

MAY 18TH

---

# EDF & Metroscope - Monitoring and Diagnostics for Power Generation assets

EDF & Metroscope

Daniela BORY & Aurélien SCHWARTZ

**AVEVA**



## Daniela Bory

eMonitoring Process Engineer

- [daniela.bory@edf.fr](mailto:daniela.bory@edf.fr)



## Aurélien Schwartz

Chief Executive Officer

- [aurelien.schwartz@metroscope.tech](mailto:aurelien.schwartz@metroscope.tech)



---

# Agenda

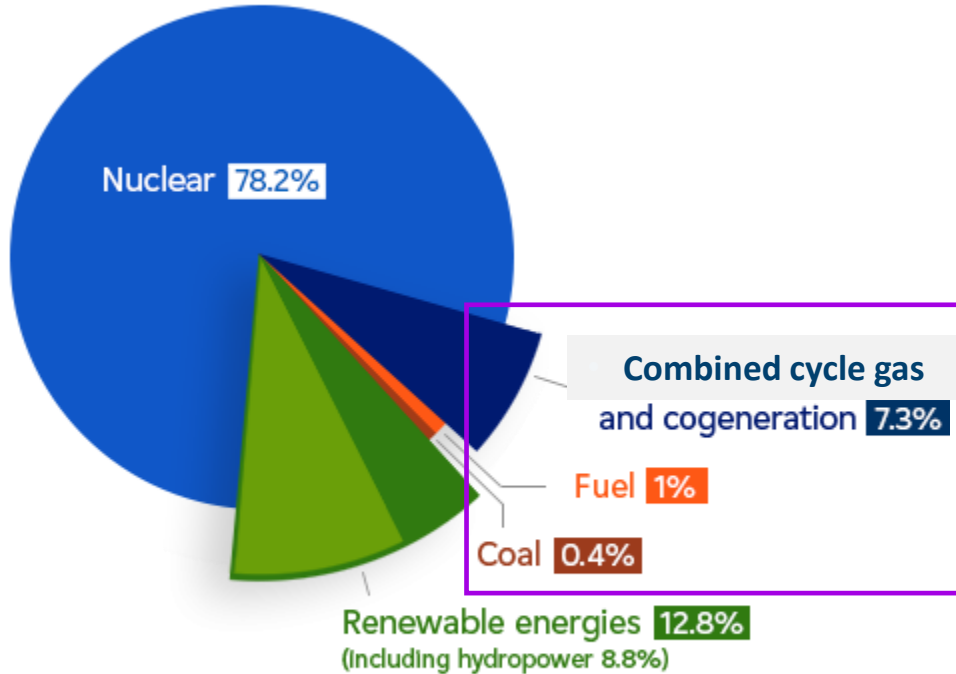
1. EDF CIST-Ingeum eMonitoring centre as PI System user
2. Monitoring and diagnostics with Metroscope - use case for gas power generation
3. Q&A

