Data Validation & Performance Monitoring: Sigmafine for Power

Katia Molino

Sigmafine Users Conference

San Francisco, April 23, 2012

PiMSOFT

INNOVATIVE SOLUTIONS

Topics

- Introduction
- Sigmafine for Power:
  - Steady State Detection
  - Online Data Validation
  - Equipment Calculations / Performance Monitoring
- Benefits

PIMSOFT INNOVATIVE SOLUTIONS

Introduction

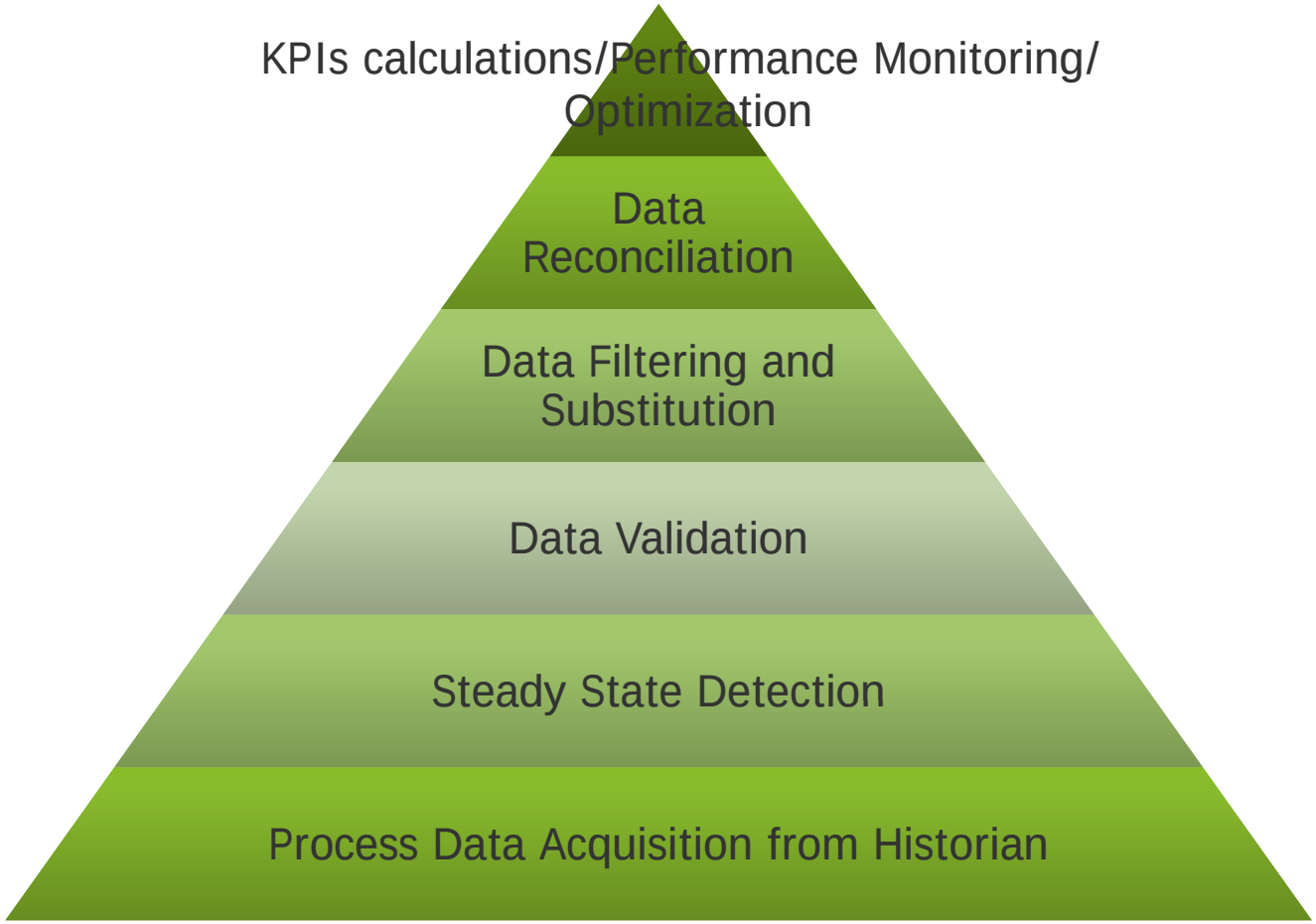
- Power industries need to monitor equipment performance and to respond to energy market requirements at short time intervals.
- A process of data check, validation, substitution, reconciliation and equipment/business calculations every 10-15 minutes is needed.
- Pimsoft has focused its effort on developing a product to satisfy those functional and business requirements.

Sigmafine for Power is a set of Data References, Analysis plug-ins and Element templates with predefined configurations, that all live on Sigmafine infrastructure.

