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# On-line steam network balance in Taqa Morocco with CONNECT and SIGMAFINE

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# Speakers

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# Agenda

- Introduction to Taqa Morocco
- The e-Monitoring Center
- Challenges
- AVEVA CONNECT and SIGMAFINE PoC
- Results
- Next steps

# About TAQA Morocco

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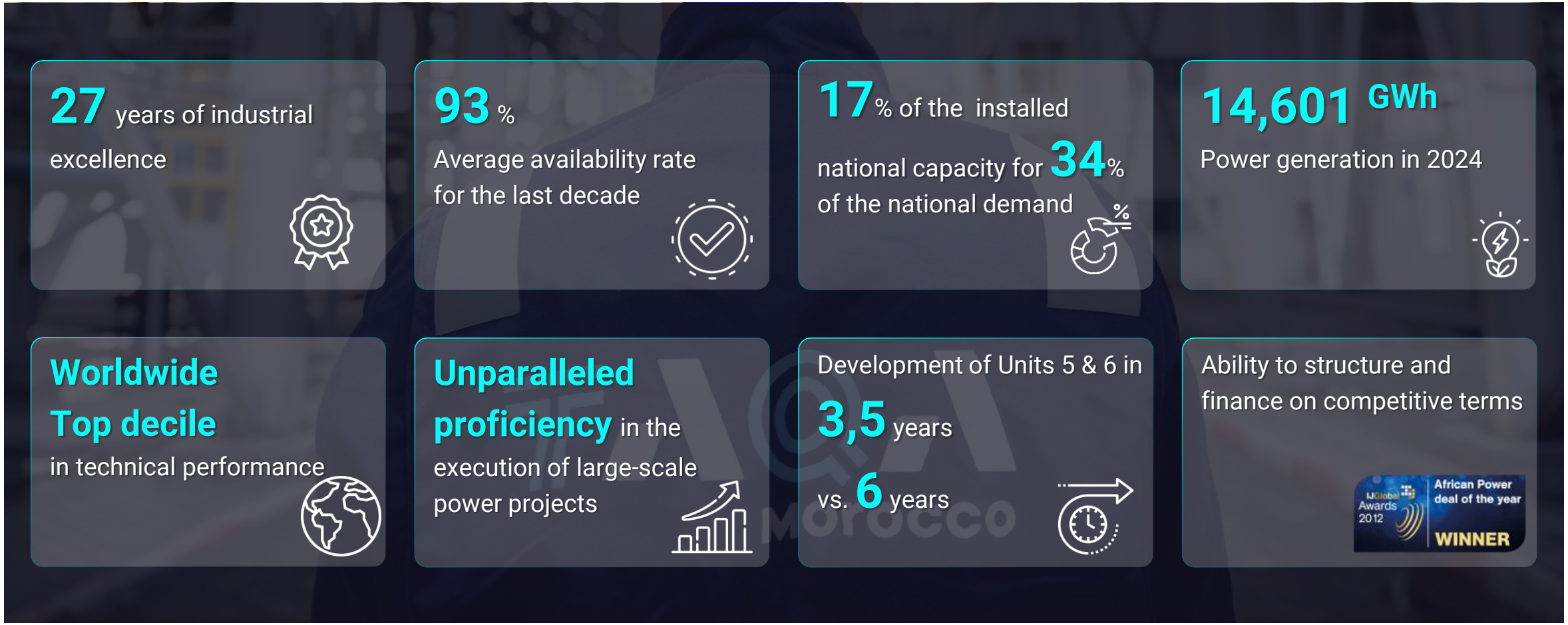
Leading independent power producer in Morocco since 1977



# E-Monitoring Center

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## Project goals

Launched in 2021, the e-monitoring center of TAQA Morocco provides an additional level of vigilance and anticipation of predictible anomalies and incidents, by cross-referencing monitoring results with site data, in coordination with O&M managers.

### Rationalize

Common infrastructure;

Better standardization across the company;

On-premise platform: Data capitalization in a dedicated Smart Room;

Endow TAQA Morocco with an Expertise & Innovation Data Center.

### Centralize

Unique data repository distributing information across the company;

Timely data availability;

Aggregation of information for better analysis;

Scalable, customized and configurable system depending on the needs and on the visions of users (new tags, KPI, reports…);

Pilot project for TAQA Morocco to assure the company's immersion in the Industry 4.0 domain through a sure-fire digital transformation.

### Improve

Operations

- Faster reaction time
- Prevent or reduce plant upset/shutdowns

Management

- Clear summary of unit performances
- Better economical figures

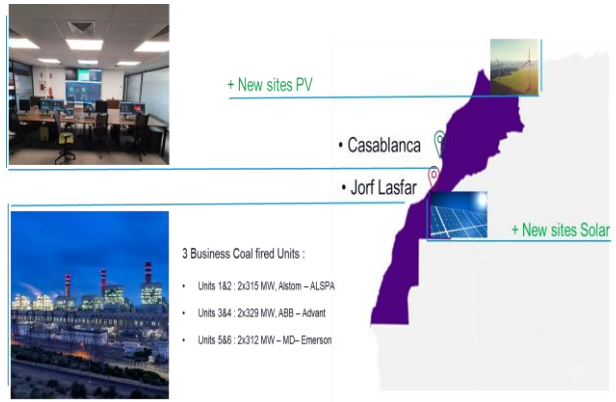
Learning

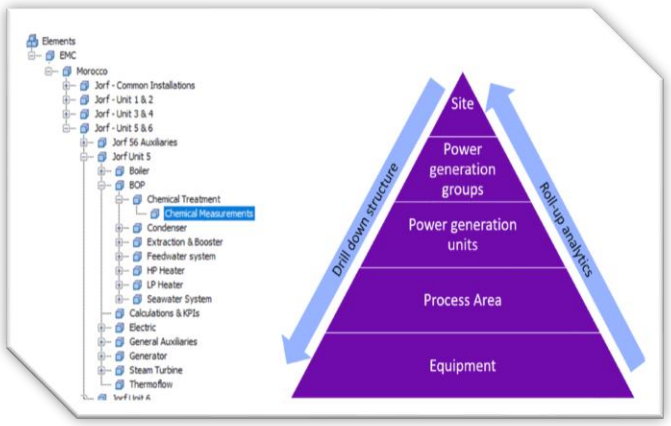
- Know-how & best practices transfer guaranteed through the creation of a melting pot environment of knowledge
- Contribution of SME, data engineers, diverse domain experts, asset mangers,… to the data lake structuration