---

# EDF CIST-Ingeum eMonitoring centre as PI System user



# EDF : Low carbon electricity world leader



- 2021 EDF France generation share

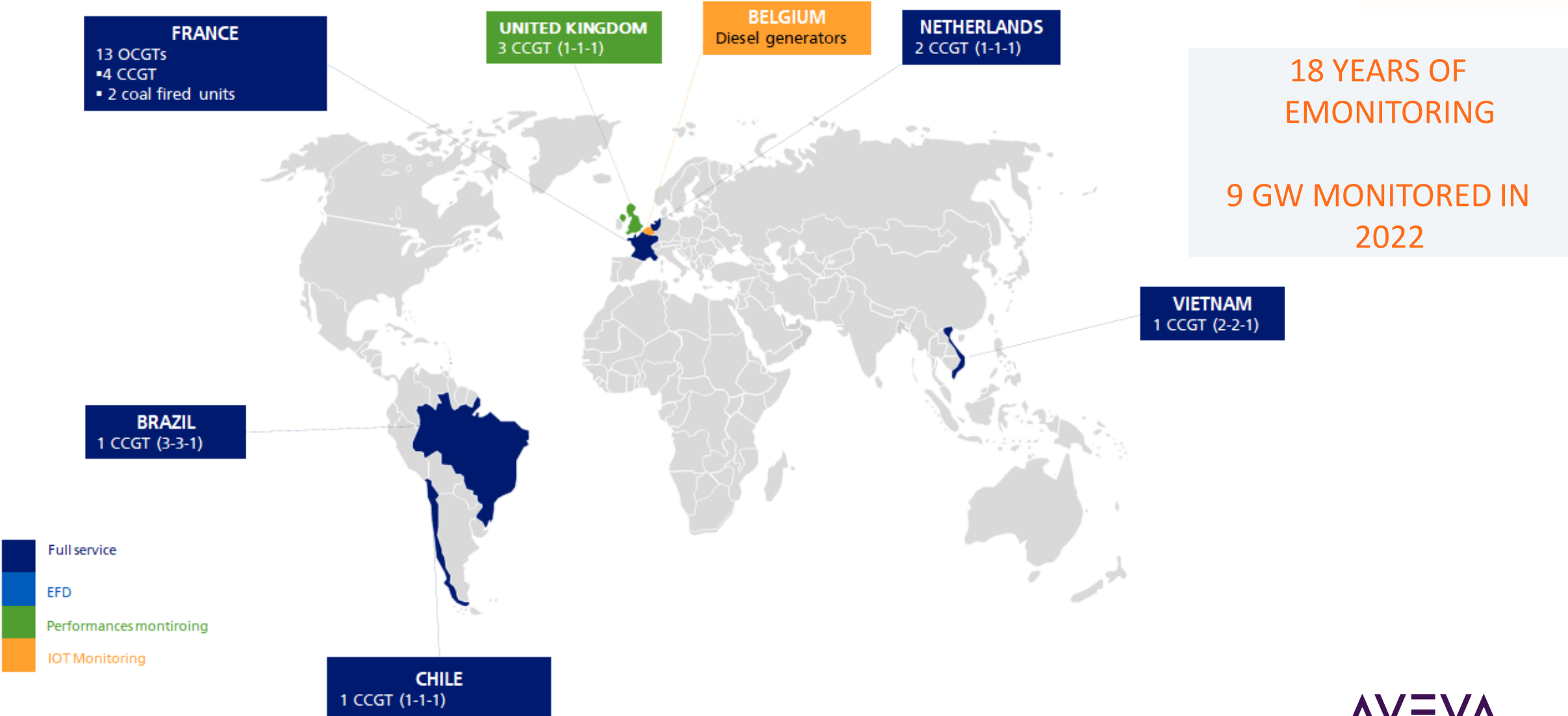
## DTEAM THERMAL ENGINEERING ASSET MANAGEMENT AND SERVICES DIVISION

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



# 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**

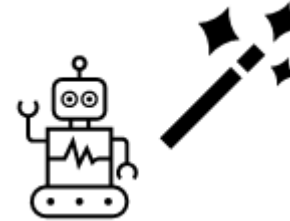


**AVEVA**

# 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



---

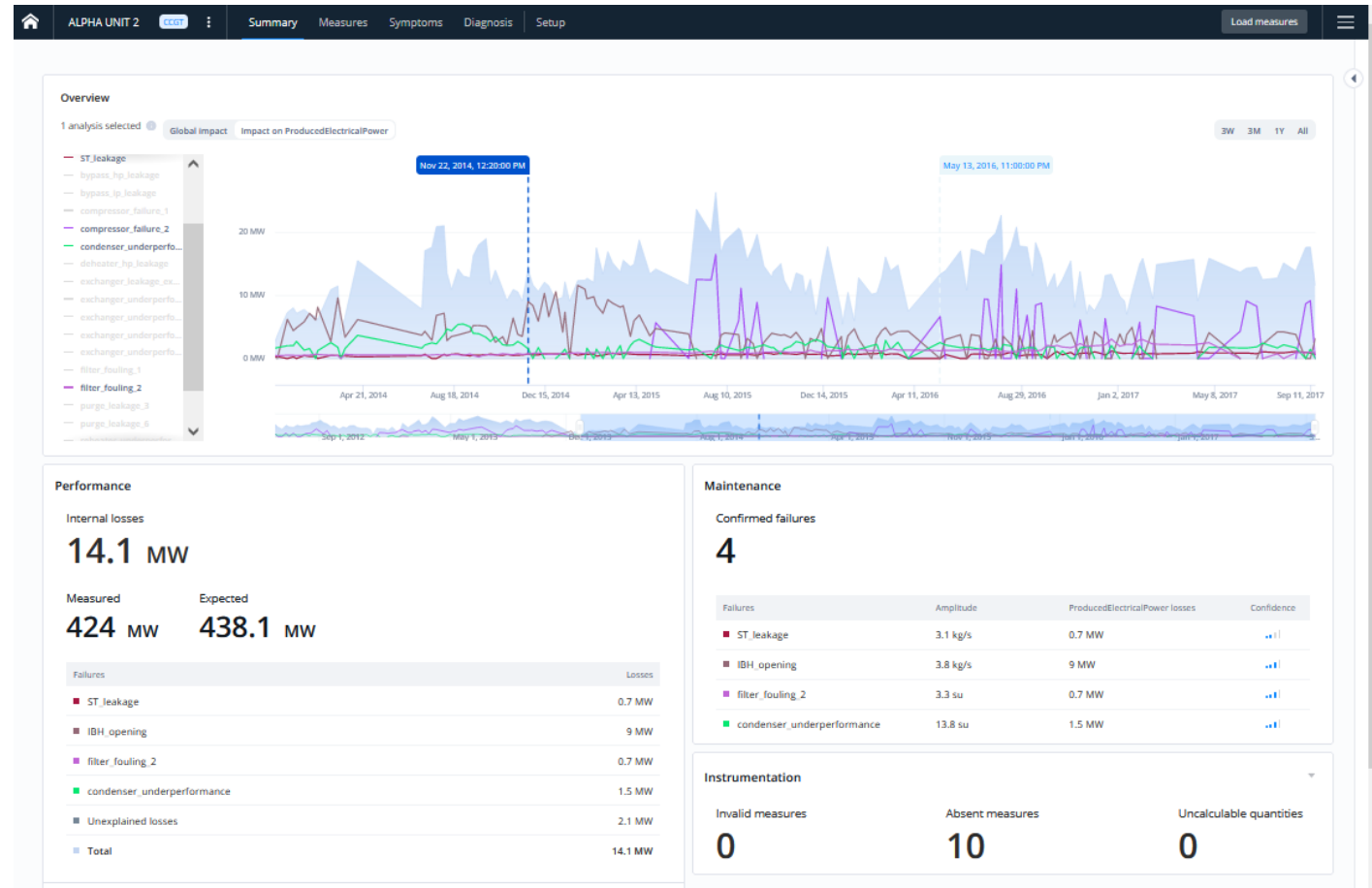
# Monitoring & Diagnostic with Metroscope use case for gas power generation



