|ResultEnthalpy;UOM=Btu/lb  
B=.\\FlueGasEnthalpyOut|ResultEnthalpy;UOM=Btu/lb  
C=.\\FlueGasEnthalpyRef|ResultEnthalpy;UOM=Btu/lb

Equations

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

Default Values Allowed

Result

Unit of Measure: % Minimum: Maximum:

Evaluate 72.607313165307 %

OK Cancel

Fundamental performance calculations exist as formulas within elements.

## Element Templates

The screenshot displays the 'PPI - PI System Explorer' application window. The interface is divided into several sections:

- Library:** A list of element templates on the left, with 'PPIstmSI\_VTL' selected and highlighted in blue.
- General Tab:** The main configuration area for the selected template. It includes a search bar and a table of attributes:

Name	Description
InputT	Temperature
OutputV	Specific Volume

- Configuration Fields:** On the right, fields for 'Name' (InputT), 'Description' (Temperature), 'UOM' (°C), 'Value Type' (Single), and 'Data Reference' (Formula) are visible. A 'Settings...' button is also present.
- Formula Editor:** A text area at the bottom contains the formula: `A=..\|Temperature;UOM=°C;[A]`
- Search Panel:** On the far right, a search panel lists categories: Formula, PI Point, PI Point Array, and Table Lookup.

The status bar at the bottom indicates: 'PPIstmSI\_VTL Modified:2/14/2009 5:04:04 PM.'

The Process Plugins™ package comes with a complete set of “Drag & Drop” Element Templates for use in PI-AF. Some routines utilize the Process Plugins™ Windows service, which delivers results back to an element.

## Lookup Tables

GasProperties							
General	Table	Define Table	Version				
GasProperties							
	Name	Molecule	MolWeight	HHVdry	LHVdry	SpecHeatRati	SpecHeatCp
	Acetylene	C2H2	26.03728	1488	0	1.232	1.69
	Air	AIR	28.963	0	0	1.4	1.01
	Ammonia	NH4	18.03846	0	0	1.31	2.19
	Argon	Ar	39.948	0	0	1.667	0.52
▶	n-Butane	C4H10	58.123	3392	3131	1.094	1.67
	i-butane	C4H10	58.123	3392	3131	1.094	1.67
	Carbon Dioxide	CO2	44.01	0	0	1.289	0.844
	Carbon Monoxide	CO	28.01	321	321	1.4	1.02
	Chlorine	Cl2	70.906	0	0	1.34	0.48
	Ethane	C2H6	30.07	1789	1636	1.187	1.75
	Ethylene	C2H4	28.05316	1614	1485	1.24	1.53
	Helium	He	4.002602	0	0	1.667	5.19
	Heptanes	C7H16	100.204	5502.5	5100	1.05	0
	Hexanes	C6H14	86.177	4755.9	4403.8	1.06	0
	Hydrogen	H2	2.016	325	273.8	1.405	14.32
	Hydrochloric Acid	HCl	36.46094	0	0	1.41	0.8
	Hydrogen Sulfide	H2S	34.08	647	596	1.32	1.017
	Hydroxyl	OH	17.00734	0	0	1.384	1.76
	Methane	CH4	16.043	1014	913	1.304	2.22
	Methyl Chloride	CH2Cl	49.47958	0	0	1.2	1.005
	Nitric Oxide	NO	30.0061	0	0	1.386	0.995
	Nitrogen	N2	28.013	0	0	1.4	1.04
	Nitrous Oxide	N2O	44.0128	0	0	1.27	0.88
	Oxygen	O2	31.999	0	0	1.395	0.919
	n-Pentane	C5H12	72.15	4200	3884	1.07	0
	i-pentane	C5H12	72.15	4200	3884	1.07	0
	Propane	C3H8	44.097	2573	2367	1.127	1.67
	Propylene	C3H6	42.07974	2383	2192	1.15	1.5
	Sulphur Dioxide	SO2	64.0638	0	0	1.29	0.64

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:

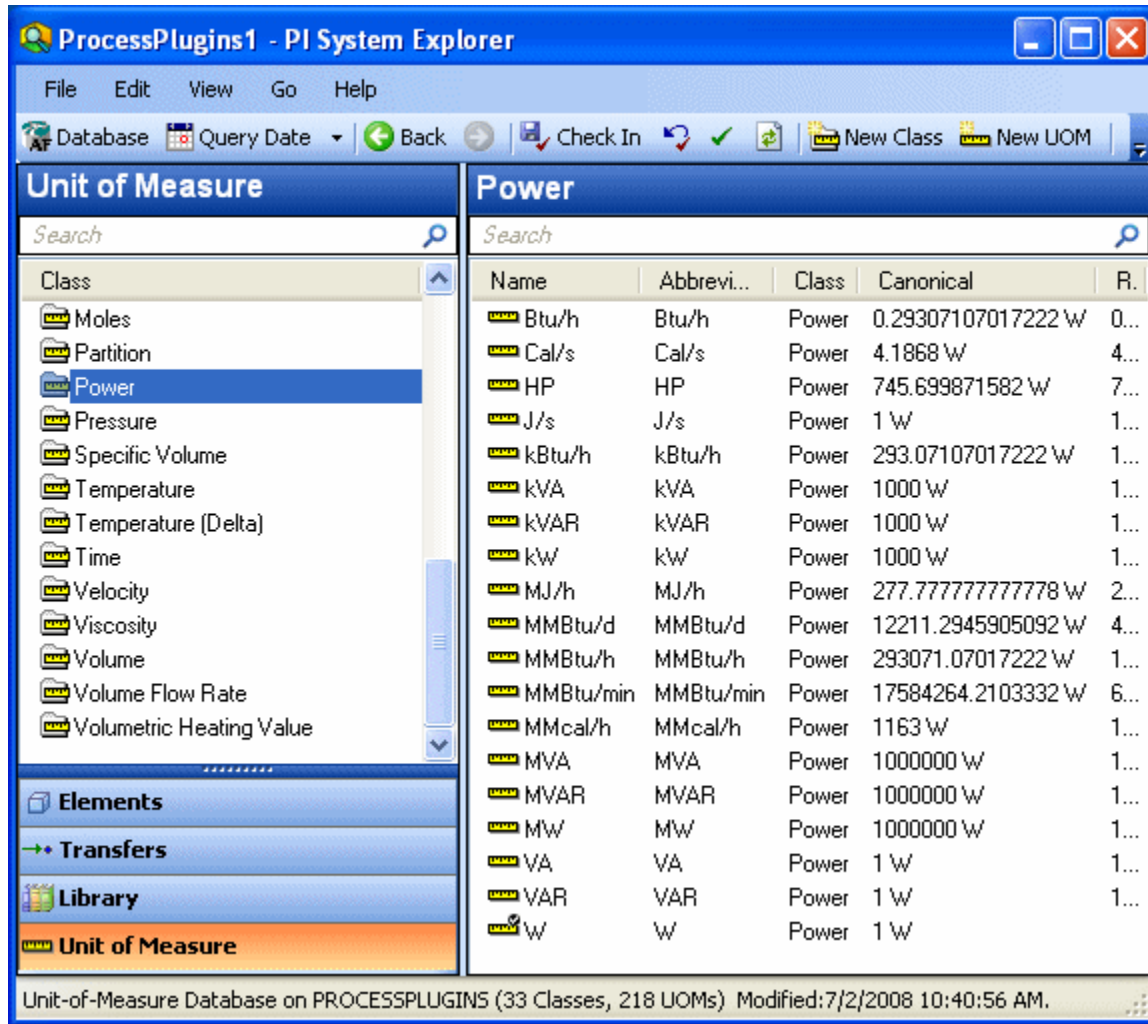
- Elements:** A tree view on the left showing a hierarchy of elements. The "Performance" folder is expanded, showing "PPI\_WriteToPI" as a child element.
- PPI\_WriteToPI Properties:** The central pane shows the "General" tab for the "PPI\_WriteToPI" element. It includes a search field and a table with the following data:

Name	Value
Formula	6508.577
PIPoint	6508.572
- Configuration Fields:** On the right, various configuration fields are visible:
  - Name: PIPoint
  - Description: (empty)
  - Configuration Item:
  - Categories: (empty)
  - UOM: <None>
  - Value Type: Single
  - Value: 6508.572
  - Data Reference: PIPoint
- Settings:** A "Settings..." button is located below the configuration fields.
- Search Results:** A search pane on the far right lists numerous elements, including "PPISmEng\_HPS", "PPISmEng\_HPT", "PPISmEng\_HPX", "PPISmEng\_HsatP", "PPISmEng\_HsatT", "PPISmEng\_HTL", "PPISmEng\_PsatT", "PPISmEng\_SPH", "PPISmEng\_SPT", "PPISmEng\_SPTL", "PPISmEng\_SPX", "PPISmEng\_SsatP", "PPISmEng\_SsatT", "PPISmEng\_TPH", "PPISmEng\_TPS", "PPISmEng\_TsatP", "PPISmEng\_TsatT", "PPISmEng\_VPH", "PPISmEng\_VPS", "PPISmEng\_VPT", "PPISmEng\_VPTL", "PPISmEng\_VsatP", and "PPISmEng\_VsatT".

The status bar at the bottom left 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



**Unit of Measure**

Search

- Class
- Moles
- Partition
- Power**
- Pressure
- Specific Volume
- Temperature
- Temperature (Delta)
- Time
- Velocity
- Viscosity
- Volume
- Volume Flow Rate
- Volumetric Heating Value

**Power**

Search

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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