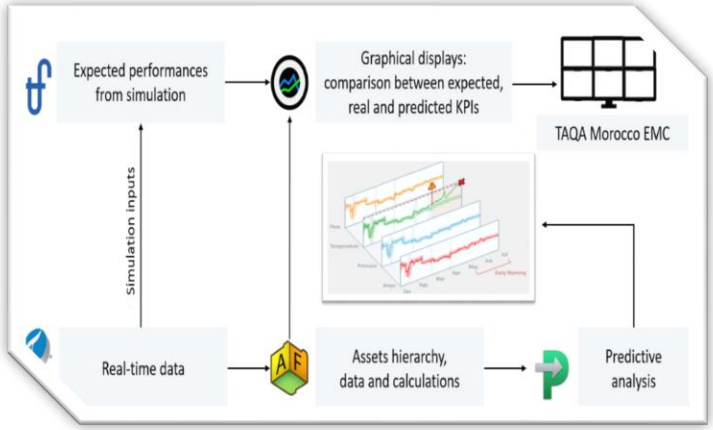
**AXE 1 : Performance Monitoring**

**AXE 2 : Early Failure Detection**

**AXE 3 : Predictive Maintenance**



# A path of continuous improvement

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**2020-21**

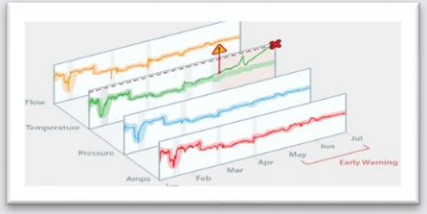
AVEVA PI System project

**2022**

Presentation of the results at AVEVA PI World

**2023**

Condition based maintenance using Predictive APR model for strategic equipment (Gen, ST, Fans, Pumps…)




**2024**

Dashboard for performance monitoring in PI Vision with a real time comparison to TFW software

**2025**

Steam network balance Proof of Concept

# Challenges

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**Operations:**

- Missing measurements on some key flow rates
- Lack of overview of steam distribution in real-time
- Incomplete data for HP, MP and LP sections (load, extraction, etc.)

- Risk of working at sub-optimal load dispatching and be less competitive on the energy market

**IT Infrastructure and cybersecurity:**

- Growing number of applications around the PI System is increasing the load on IT department in terms of maintenance
- Potential need of data sharing in a “disperse” scenario with a foreign shareholder (UAE based) maintaining strict security access

# Addressing Operations concerns

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Leveraging combination of soft sensors and data reconciliation

## Soft sensors:

- Generation of tentative estimation of unmeasured streams based on design data at different loads (e.g. steam extractions, MP and LP steam flow-rate)

## On-line Data Reconciliation:

- Calculation of a thermodynamic mass and energy balance minimizing the corrections on the measurements
- Data redundancy is ensured by combining measured flow-rates, estimated flow-rates and enthalpy data (through steam tables)

# Addressing IT concerns

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A Hybrid architecture

- Original process data are available in PI System and shall stay on-prem
- Minimize software installation on local machines
- Share only needed data on a cloud platform on which Taqa still maintains full control
- Third-party applications offering SaaS model shall interact at cloud level
- Still maintain the ability to get relevant data back into PI System for consumption inside the e-Monitoring Center and on PI Vision displays
- Provide easy scalability, shall the solution expand, or other systems be added in the future

# Proof of Concept proposition

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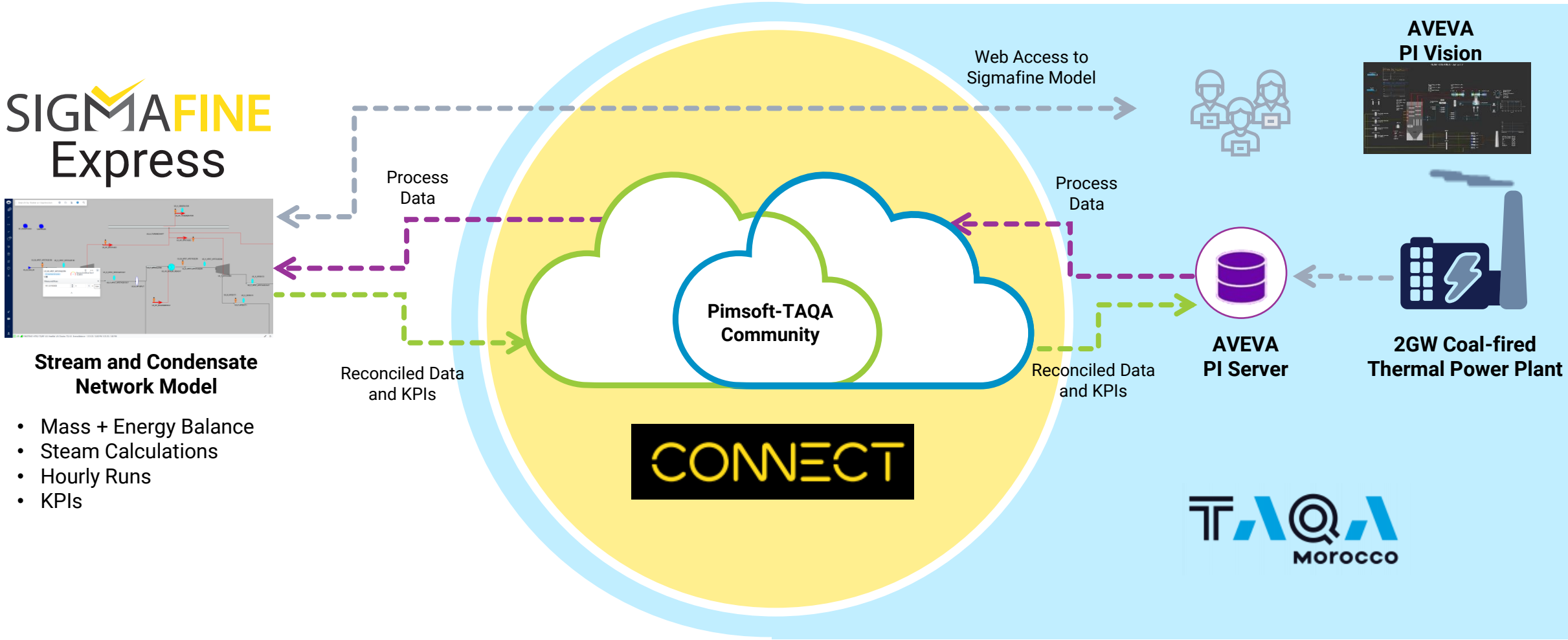
A solution for on-line mass and energy balance running in near-real time