# Monitoring & Diagnostic Software

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

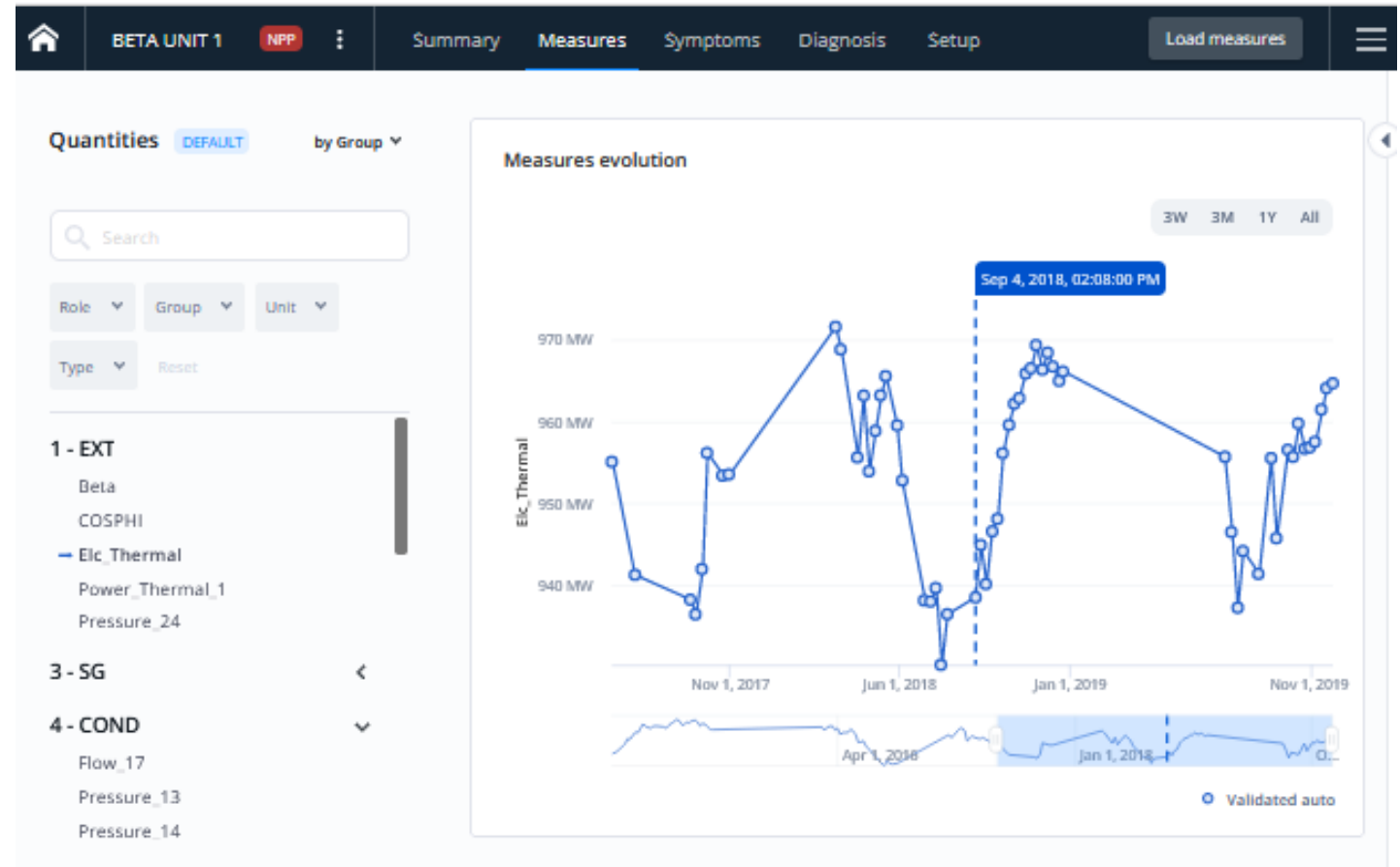
- Monitor key parameters
- Monitor deviations
- Automatic detection of energy losses
- Automatic and live fault diagnostic
- Impact on performance
- Interactive features



# Explore key parameters

## Metrological check of sensors and visualization of plant's KPIs

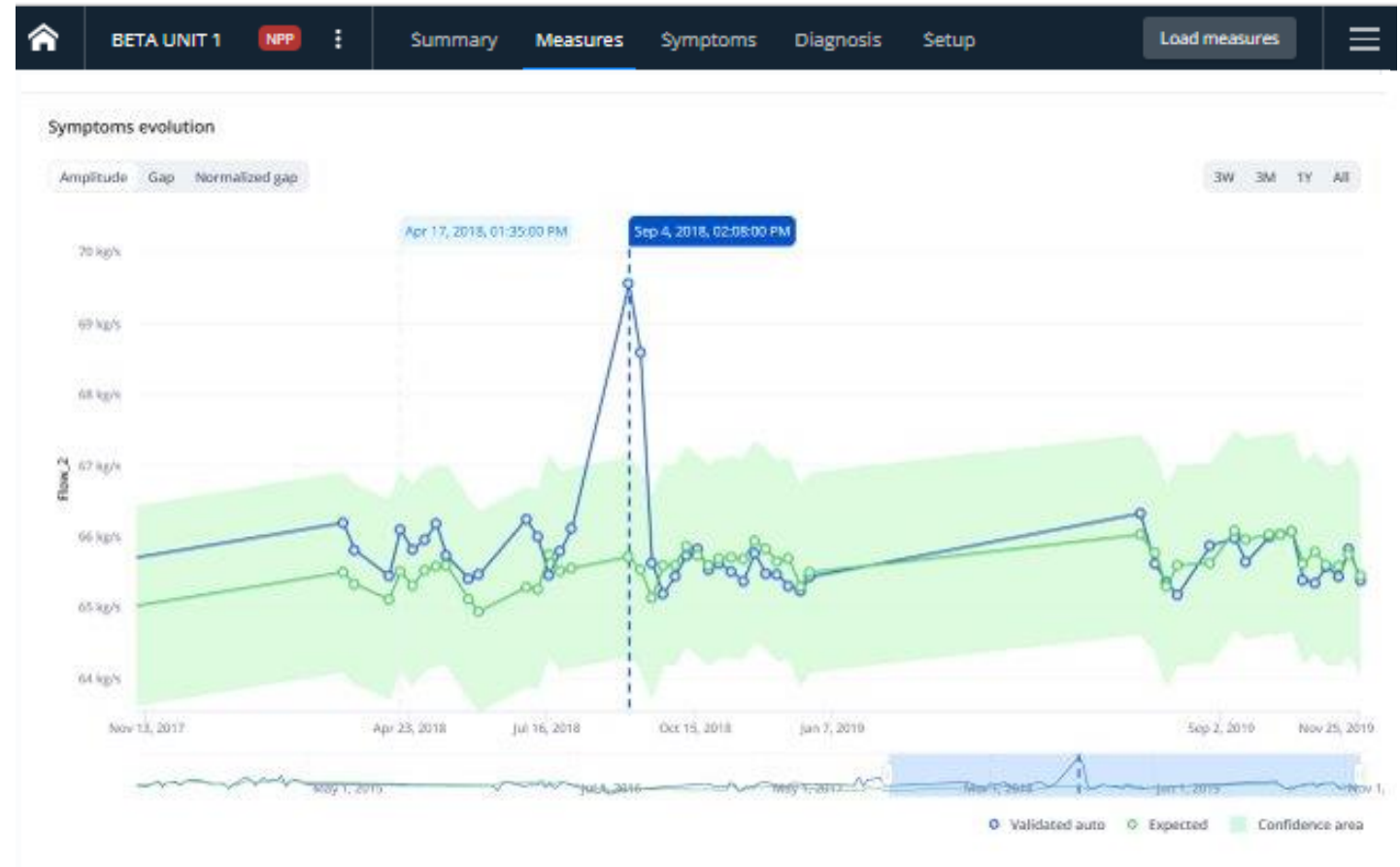
- key parameters accessible over the plant's history
  - measurements from sensors
  - calculated according to thermodynamic properties, law of physics and mathematics.
- grouped by component, system, measure units etc.
- customizable



