MAY 18TH

EDF & Metroscope - Monitoring and Diagnostics for Power Generation assets

EDF & Metroscope

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Agenda

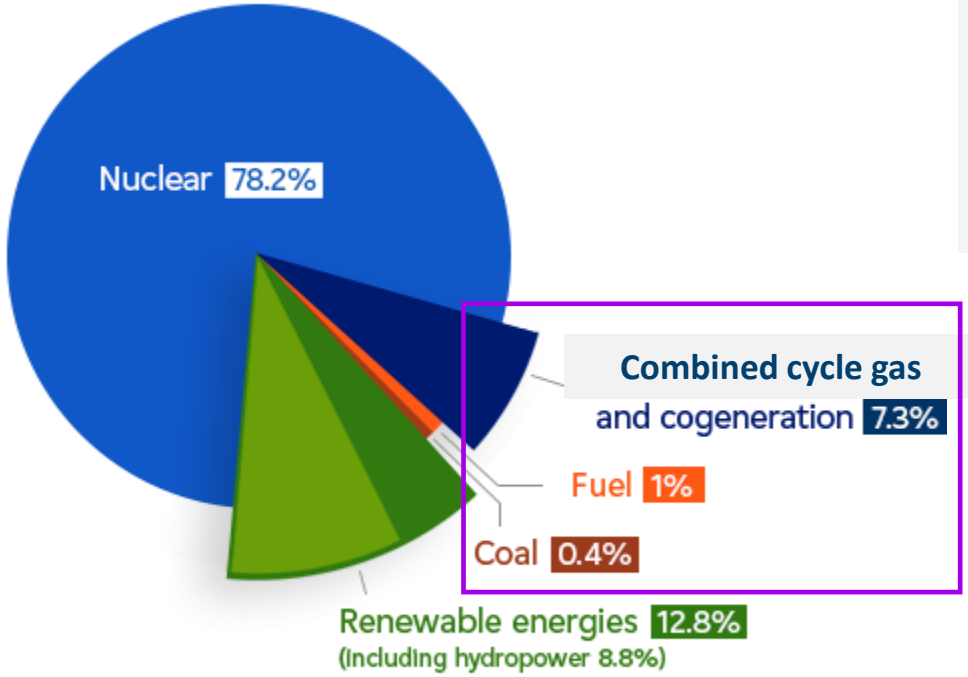
1. EDF CIST-Ingeum eMonitoring centre as PI System user

2. Monitoring and diagnostics with Metroscope - use case for gas power generation

3. Q&A

EDF CIST-Ingeum eMonitoring centre as PI System user

EDF : Low carbon electricity world leader



- 2021 EDF France generation share

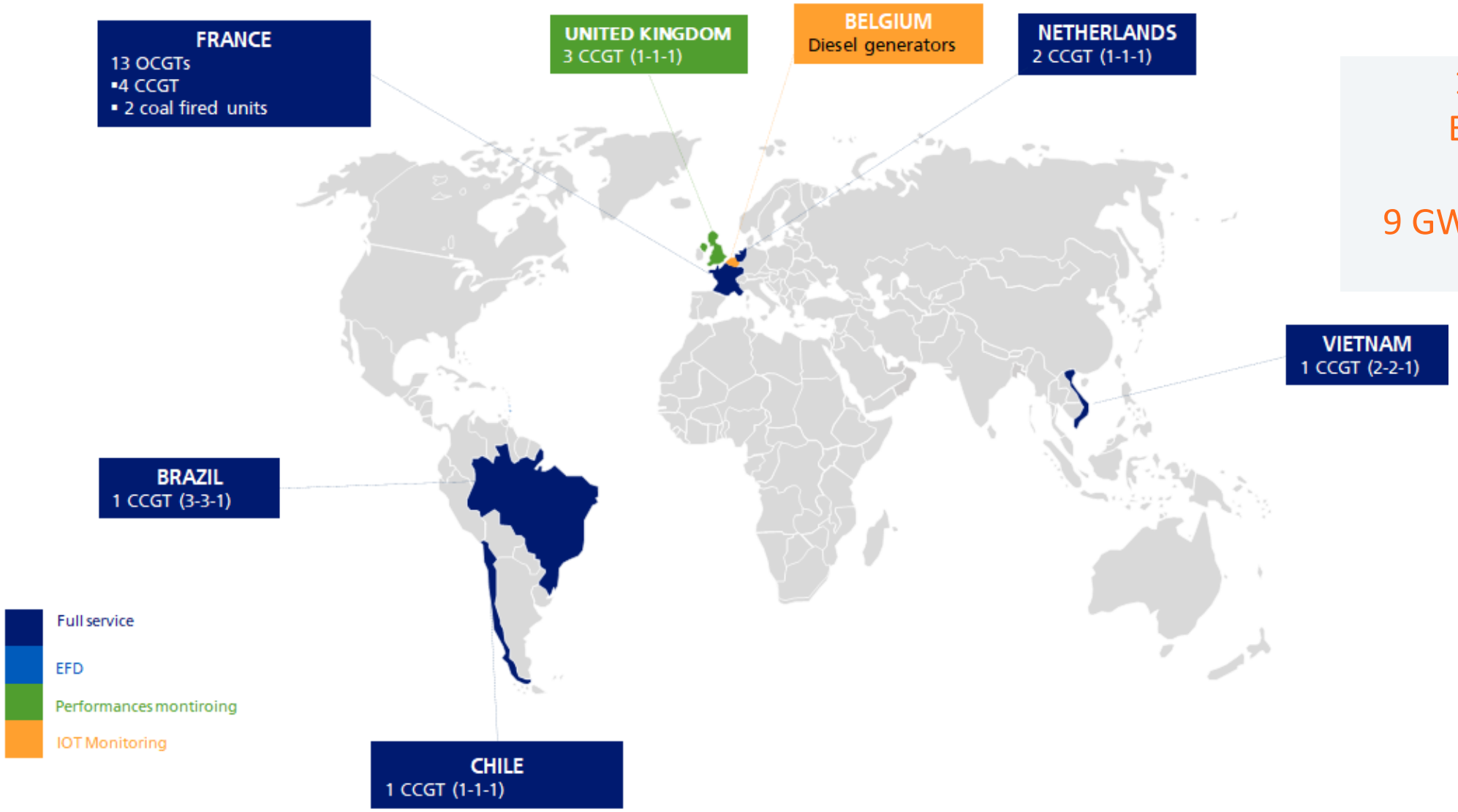
DTEAM THERMAL ENGINEERING ASSET MANAGEMENT AND SERVICES DIVISION

Accelerator of group industrial performance

CIST-INGEUM-eMONITORING SERVICE

A unique centre located in PARIS
15 engineers: all the service chain from the DCS to engineering studies
CIST-INGEUM process expertise of 60 years of experience of thermal plant operation and close to the CIST-INGEUM equipment and process experts