| | Minimize impact on infrastructure | Cloud based, web based | Secure, role based |
|---|---|---|---|
| CONNECT | • Installation of *PI to CONNECT* agent on a dedicated VM, separate from PI System Server<br>• Setup of permissions to read from PI System archive (read-only) | • All the management is done from CONNECT web portal | • IT has assigned user roles with different privileges<br>• Only the data really needed have been shared to Pimsoft tenant |
| SIGMAFINE Express | • New *Express* version, packaged for rapid deployment<br>• Fully hosted under Pimsoft infrastructure, zero impact for Taqa | • SigmafineHub GUI is fully web based<br>• Sigmafine server available for access through authentication in Microsoft Azure | • Claim based authentication<br>• Role based model |

# PoC data workflow

On-line steam network balance in TAQA Morocco



# Community

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Sharing data across the tenants

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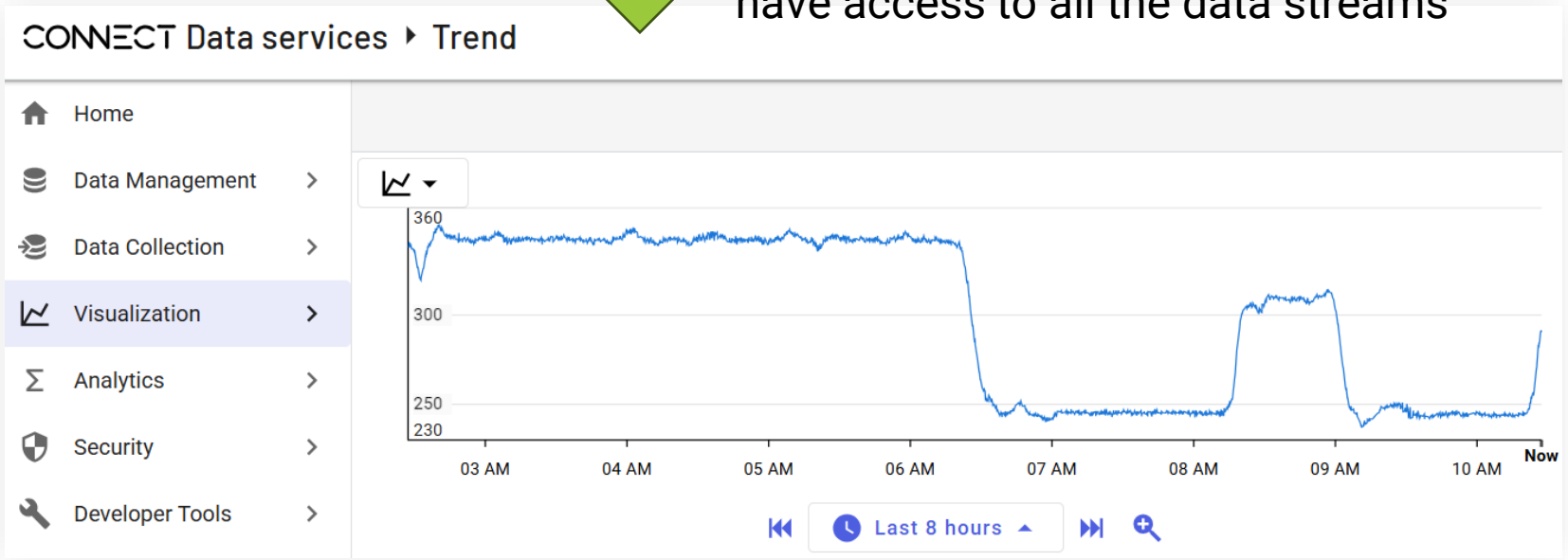
Data services