# Detect symptoms

## Automated detection of abnormal behaviors thanks to the Digital Twin

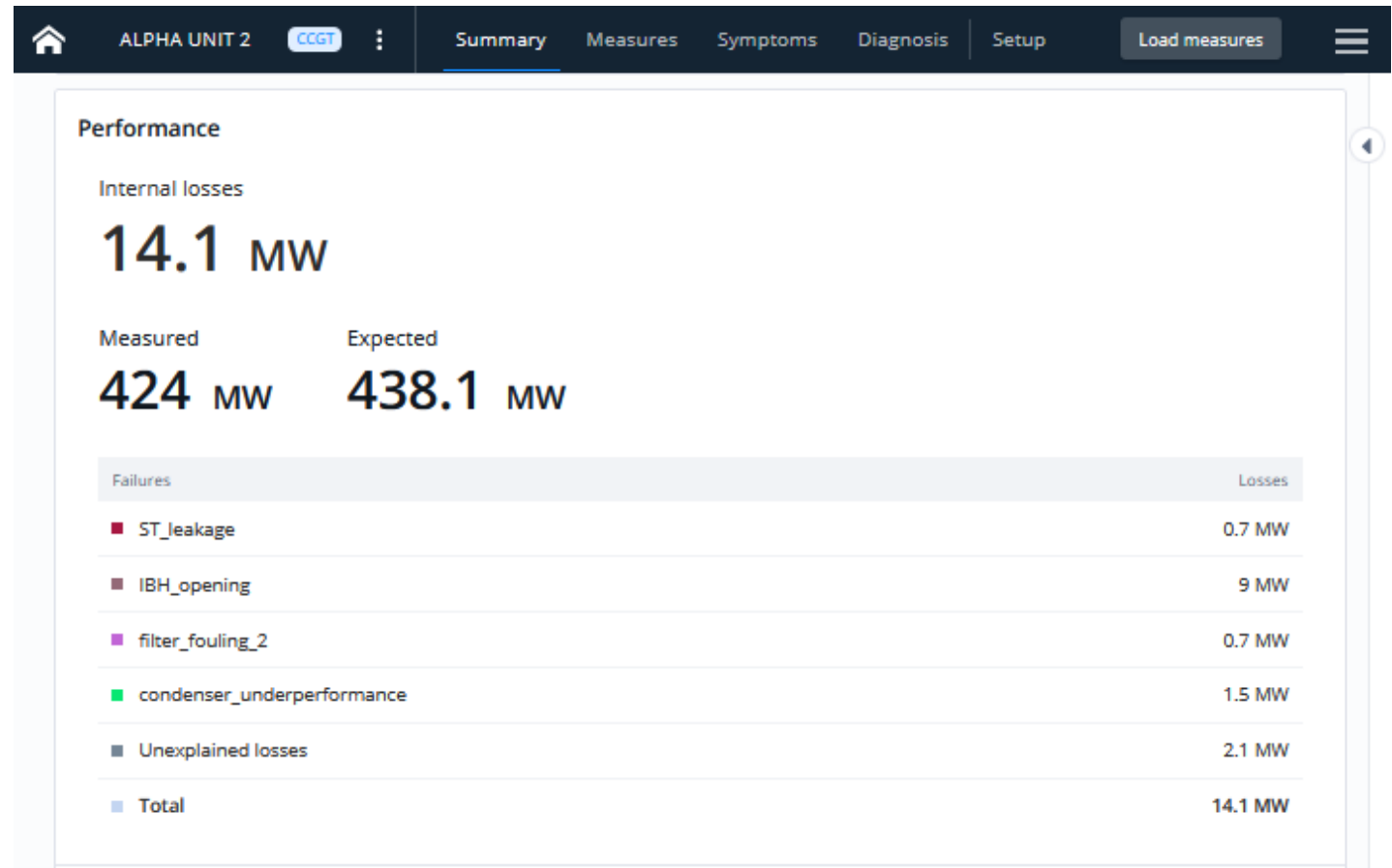
- key parameters (blue line in the picture) are compared to their expected value given by the Digital Twin (green line) over the history
- Visual cues to pinpoint symptomatic behaviors
- Follow and highlight the evolution of the symptom over time.



# Understand root causes

Diagnostics results from thousands of faults scenarios in the Digital Twin

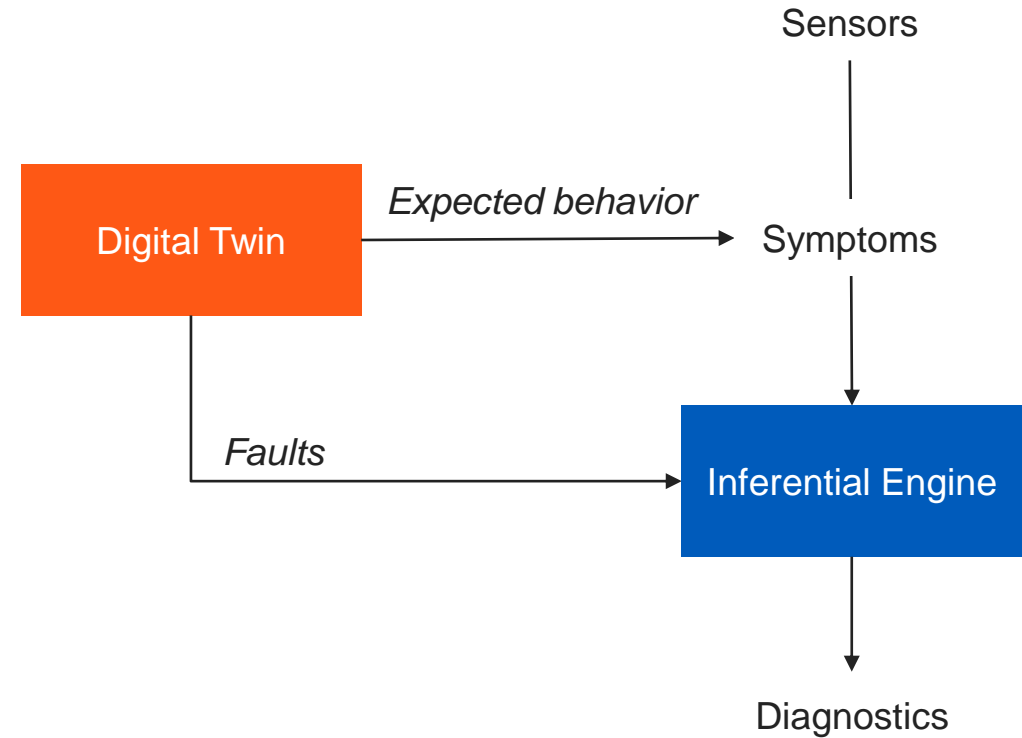
- automatic identification of faults and their magnitude
- automatic quantification of specific impact on the overall performance
- associated level of confidence for each fault