Thermal plants eMonitored by EDF CIST-INGEUM CENTRE



18 YEARS OF EMONITORING

9 GW MONITORED IN 2022

Why and how we monitor our plants

POWER RECOVERY

HEAT RATE IMPROVEMENT

MAINTENANCE COSTS REDUCTION

AVOIDED OUTAGE

metroscope

Diagnostics of performance losses thanks to plant Digital Twin

AVEVA PREDICTIVE ANALYTICS

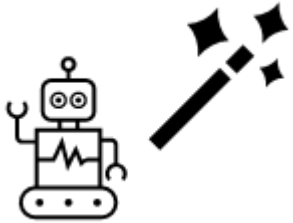
Early fault detection thanks to Machine Learning models

PI SYSTEM

OSIsoft. is now part of AVEVA

Today business challenges

Be closer to real time detection



Move towards predictive maintenance methods and automated diagnostics

Involve O&M staff of the plant in an active approach to drive the economic performance of the plant

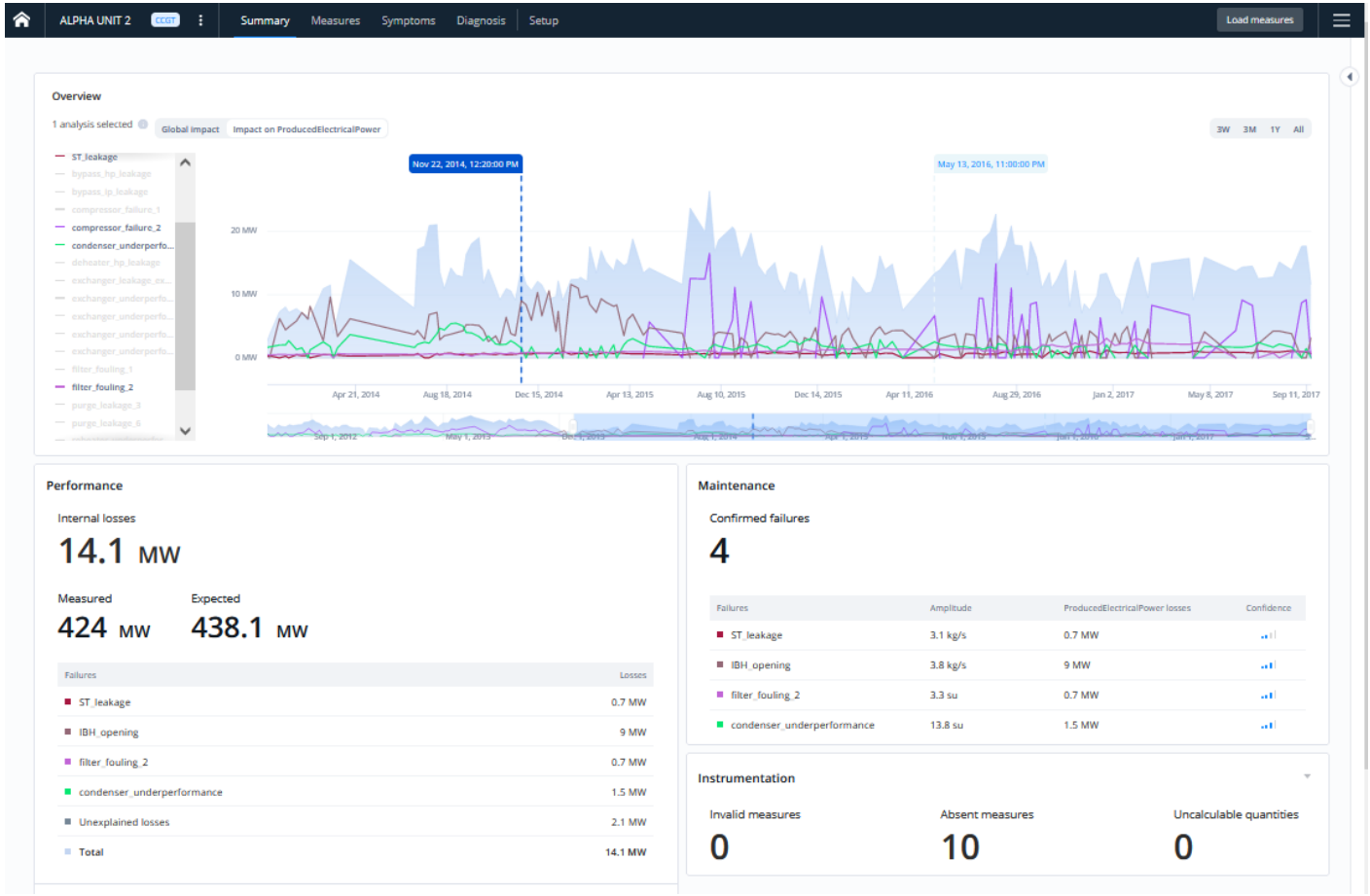
Upgrade the engineering expertise for conventional and new sustainable electric energies

Monitoring & Diagnostic with Metroscope use case for gas power generation

Monitoring & Diagnostic Software

Metroscope provides a software to understand faults and energy losses on industrial equipment