**Pimsoft-TaqaMorocco**

| | |
|---|---|
| Tenants | 2 |
| Sharing Status | All Tenants Active |

Authorized members of the community have access to all the data streams



# Selection of data to be streamed to CONNECT

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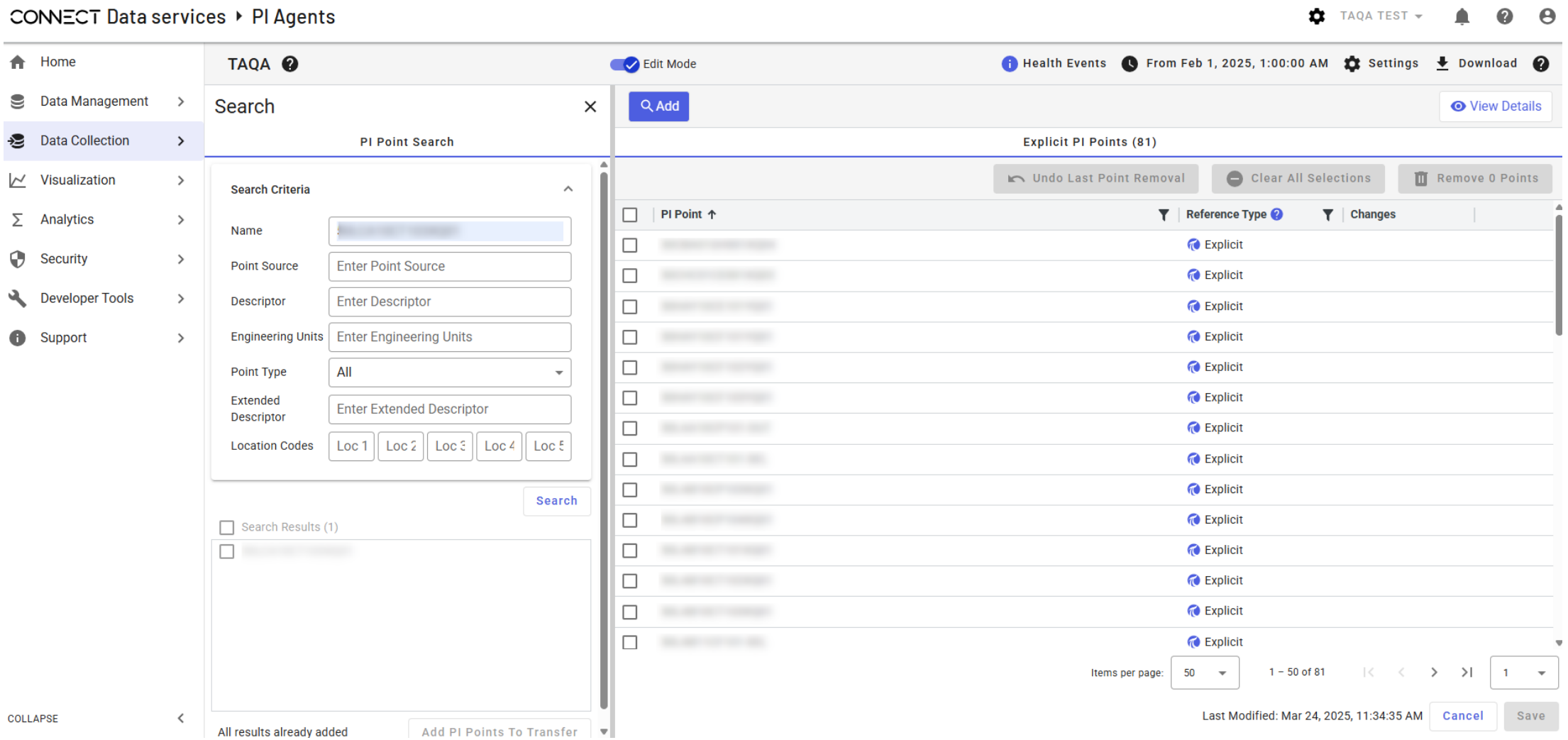
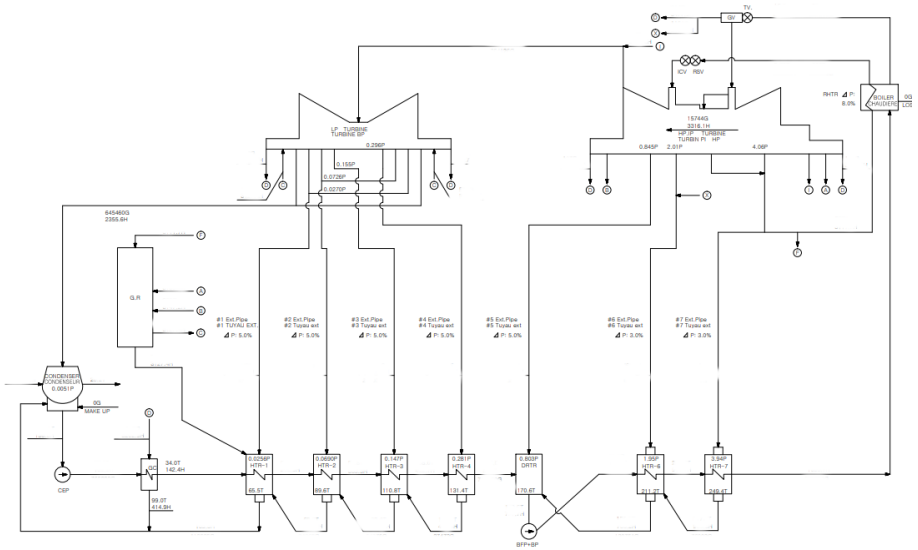
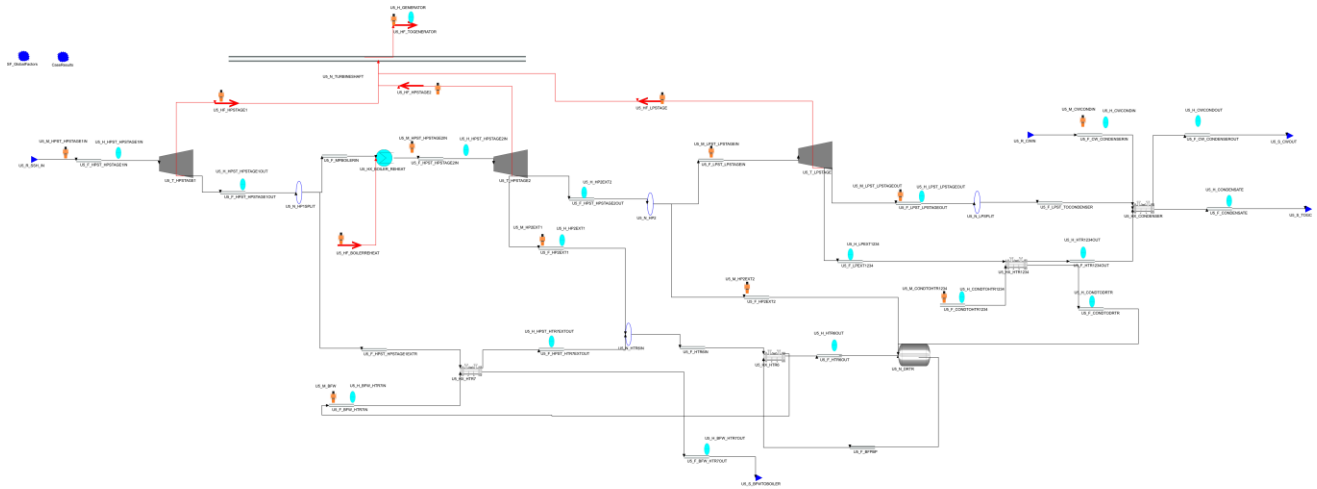
PI to CONNECT agent configuration is capable to automatically find relative PI Point and map all its configuration to be streamed in CONNECT