# 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

$$\text{diagnostics} = P(\text{faults} \mid \text{symptoms})$$



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

Gartner 2021

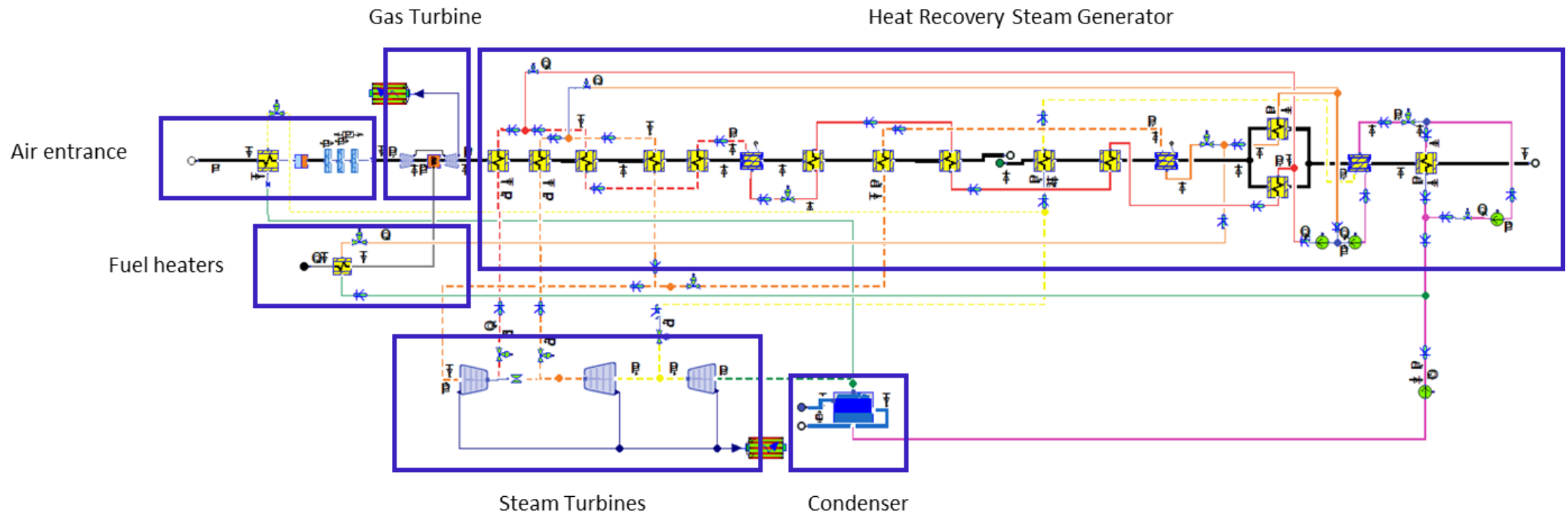
## Blénod (France) – CCGT

- **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



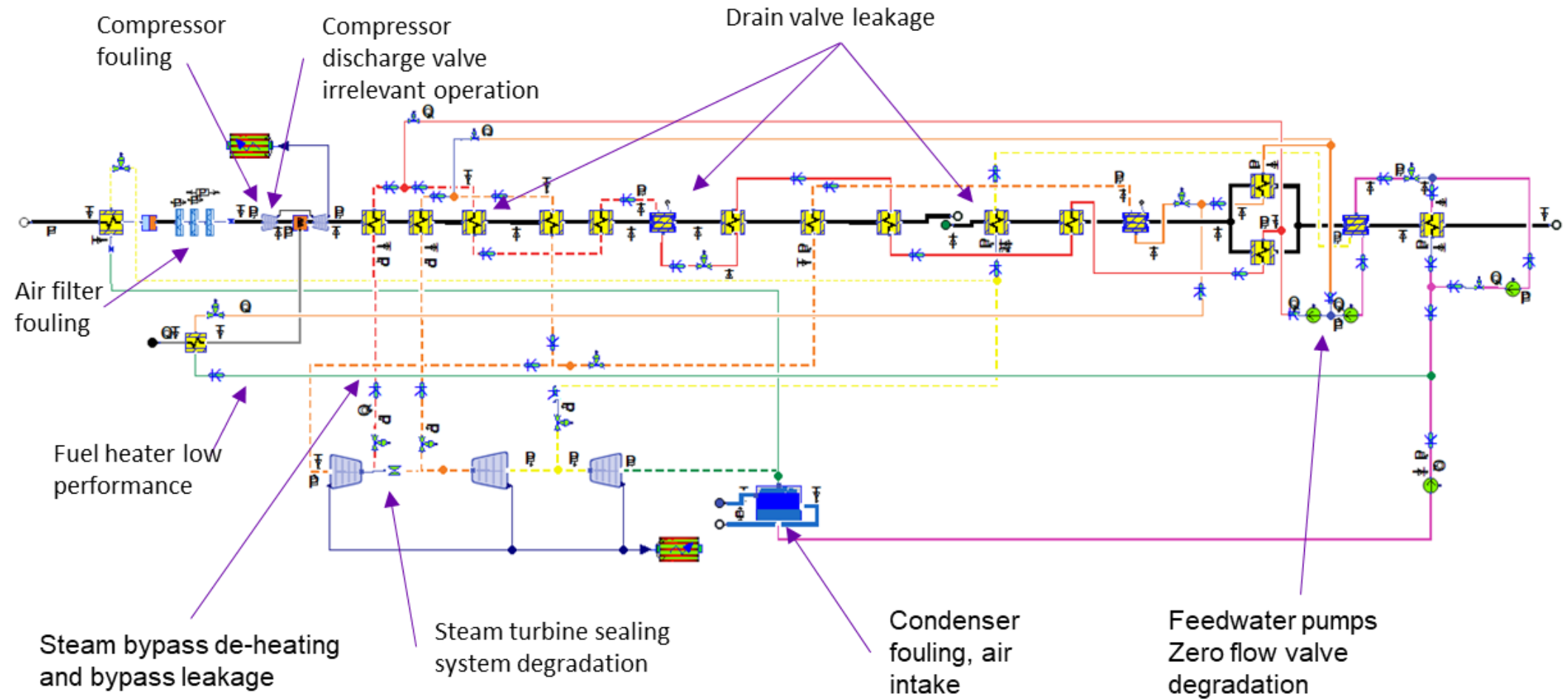
# Blénod CCGT – Overall performance 2/2

## 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

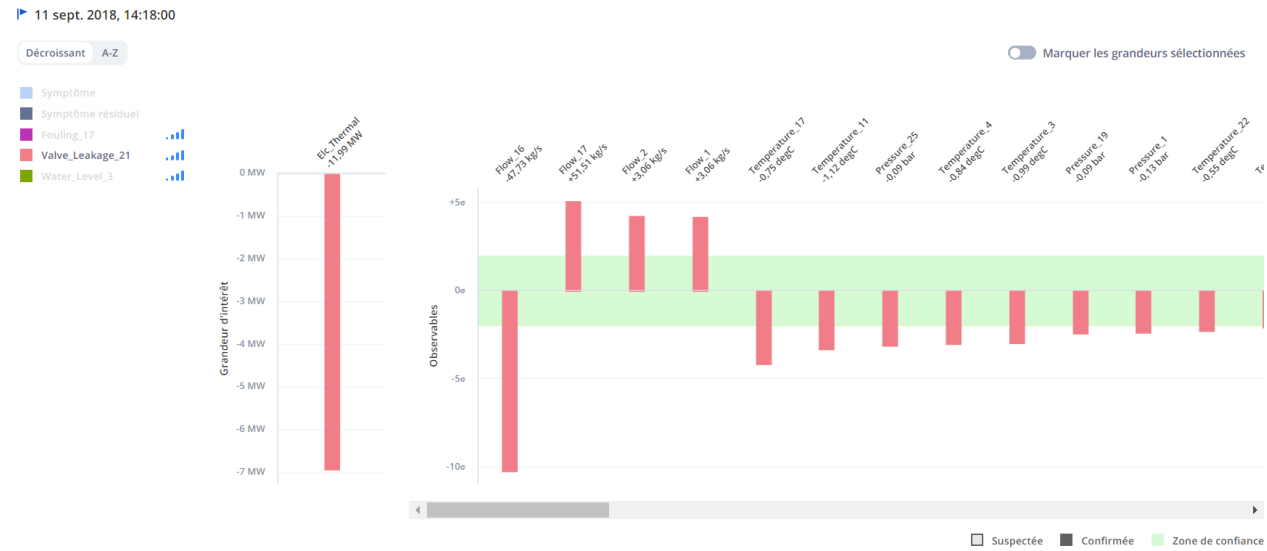


# Blénod CCGT Digital Twin – The Faults Matrix

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

Faults

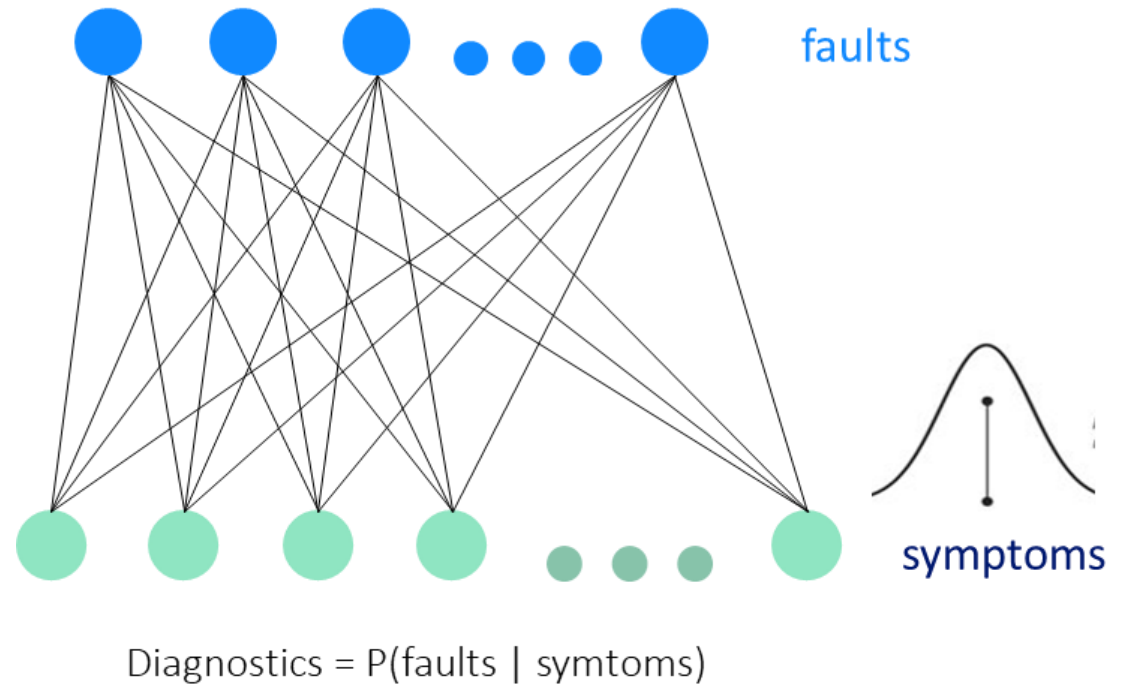
Measurements													
technicalName	commonName	magnitude	PACT	PEE301	PEE301	PEE301	PV4EADG	PV4EHP	PV4E21	PV4EHP	PV55	PV56	PV58
Bypass_304VL	Bypass_304VL	136.749	-2.62	0.0992	-0.7282	0.0123	0.09617	-0.1469	-0.005	0.0488	-0.0762	-0.1367	-0.00
Bypass_ADG11VV	Bypass_ADG11VV	6.38059	-1.97	0.0594	0.0033	0.0558	0.0565	-0.2289	-0.0027	0.0374	-0.0249	-0.0766	0.008
Bypass_AHP701RC3	Bypass_AHP701RC3	12.5977	-0.29	0.0034	0.0098	0.0037	0.00298	-0.0405	0.0005	0.0055	0.001	-0.0052	0.001
Bypass_AHP702RC3	Bypass_AHP702RC3	12.9891	-0.3	0.0035	0.0719	0.0038	0.00308	-0.0418	0.0005	0.0056	0.001	-0.0054	0.001
Bypass_AHP703RC3	Bypass_AHP703RC3	15.1574	-0.35	0.004	0.0842	0.0044	0.00353	-0.0486	0.0006	0.0066	0.0012	-0.0062	0.001
Bypass_AHP704RC3	Bypass_AHP704RC3	12.1778	-0.28	0.0032	0.0677	0.0035	0.00283	-0.0391	0.0005	0.0053	0.001	-0.005	0.001