PIMSOFT INNOVATIVE SOLUTIONS

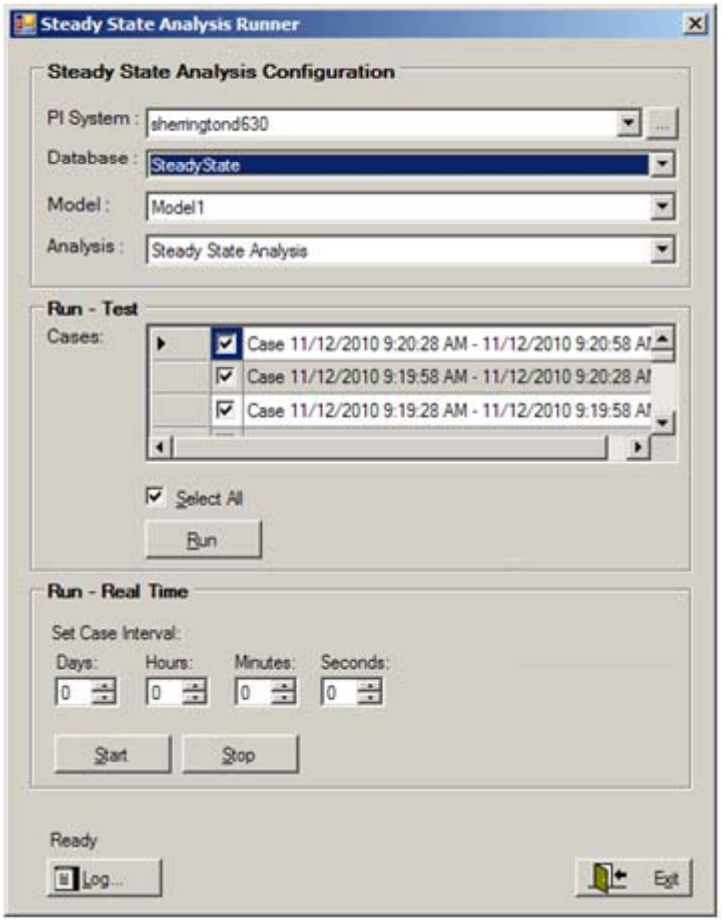
Introduction

Pyramid of Process Operations for Online Industrial Applications



PIMSOFT INNOVATIVE SOLUTIONS

Steady State Detection



- The Steady State Analysis detects unsteady states in processes in a given period of time.
- For each element, the analysis output is either 0 or 1, indicating a steady or unsteady state for that element respectively.
- After the steady states are verified, users may:
  - Automatically exclude the unsteady state period from further analysis
  - Mark the period or element as 'unsteady' for that specific period

Moving window algorithm

PIMSOFT INNOVATIVE SOLUTIONS

Online Data Validation

Why Data Validation?

Online data validation:

- Meters are generally subject to errors, due to a variety of causes.
- Data validation needs to be the first step for checking the reliability of data.
  It becomes the first warning that users receive about potential bad measurements because it is done online.
- After validation, data can be reconciled.
- As a result, equipment calculations are more reliable because they are performed with validated data.