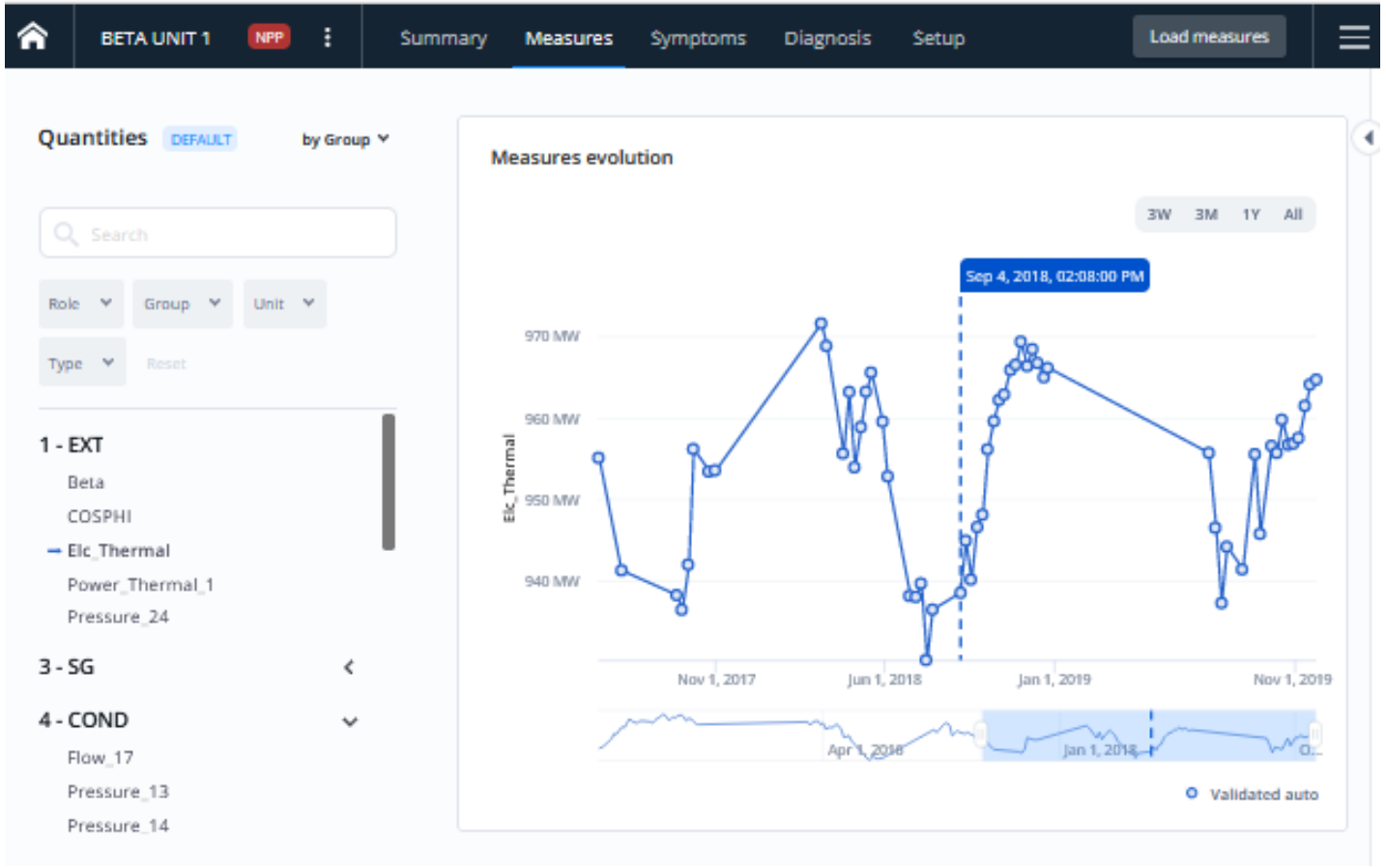
- Monitor key parameters
- Monitor deviations
- Automatic detection of energy losses
- Automatic and live fault diagnostic
- Impact on performance
- Interactive features



Explore key parameters

Metrological check of sensors and visualization of plant's KPIs

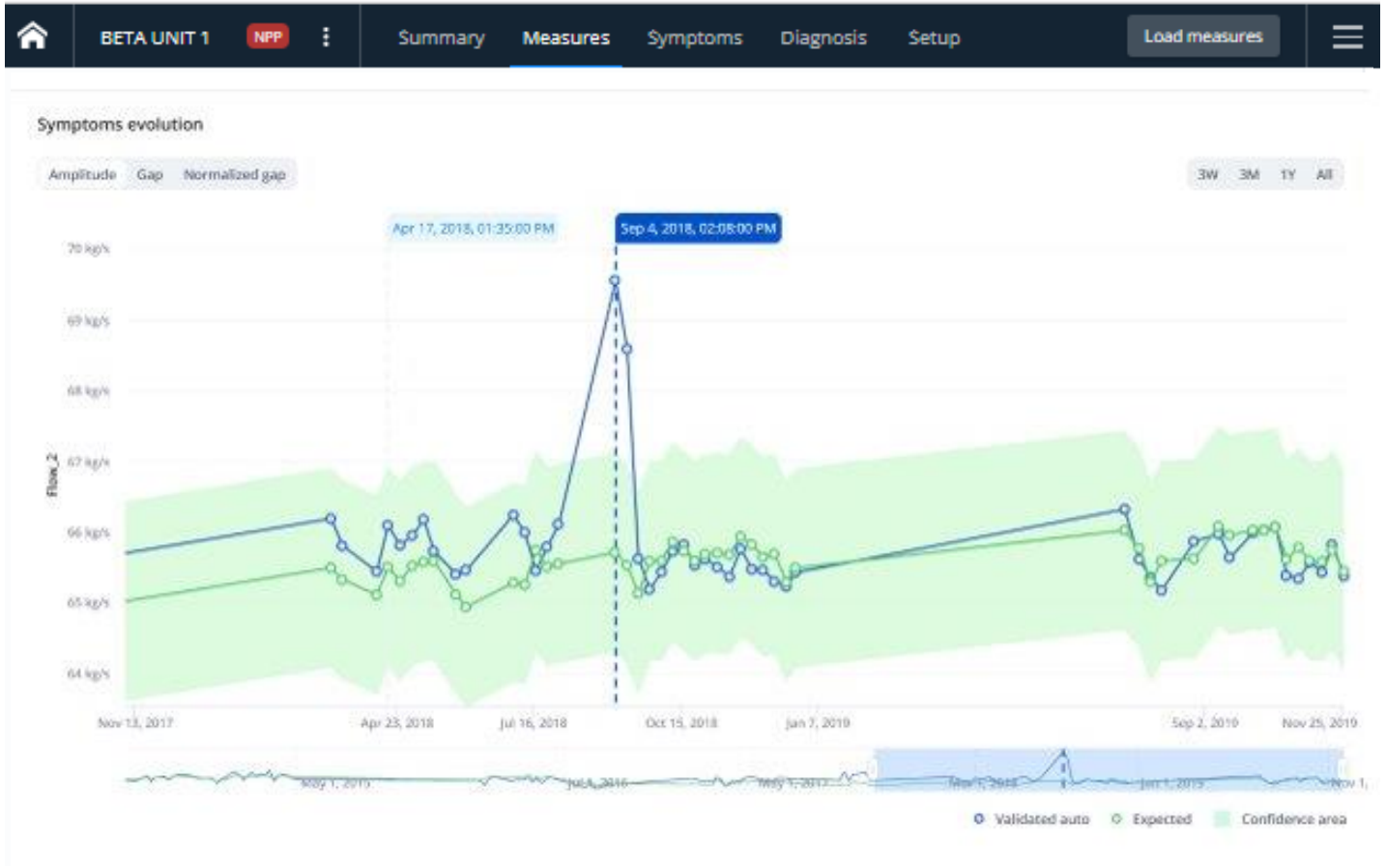
- key parameters accessible over the plant's history
  - measurements from sensors
  - calculated according to thermodynamic properties, law of physics and mathematics.
- grouped by component, system, measure units etc.
- customizable