COP_ABP101RE	COP_ABP101RE	30	-0.2	-0.0004	0	-0.0004	-0.00035	-0.0001	0	0.0039	-0.0002	-0.0001	-0.00
COP_ABP102RE	COP_ABP102RE	30	-0.21	-0.0004	0	-0.0004	-0.00034	-0.0002	0	0.004	-0.0002	-0.0001	-0.00
COP_ABP103RE	COP_ABP103RE	30	-0.22	-0.0004	0	-0.0004	-0.00036	-0.0002	0	0.0042	-0.0002	-0.0002	-0.00
COP_ABP101RE	COP_ABP101RE	30	-0.31	-0.0035	0.0001	-0.003	-0.00298	-0.001	0.0001	0.0059	-0.0016	-0.0013	-0.00
COP_ABP102RE	COP_ABP102RE	30	-0.2	-0.0022	0.0001	-0.002	-0.00199	-0.0007	0.0001	0.0039	-0.0011	-0.0009	-0.00
COP_ABP103RE	COP_ABP103RE	30	-0.18	-0.002	0.0001	-0.0018	-0.00182	-0.0006	0.0001	0.0034	-0.001	-0.0007	-0.00
COP_ABP101RE	COP_ABP101RE	30	-0.32	-0.031	0.0011	-0.027	-0.02753	-0.0047	0.0048	0.0062	-0.0113	-0.0084	-0.01
COP_ABP102RE	COP_ABP102RE	30	-0.32	-0.0302	0.0011	-0.0265	-0.02708	-0.0046	0.0047	0.0061	-0.0111	-0.0082	-0.01
COP_ABP103RE	COP_ABP103RE	30	-0.35	-0.0337	0.0012	-0.0296	-0.03018	-0.0051	0.0053	0.0067	-0.0124	-0.0092	-0.01
COP_AHP401RC2	COP_AHP401RC2	30	-0.13	-0.0002	0	-0.0002	-0.00017	-0.0001	0	0.0005	-0.0001	-0.0001	-0.00
COP_AHP401RC3	COP_AHP401RC3	30	-0.17	-0.0002	0	-0.0002	-0.0002	-0.0001	0	0.0002	-0.0002	-0.0001	-0.00
COP_AHP402RC2	COP_AHP402RC2	30	-0.12	-0.0002	0	-0.0002	-0.00014	-0.0001	0	0.0003	-0.0001	0	-0.00
COP_AHP402RC3	COP_AHP402RC3	30	-0.14	-0.0002	0	-0.0002	-0.00017	-0.0001	0	0.0007	-0.0001	-0.0001	-0.00
COP_AHP403RC2	COP_AHP403RC2	30	-0.12	-0.0002	0	-0.0002	-0.00014	-0.0001	0	0.0003	-0.0001	0	-0.00