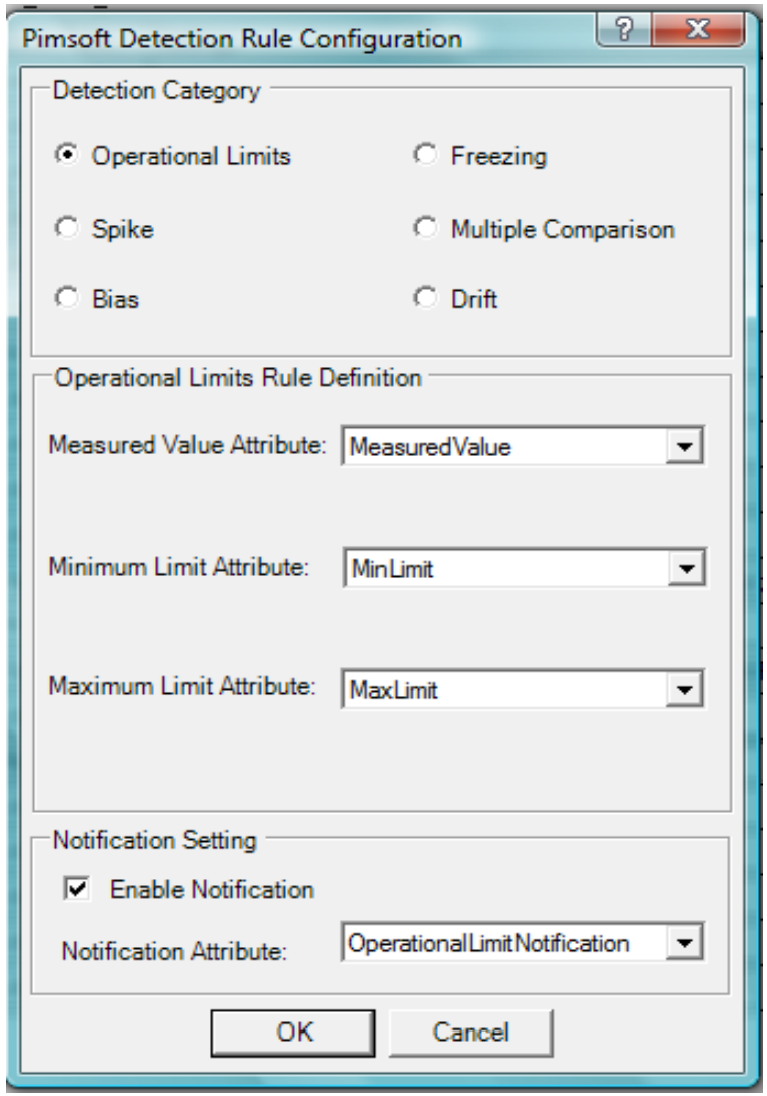
PIMSOFT INNOVATIVE SOLUTIONS

Online Data Validation

Data Validation Features

Pimsoft MPM Data Reference provides the following set of features for Data Validation:

- Check of a set of data validation rules:
  - Spike and multi-spike
  - Freeze
  - Operational limits
  - Multiple measures comparison
  - *Bias*
  - *Drift*
- After validation check it is possible to:
  - Substitute invalid data with a required value or formula or filtering of data
  - Track validation results: writing of results back to historian (tags, annotations..)
  - Send notifications (emails, warning ..) to specific operators
- Validation analysis can be scheduled and run at the desired time frequency.



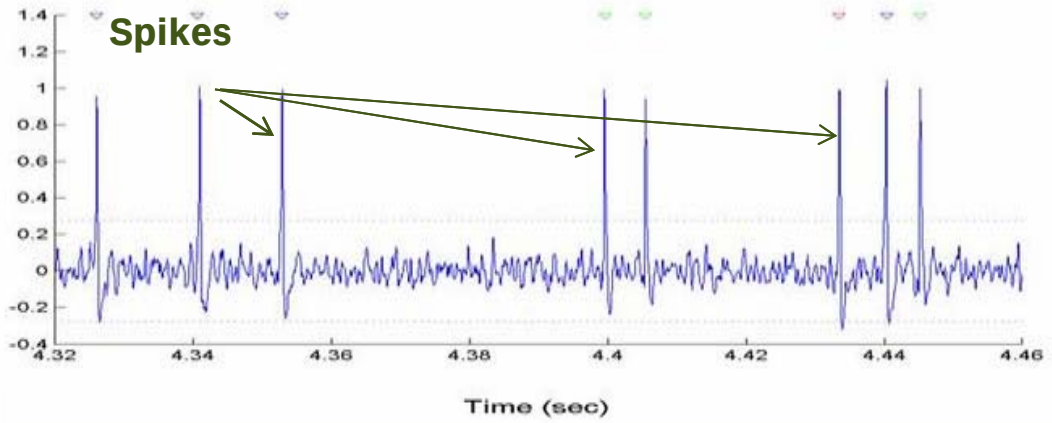
PIMSOFT INNOVATIVE SOLUTIONS

Online Data Validation

Data Validation Rules

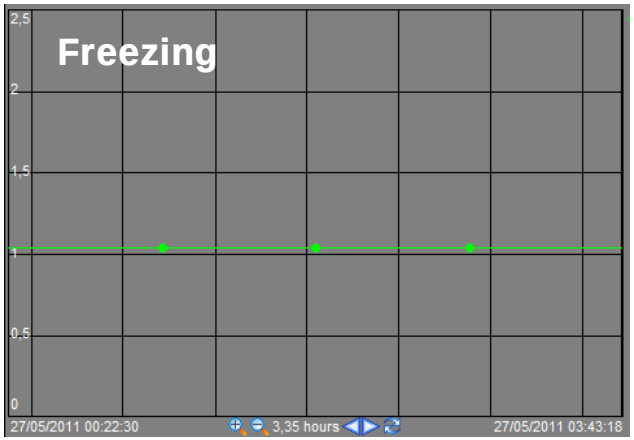
- *Spike and multi-spike detection :*

A spike is a sudden change in the measured value within a short time interval. Single or multiple spikes in a time interval are identified and users are notified.



- *Freezing detection* :

Freezing happens when the measurement remains fixed on a same value for a certain minimum time. The event is identified and users are notified.