Detect symptoms

Automated detection of abnormal behaviors thanks to the Digital Twin

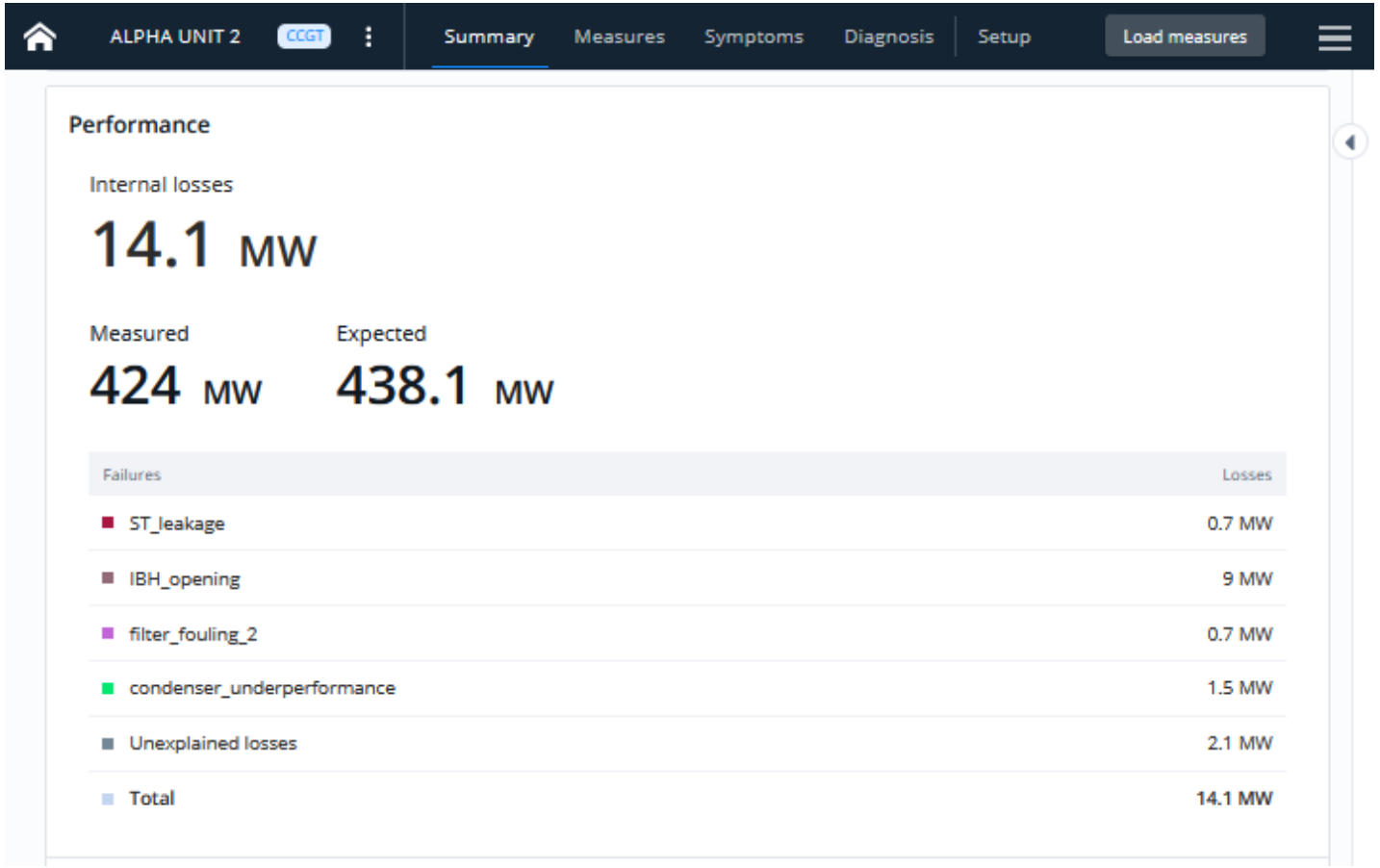
- key parameters (blue line in the picture) are compared to their expected value given by the Digital Twin (green line) over the history
- Visual cues to pinpoint symptomatic behaviors
- Follow and highlight the evolution of the symptom over time.



Understand root causes

Diagnostics results from thousands of faults scenarios in the Digital Twin

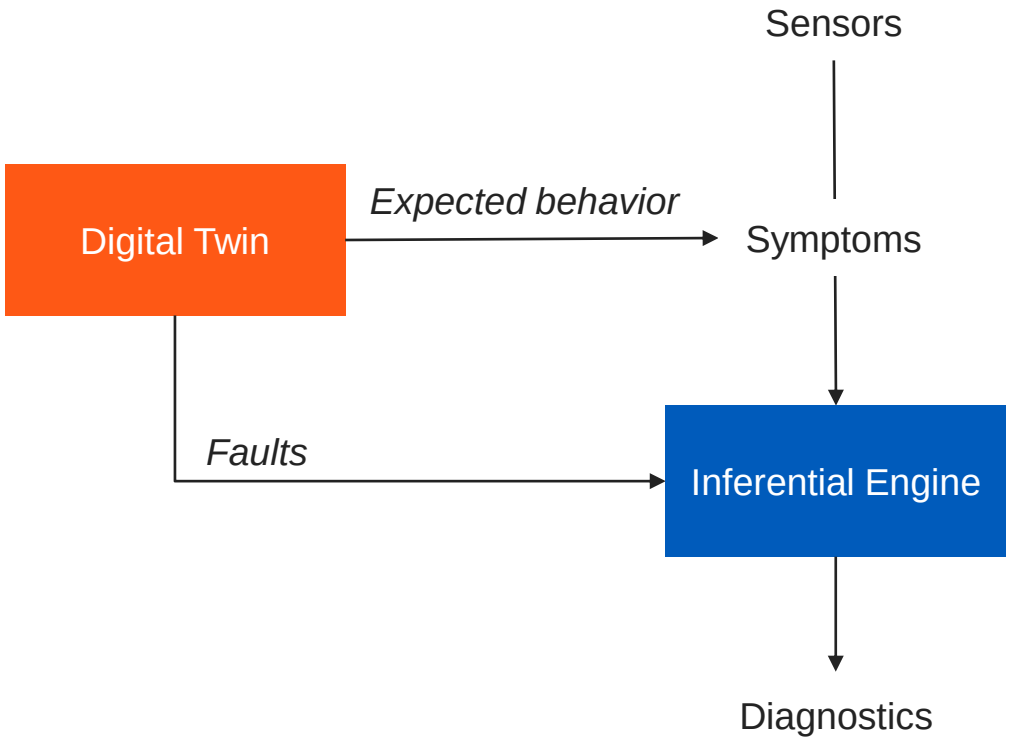
- automatic identification of faults and their magnitude
- automatic quantification of specific impact on the overall performance
- associated level of confidence for each fault