# 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.



# 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

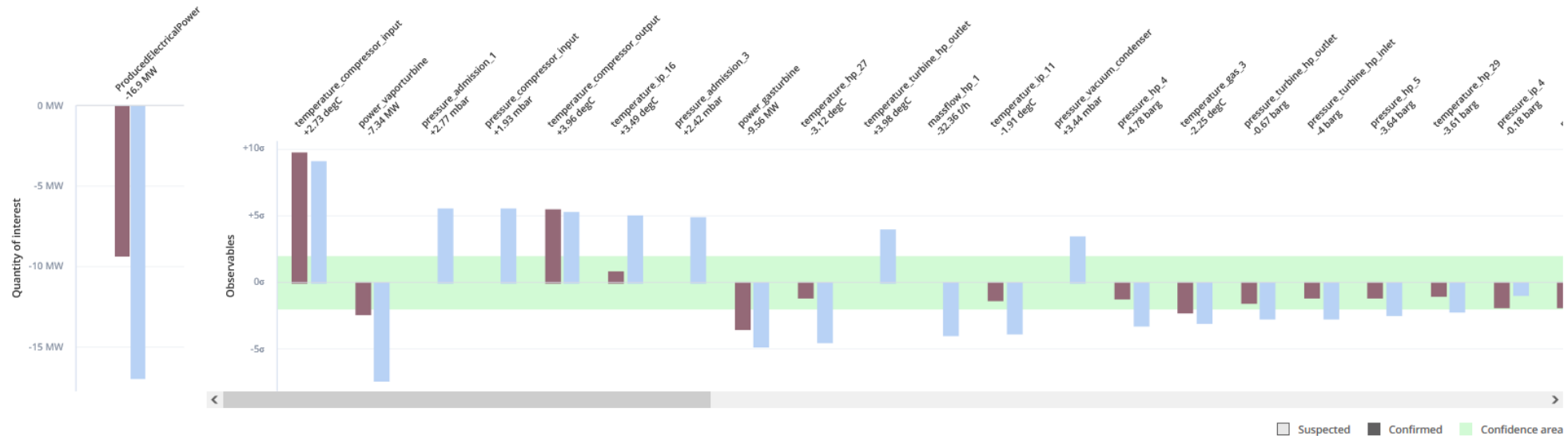
## Signature of the Inlet Bleed Heating (IBH) valve opening

Focus on the selected analysis (Mar 6, 2015, 04:40:00 PM)

Decreasing A-Z

Flag selected quantities

- Symptom
- Remaining symptom
- condenser\_underperfo...
- filter\_fouling\_2
- IBH\_opening
- ST\_leakage