# From Design to Sigmafine Model





- PFDs
- Design Data
- Measurement tags (from PI System through CONNECT)

- Asset modeling
- Thermodynamic model based on steam tables
- Automatic coupled mass and energy reconciliation
- Hourly data reconciliation

# Validation of reconciliation model

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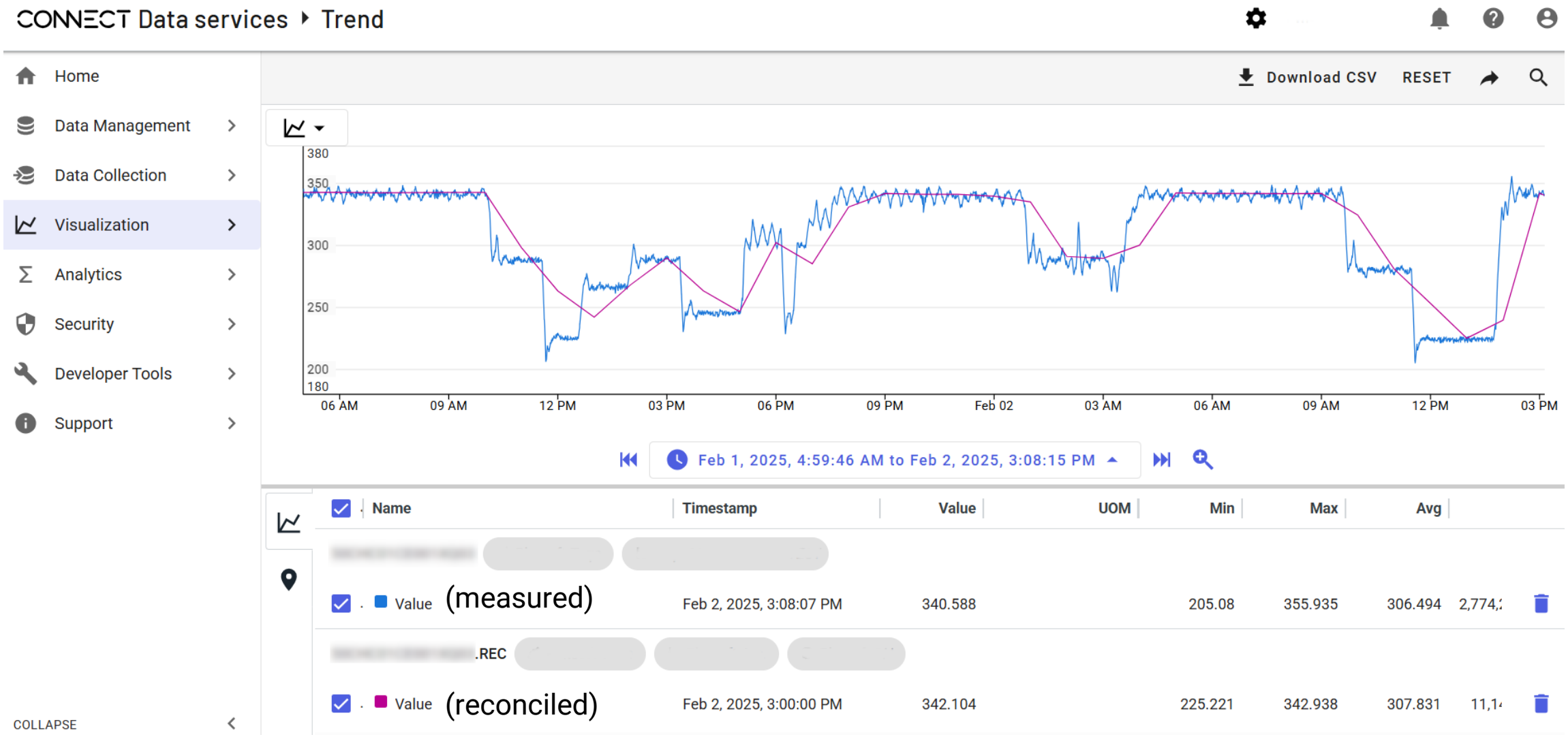
Comparison between generator load (measured vs reconciled)