Key Principles

- The digital twin is encapsulated in our software and governed by an inferential engine in charge confronting the twin to the process data
- Any fault impairing the process is automatically located and classified by order of likelihood. Its magnitude is quantified and its impact on generation is qualified

$$diagnostics = P(faults \mid symptoms)$$



“A digital twin is a digital representation of a real-world entity or system ”

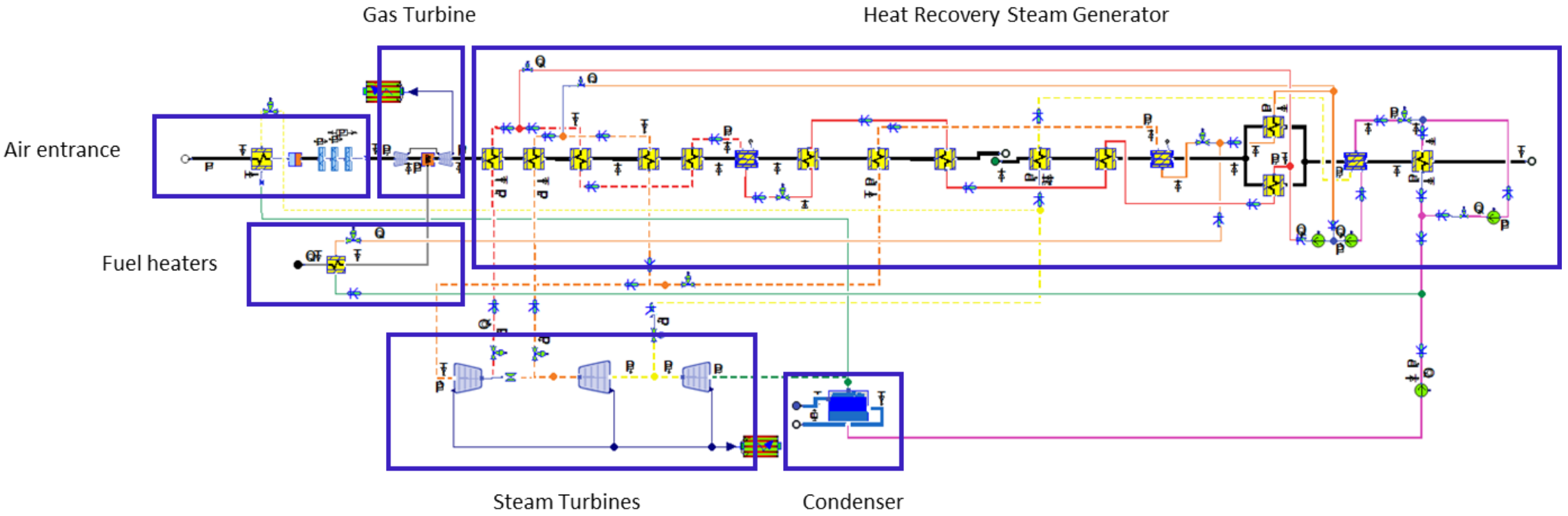
Gartner 2021

Blénod (France) – CCGT

- **Name** Unit 5
- **Design** Combined Cycle Gas Turbine (CCGT)
- **Manufacturer** General Electric
- **Power Gen** 430 MW
- **Initial operation** 2011
- **Location** Europe