- *Operational limits check* :

Checks if the measure value is inside a range of specified upper and lower limits. Values outside those limits are noted.

- *Multiple measures comparison* :

This rule can be applied to multiple measures of the same quantity.
The measurement trends are compared and if one or more of them differ within a range limit from the others, this measurement is considered invalid and is noted.

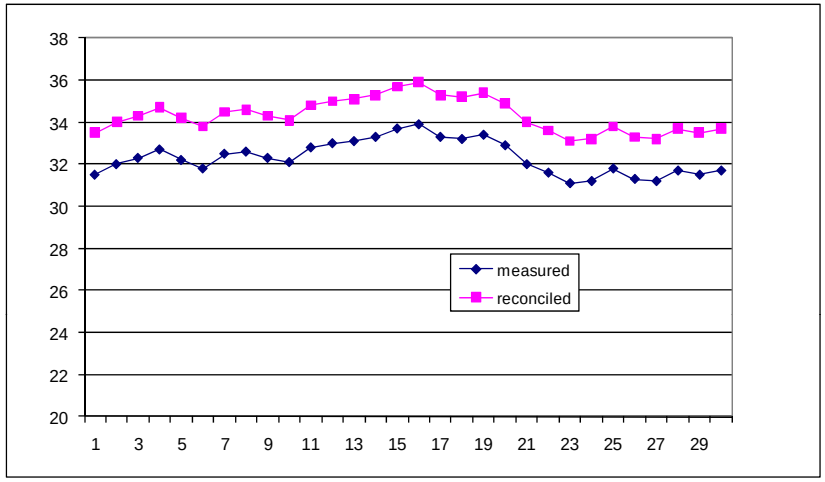
PIMSOFT INNOVATIVE SOLUTIONS

Online Data Validation

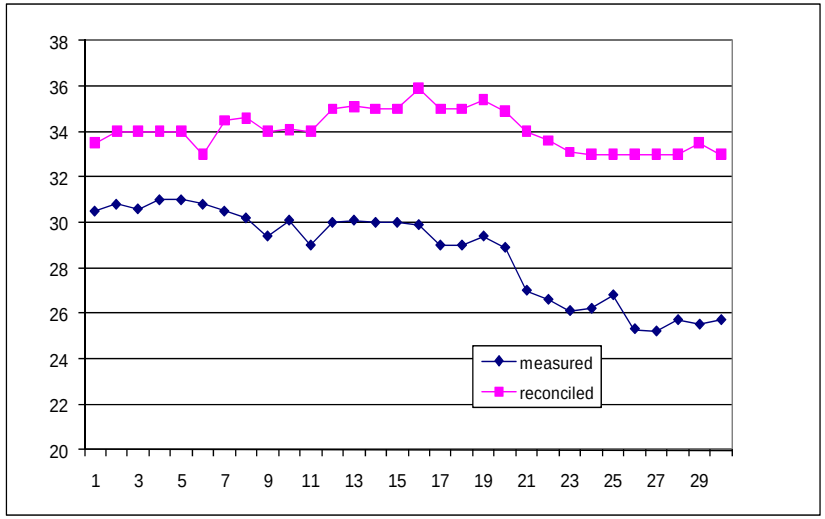
Bias and Drift

Bias and drift are detectable within a longer time period, comparing measured and reconciled meter values.

- *Bias :* When a meter is biased, the difference between the reconciled and measured value tends to remain stable with the time.