# Imbalance diagnosis

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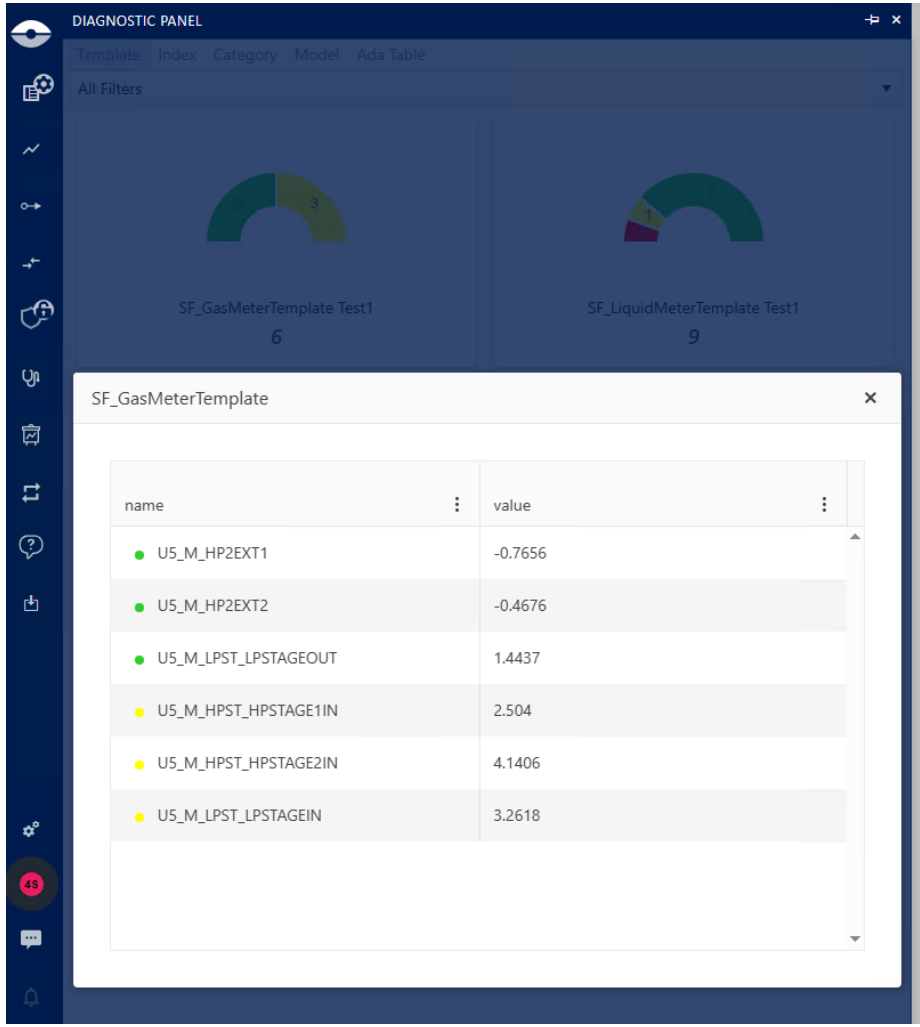
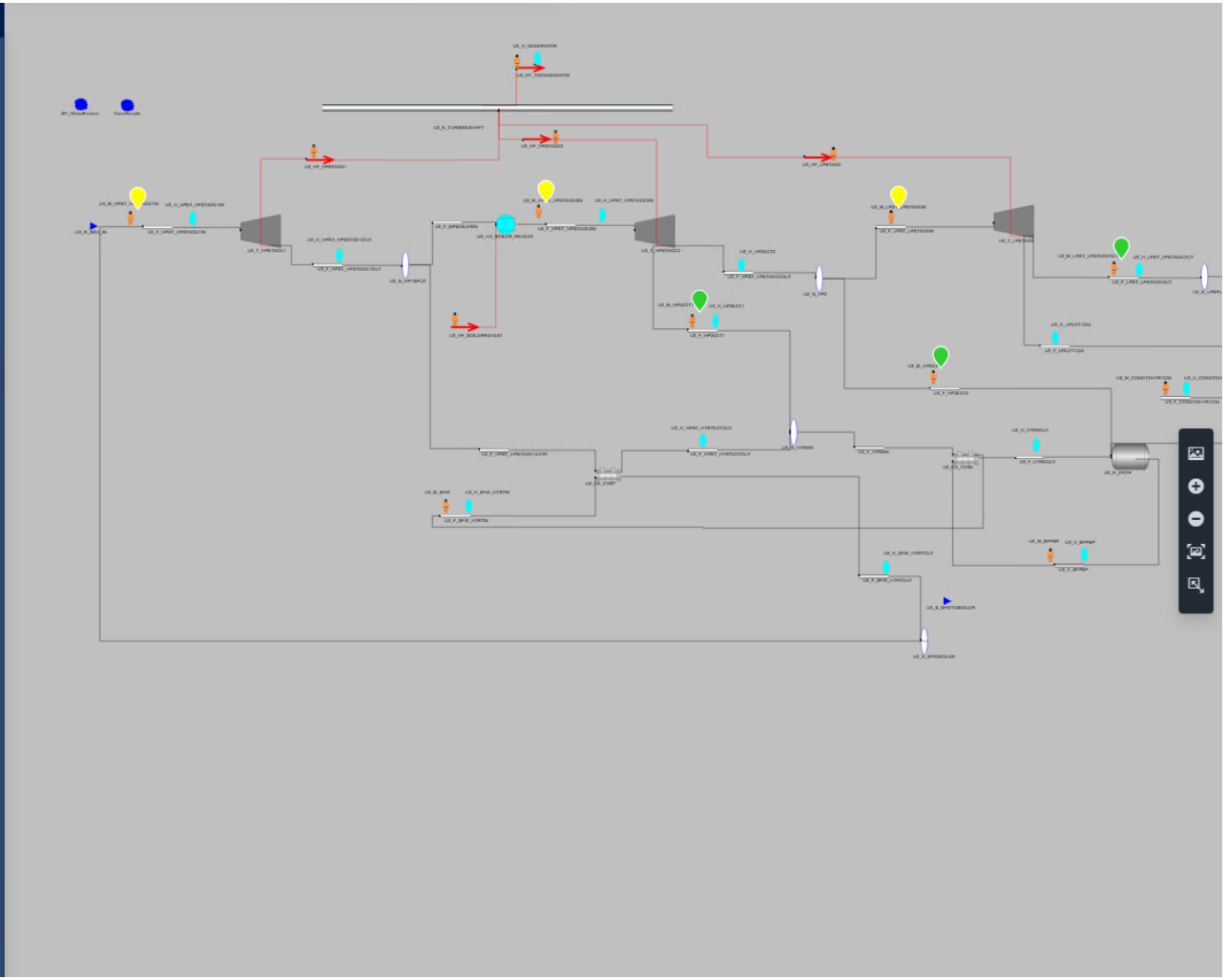
Provision of reliability indicators regarding the balance points, the measurements and the estimations



# Analysis of HP steam throughput

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Comparison of Measured vs Reconciled data highlights a potential bias on the measurement of about 20t/h to be investigated