Blénod CCGT Digital Twin – Reference

146 sensors, 7700 physical equations, 9 years of historic data



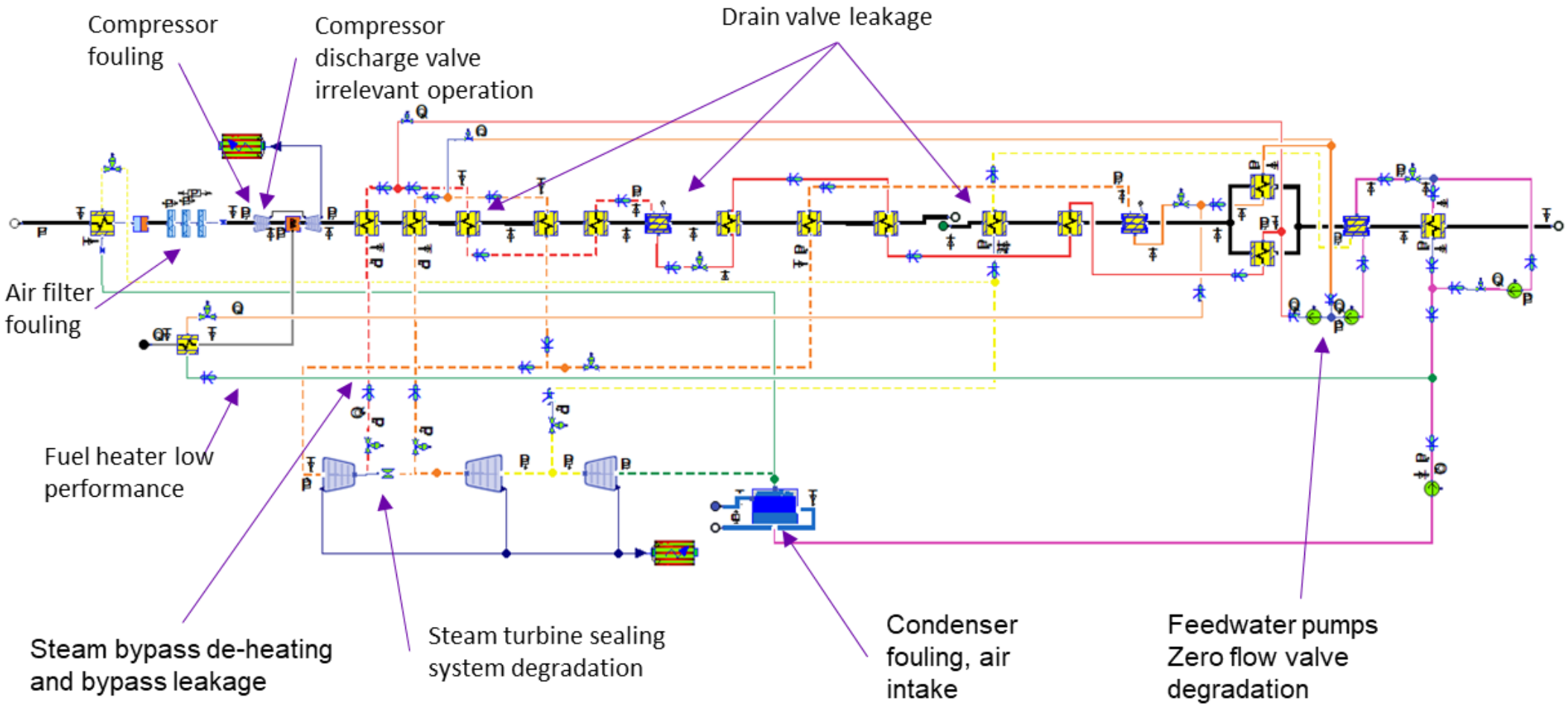
Blénod CCGT – Overall performance 1/2

Blénod CCGT – Overall performance 2/2

Visualization of the overall energy losses

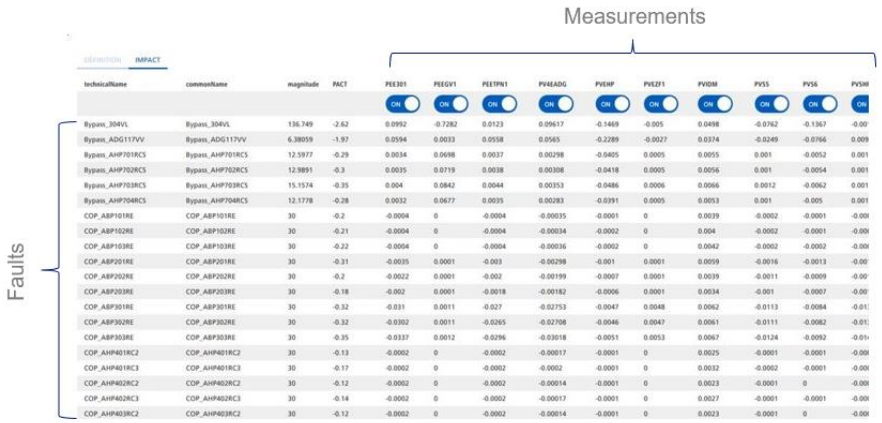
- Between 2014 and 2017 the unit has lost 15 MW (-2% efficiency)
- 60% of the losses are due to faults identified by Metroscope

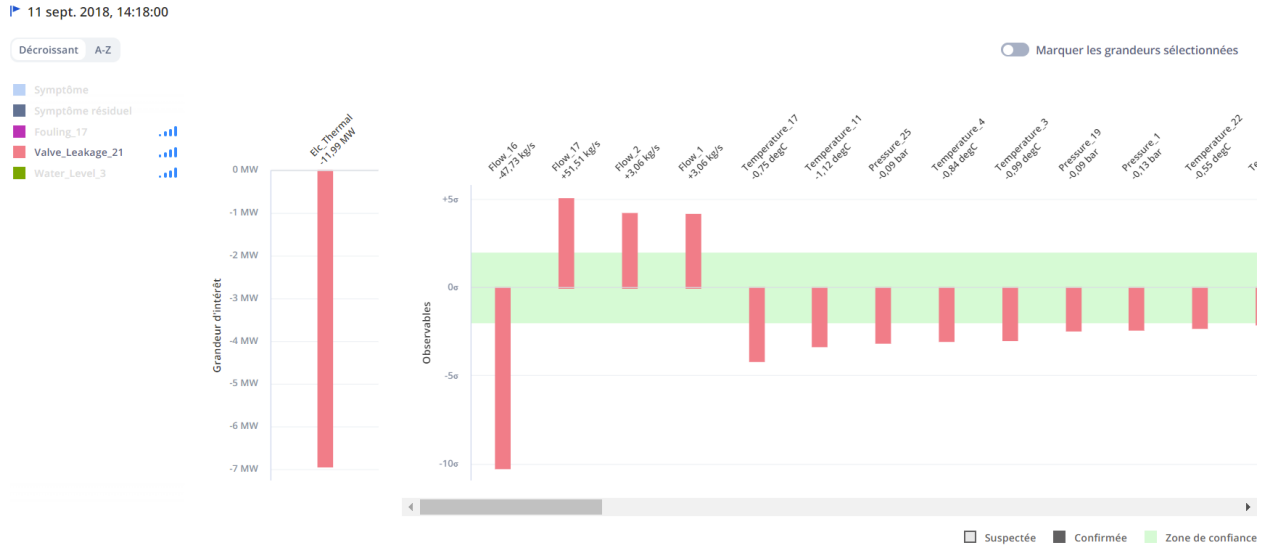
Blénod CCGT Digital Twin – Faults scenarios



Blénod CCGT Digital Twin – The Faults Matrix

The Digital Twin reveals the specific signature of faults according to their symptoms

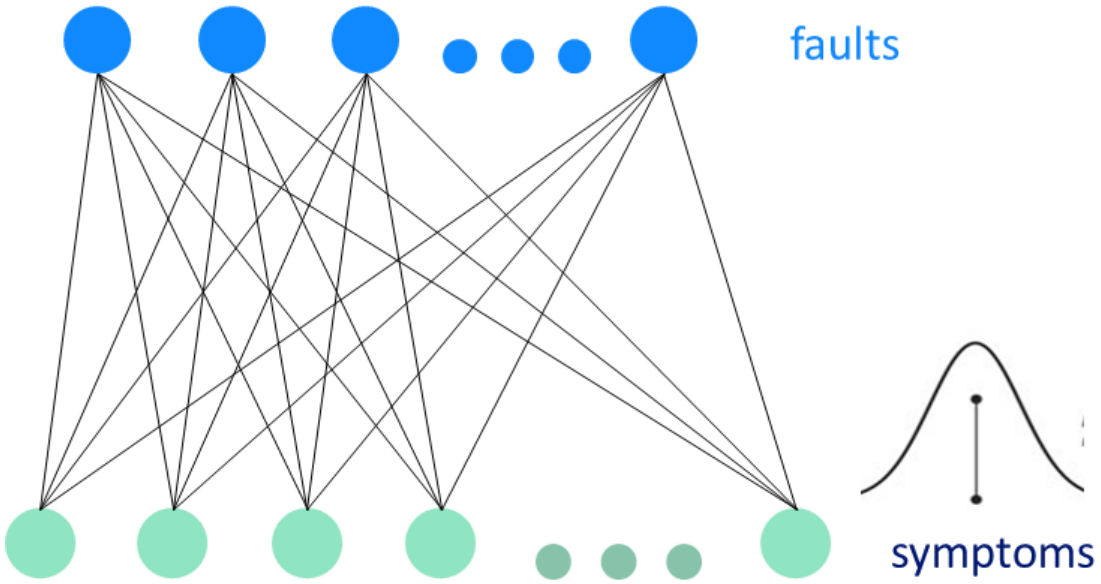




Blénod CCGT Digital Twin – The Inferential Engine

What is the most likely faults scenario to explain the current symptoms?