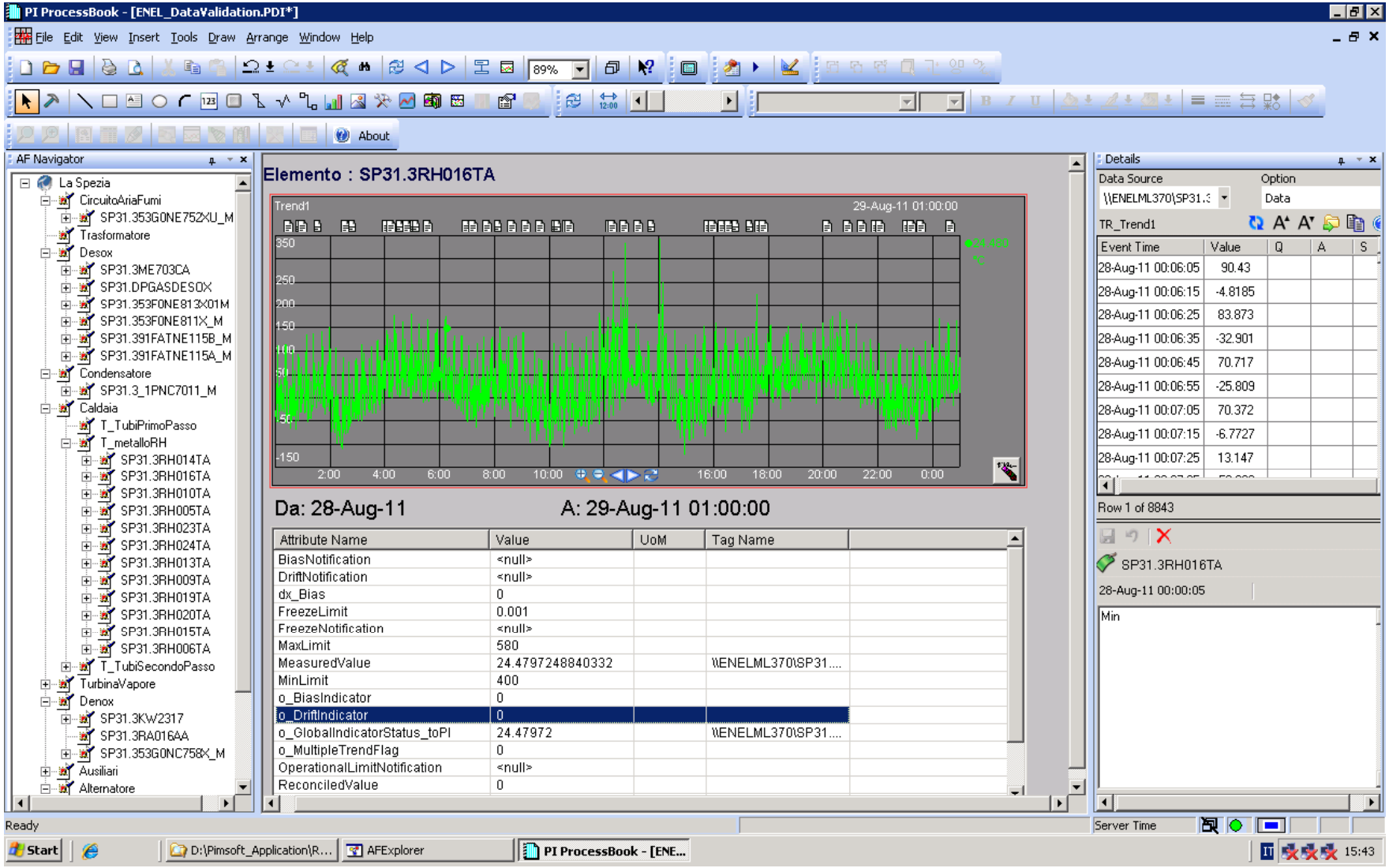
- *Drift* : Drift is an observed change in meter performance that occurs over a period of time and is usually uncontrolled. When a meter is in drift, the measured values tend to diverge from the reconciled value with time.