# Provision of steam extraction

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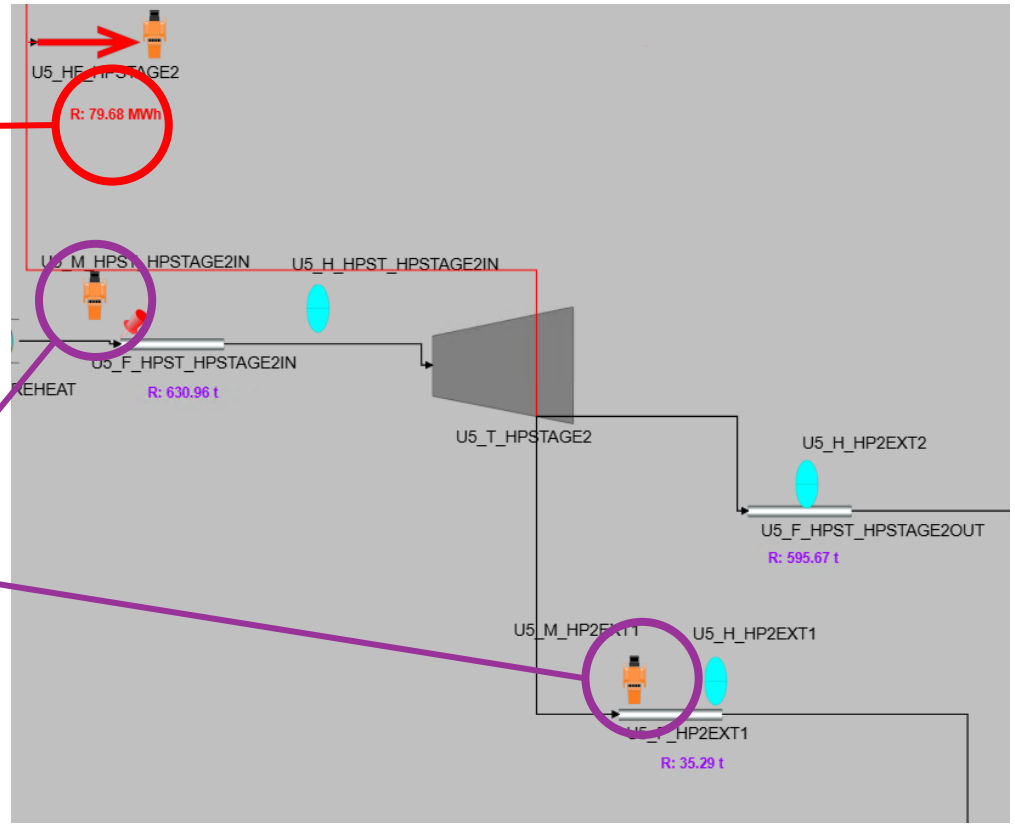
Sigmafine Express providing full details of balance both on mass and energy, and providing data quality indicators for data reliability

Reconciled stage load

Soft sensors

Steam balance around medium pressure stage




Inlet to medium pressure stage:


Measured (estimated): 599±12 t

Reconciled: 631±6 t

# Overview of power loads on all turbine stages

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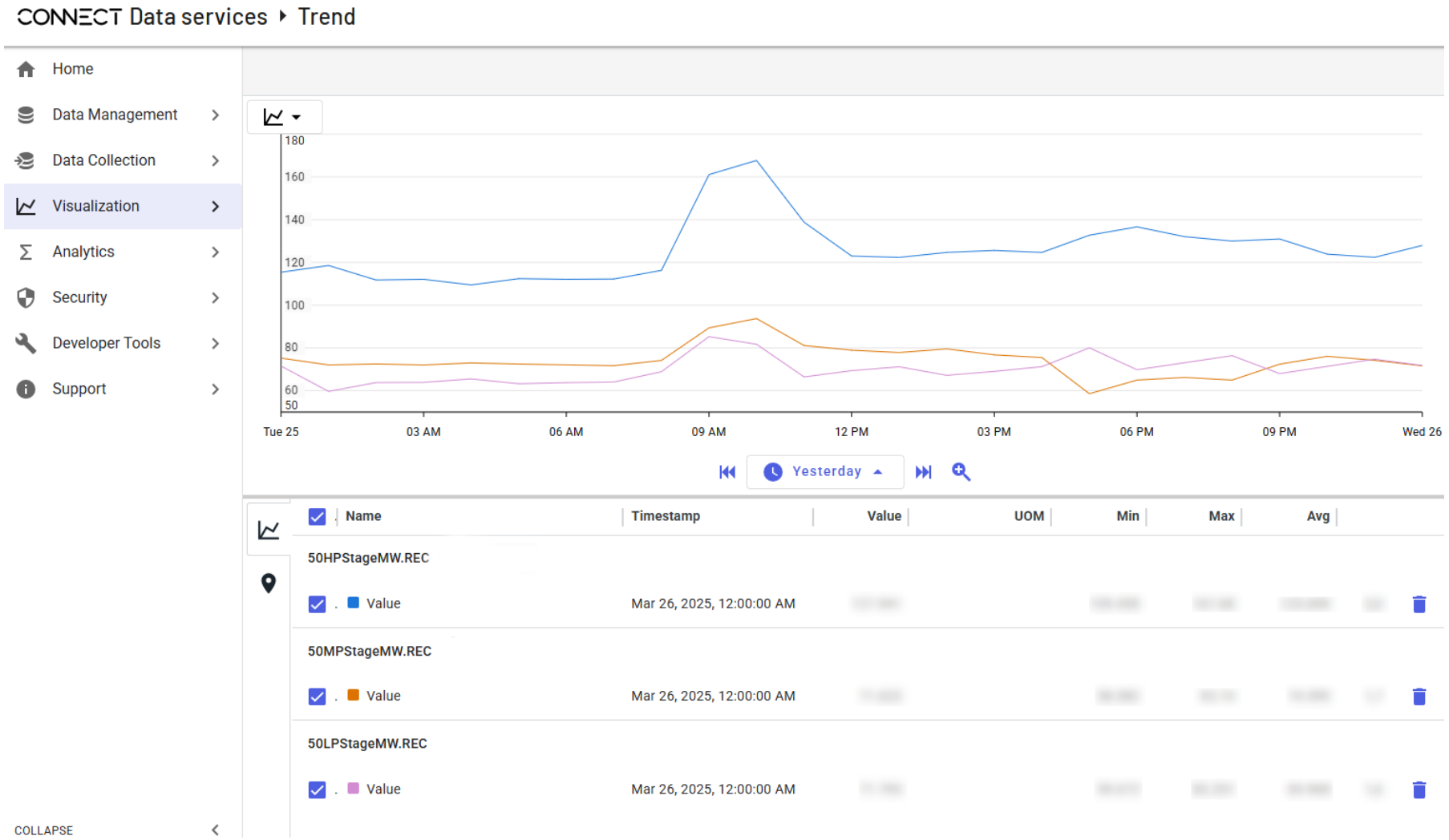
Sigmafine Express reconciled data provides insight on how load is distributed across the turbine stages (previously not available), supporting operations on balance load decision