- Performs a Root Cause Analysis through a continuous probabilistic approach
- Using Bayesian networks
- Testing thousands of faults scenarios
- While giving special care to uncertainties.



Diagnostics = P(faults | symtoms)

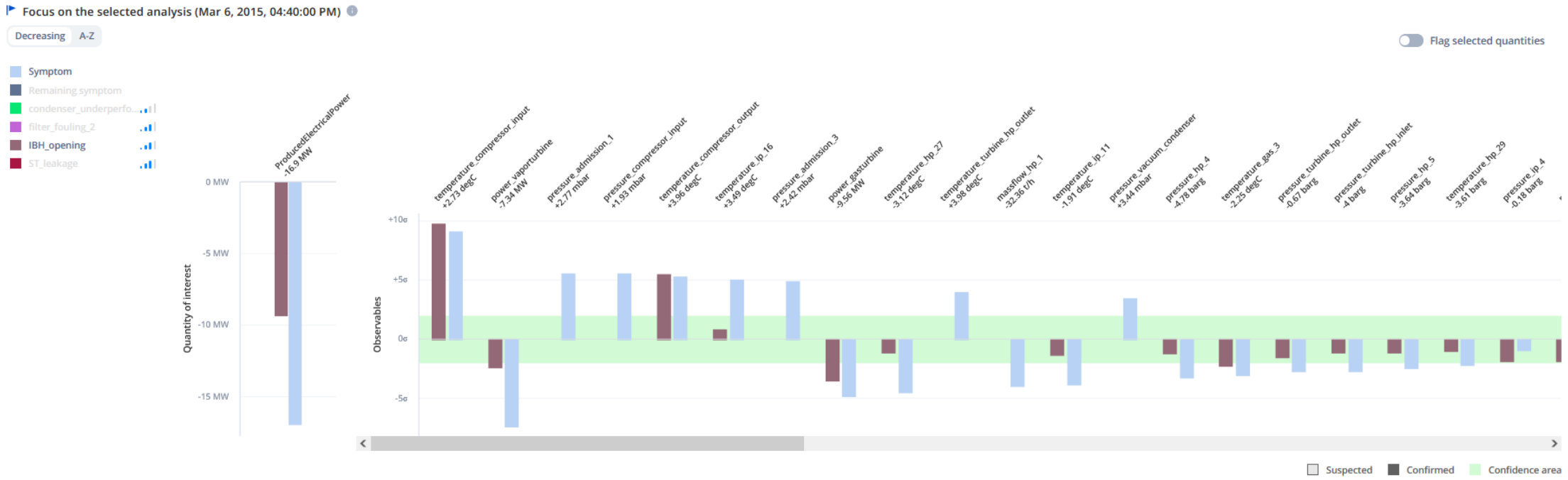
Blénod CCGT – Diagnostics Example

Identification of Inlet Bleed Heating (IBH) valve opening at unusual operating points

- Up to 10 MW losses
- Regulation issue on the valve after a maintenance by the O&M
- Diagnostic key to challenge O&M