PIMSOFT INNOVATIVE SOLUTIONS

Online Data Validation

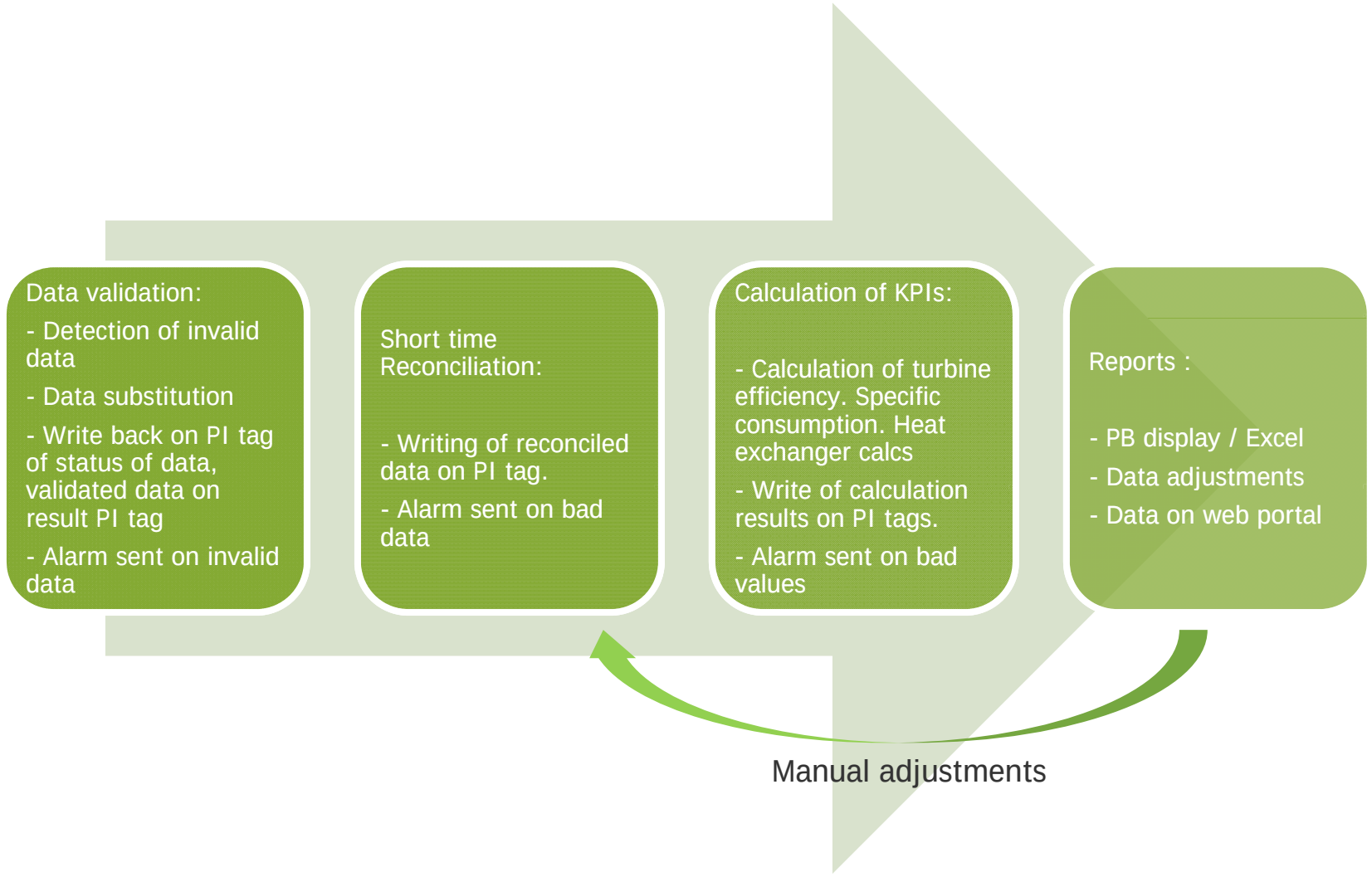
Data Validation Product – Example of ProcessBook Display Report