POWER | MOROCCO

# TAQA Morocco enabled real-time steam distribution and load balancing with minimal impact to existing IT systems

## Challenge

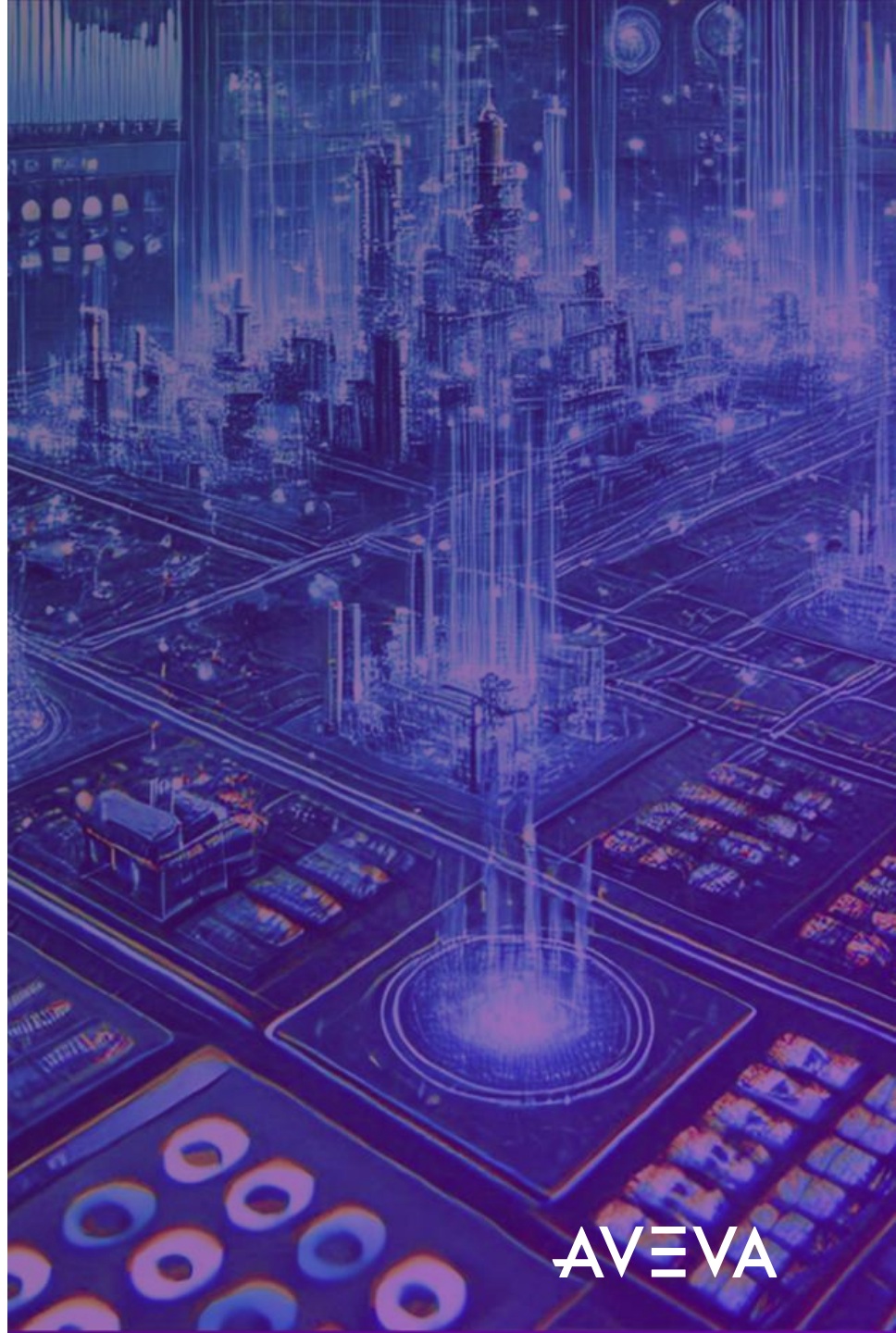
- Only main steam flow-rate and few condensate water flow-rate available
- Need to improve visibility on steam distribution and load balance between HP, MP and LP stage
- Avoid overload of AVEVA PI System from other applications

## Solution

- Raising a Proof of Concept to intercept the needs relying on a hybrid cloud infrastructure
- CONNECT as cloud platform with PI to CONNECT agent for data streaming
- Pimsoft SIGMAFINE for on-line mass and energy balancing

## Results

- **PoC was able to deliver a detailed overview of steam distribution and power load across all the stages**
- **Very low impact on IT infrastructure (one VM + installation of PI to CONNECT agent)**
- **From zero to on-line solution in less than 30 days compared to 2 months at least with a classical approach**



# Next steps

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Add calculations for Turbine isentropic efficiency of each stage

Sending results back to the e-Monitoring Center, feeding PI Vision displays to fully integrate in the e-Monitoring center solution

Extending the **Sigmafine Express** model to the boiler to improve coal consumption estimation and to verify coal quality to complete the overall mass and energy balance of unit 5

Scale up the model from unit 5 to the other power generation groups

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# Thank You

TAQA morocco