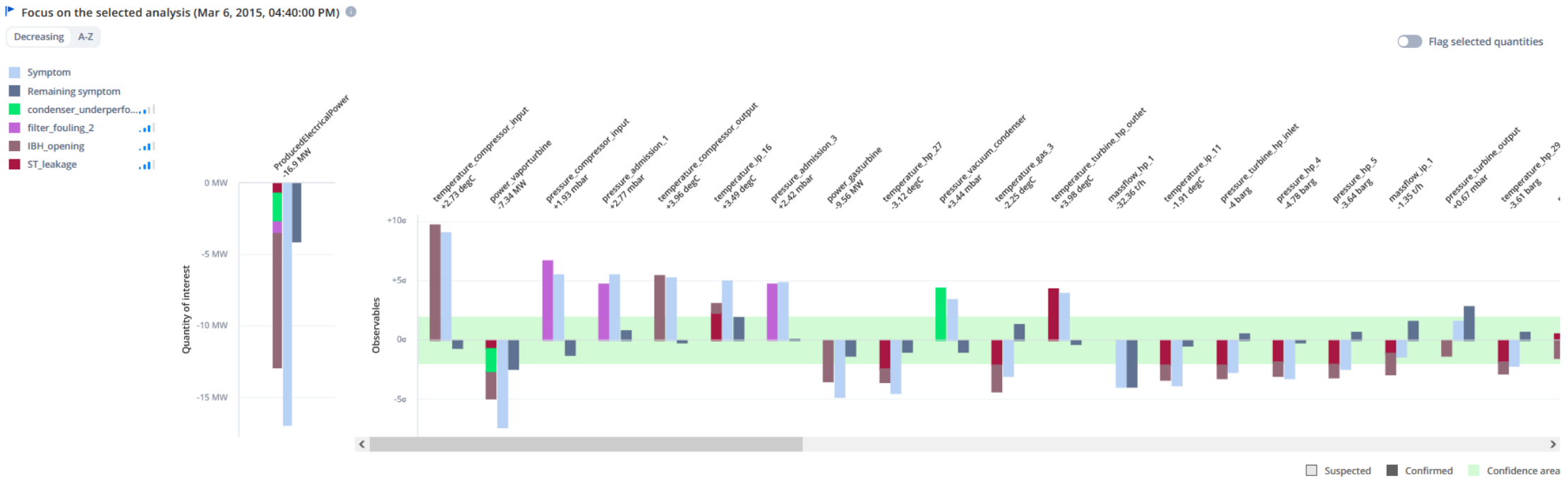
Blénod CCGT – Diagnostics Example

Signature of the Inlet Bleed Heating (IBH) valve opening

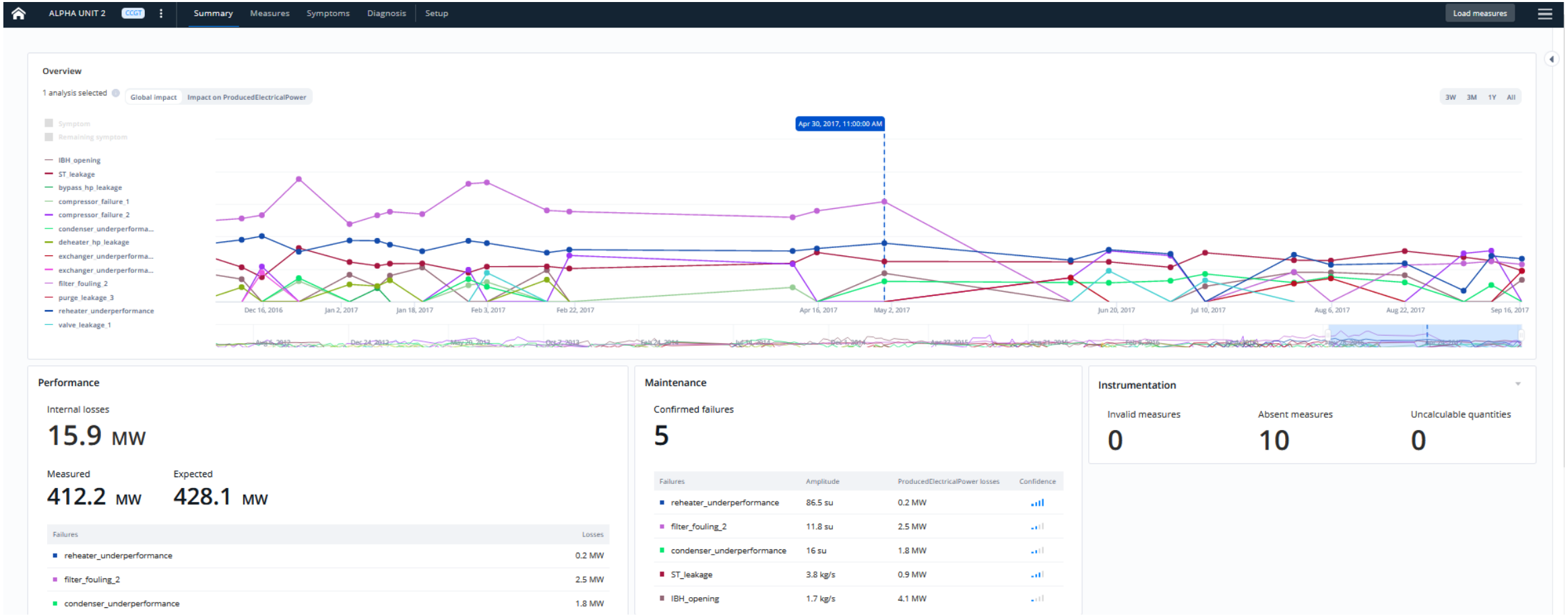


Blénod CCGT – Diagnostics Example

Full diagnostics (cumulated signatures of the 4 faults)



Blénod CCGT – Diagnostics Example



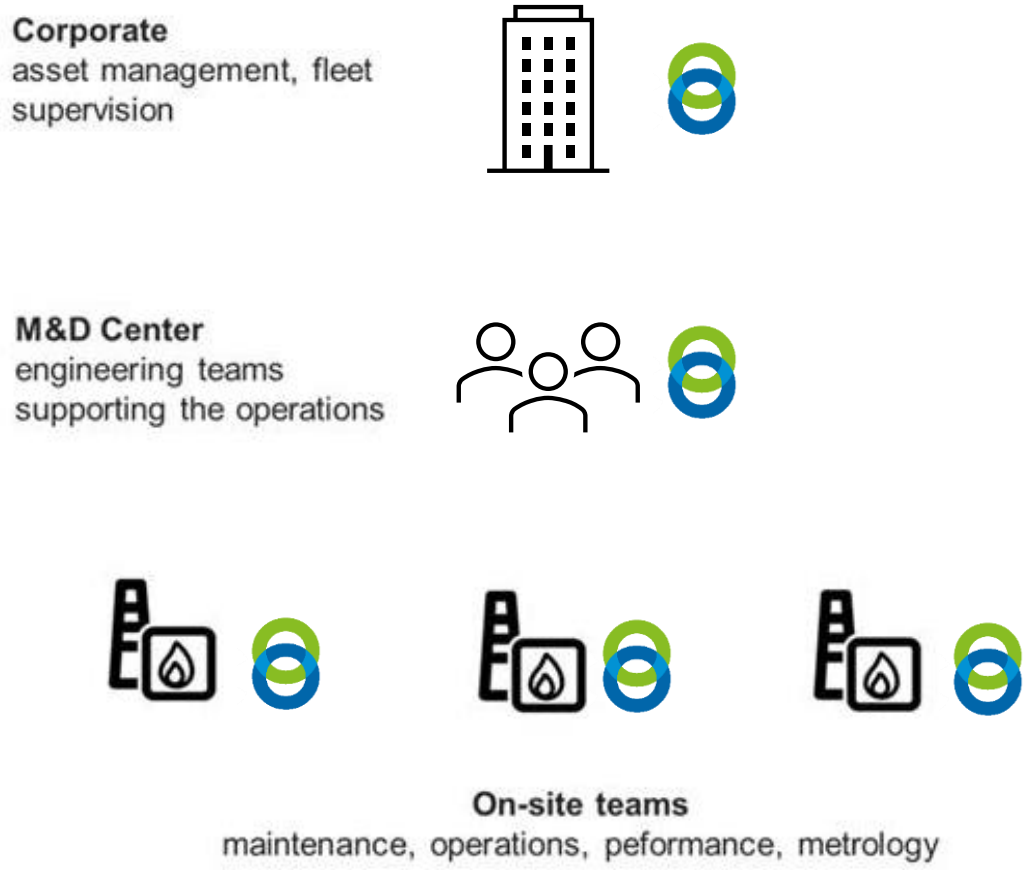
Metroscope in our customer organization

Metroscope at Blénod:

- 10 trained users (out of 40 site members)
- Weekly utilisation (3 x week) for O&M monitoring and outage preparation

Metroscope overall:

- More than 300 active users worldwide
- Accessible and usable by as many people as possible.
- 80% users display MTS results outside of their division



A few facts about Metroscope

65
Units
equipped worldwide

2000 GWh
Losses
detected in 2021, approx 980 000 tons of CO_2

>90 %
reliability
according to our customer's experience

To sum up!

Thermal unit challenges

- Be able to detect degradation closer to real time
- Involve the staff driving the short and long term performance of the plant
- Upgrade the ability to diagnostic degradation of performance

An AI solution for diagnostic

- Software for monitoring and diagnostics.
  Provide a Digital twin technology to understand faults and energy losses on industrial equipment

Benefits

- Exchange with the O&M staff weekly about the detections
- Give a tool that display in real time the degradation
- Enrich the library of degradations

Questions?

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