PIMSOFT INNOVATIVE SOLUTIONS

Sigmafine for Power

Data Validation and Calculations: Process Flow

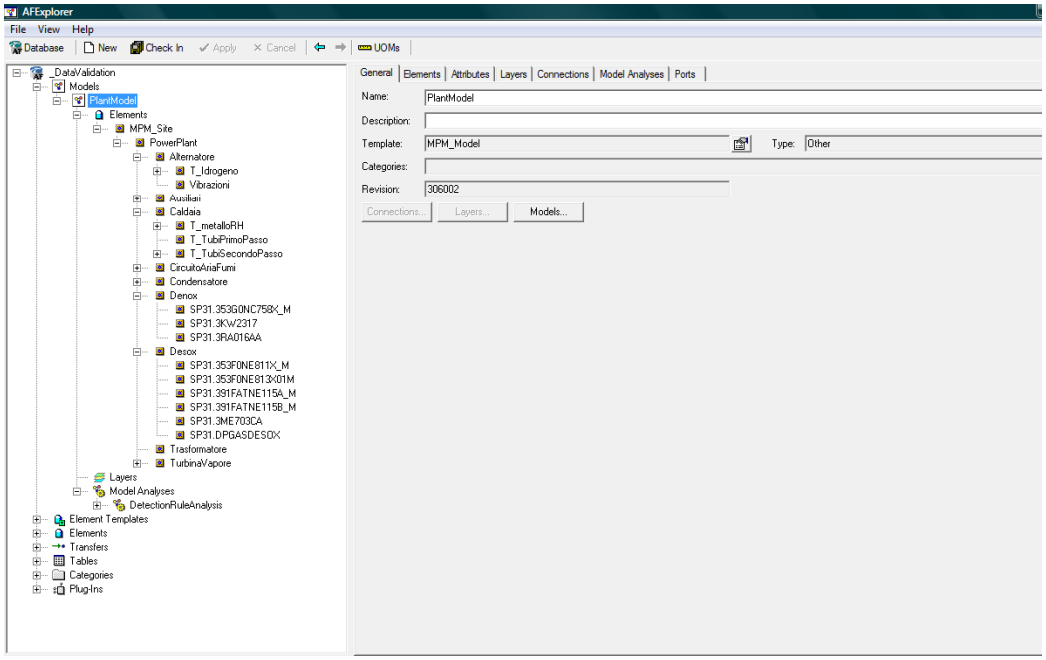


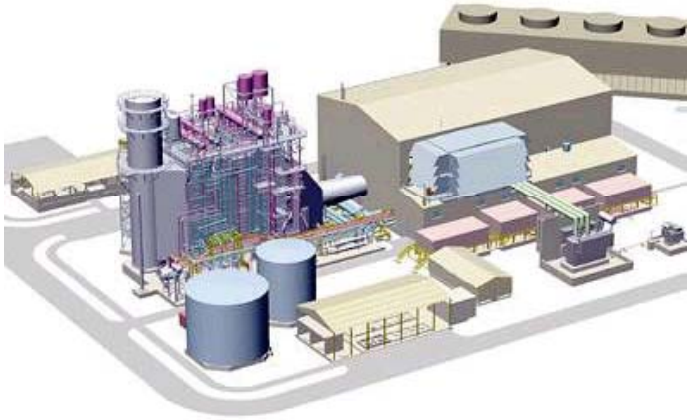
PIMSOFT INNOVATIVE SOLUTIONS

Sigmafine for Power

Sigmafine for Power: General Features

- Consists of a set of Data References, Analysis Plug-ins and Element templates with specific configurations
- Hierarchical AF model can be designed and implemented to represent the set of equipment and meters of the plant
- Validation, reconciliation and calculations analysis can be run and scheduled on the desired time range
- Correction/Characteristic curve can be managed through a web interface



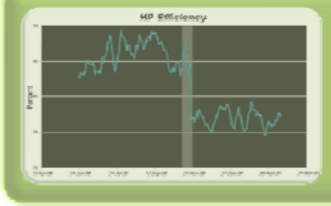


PIMSOFT INNOVATIVE SOLUTIONS

Sigmafine for Power

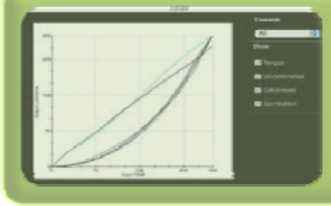
Features

Previously validated process data is used to perform the following steps:



Technical Performance Monitoring

Notification



Correction Curves Management

Reporting

PIMSOFT INNOVATIVE SOLUTIONS

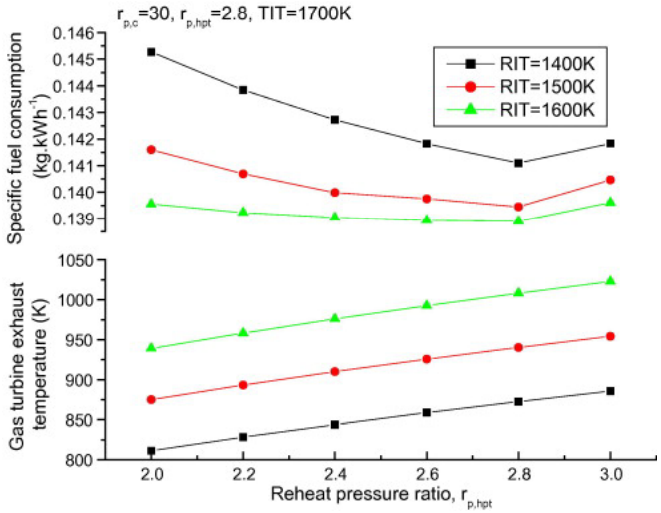
Sigmafine for Power

Technical Performance Monitoring

Technical Performance Monitoring: Equipment Calculation

- Calculates, from validated/reconciled data, significant performance data and indicators as:
  - Turbine efficiencies
  - Specific consumption
  - Heat exchangers fouling factor

- Warnings are issued in the event of significant deviations from the expected values.
- Current deviations are analyzed by comparing them to historical performance data.
- Calculated data is written to PI Tags.



PIMSOFT INNOVATIVE SOLUTIONS

Sigmafine for Power

Technical Performance Monitoring

Turbine Efficiency – Specific Consumption

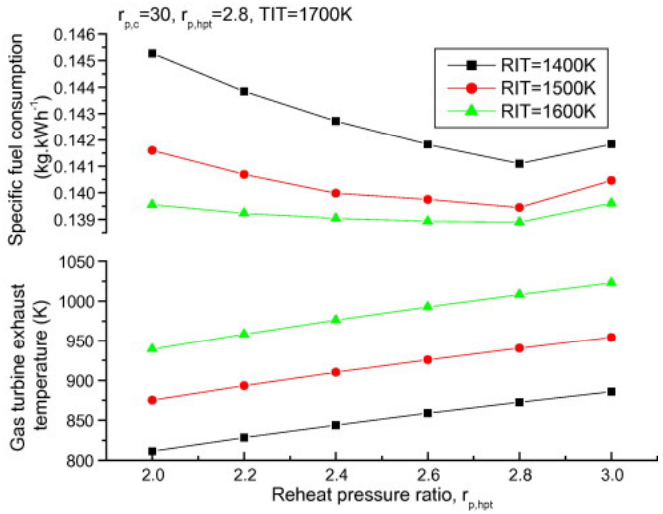
The Specific consumption is the ratio between the consumed heat and the produced net power of a turbine and reflects its level of efficiency.

SC = Q/P [MJ/MWh or KJ/Kwh]

where

Q = input heat [kJ/h]

P = net power [kW]



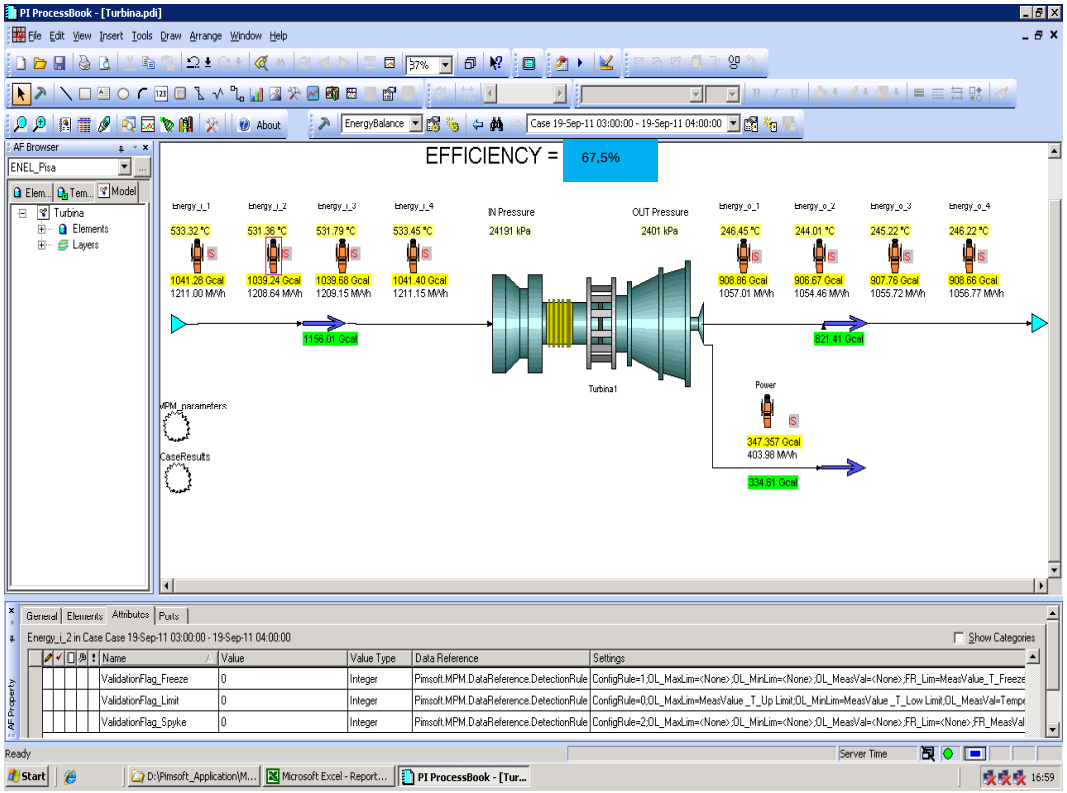
PIMSOFT INNOVATIVE SOLUTIONS

Sigmafine for Power

Technical Performance Monitoring

Turbine Efficiency

Example of a turbine model



- Calculation of Enthalpy through the Sigmafine steam table DR
- Sigmafine Energy Balance of a turbine model
- Deduction of unmeasured quantities
- Turbine efficiency calculation with validated and reconciled data

Sigmafine for Power

Additional Features

Notification

- Emails can be sent to users when any critical events occur (e.g.: invalid raw data, invalid calculated data, gaps with the expected results, etc...).
- The processing and organization of the data can allow quick and clear identification of root causes for many conditions.

Curves Management

- Dataset of AF tables containing all data of correction curves.
- Different functional forms supported: Table, Formula, Polynomial
- Correction and characteristics curves are loaded, managed and updated through the Pimsoft web data interface.

Reporting

- Validated and calculated data are reported in Excel report and/or PB Displays.
- Report data is exposed in the web portal.

Sigmafine for Power

Benefits

- Visualize, monitor, and analyze real-time data from both operational and business perspectives
- Improve availability and reliability due to online monitoring of key components
- Offer advice to operators on specific actions to reduce energy costs
- Targeted equipment maintenance program
- Reduce equipment maintenance costs

- Completely integrated with plant historian system
- Easily configurable and customizable
- Simple maintainability

PIMSOFT INNOVATIVE SOLUTIONS

Thank you.

Katia Molino

katia.molino@pimsoftinc.com

PIMSOFT
INNOVATIVE SOLUTIONS