# Blénod CCGT – Diagnostics Example

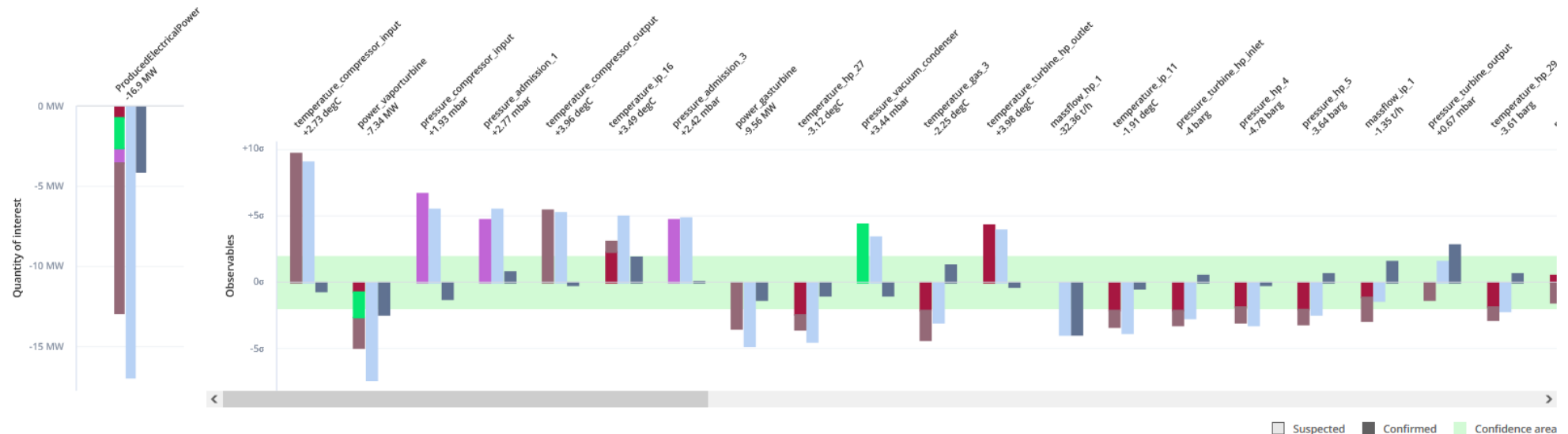
Full diagnostics (cumulated signatures of the 4 faults)

Focus on the selected analysis (Mar 6, 2015, 04:40:00 PM)

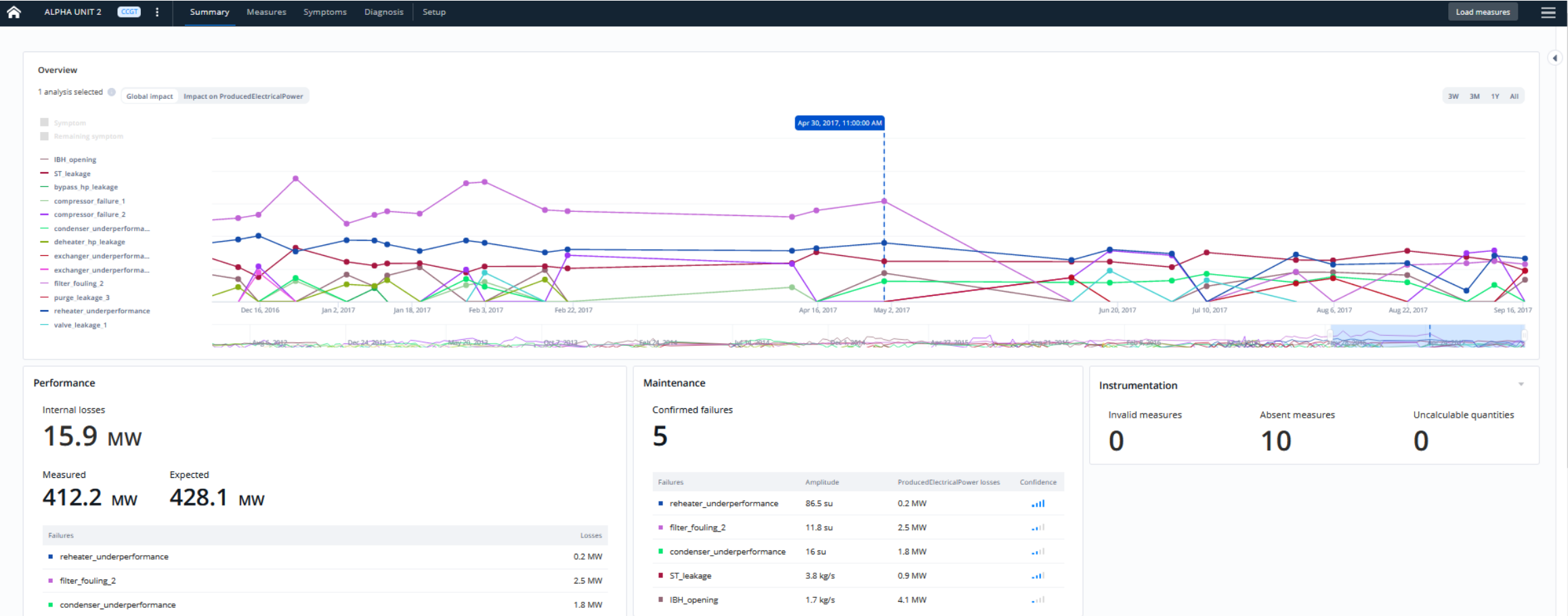
Decreasing A-Z

Flag selected quantities

- Symptom
- Remaining symptom
- condenser\_underperfo...
- filter\_fouling\_2
- IBH\_opening
- ST\_leakage



# 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

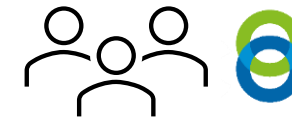
## Metroscope overall:

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

**Corporate**  
asset management, fleet  
supervision



**M&D Center**  
engineering teams  
supporting the operations



**On-site teams**  
maintenance, operations, performance, metrology

# A few facts about Metroscope

**65  
Units**

equipped worldwide

**2000 GWh  
Losses**

detected in 2021, approx  
980 000 tons of CO2

**>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?





[illegible]

This presentation may include predictions, estimates, intentions, beliefs and other statements that are or may be construed as being forward-looking. While these forward-looking statements represent our current judgment on what the future holds, they are subject to risks and uncertainties that could result in actual outcomes differing materially from those projected in these statements. No statement contained herein constitutes a commitment by AVEVA to perform any particular action or to deliver any particular product or product features. Readers are cautioned not to place undue reliance on these forward-looking statements, which reflect our opinions only as of the date of this presentation.

The Company shall not be obliged to disclose any revision to these forward-looking statements to reflect events or circumstances occurring after the date on which they are made or to reflect the occurrence of future events.



 [linkedin.com/company/aveva](https://www.linkedin.com/company/aveva)

 [@avevagroup](https://twitter.com/avevagroup)

#### ABOUT AVEVA

AVEVA is a global leader in industrial software, driving digital transformation and sustainability. By connecting the power of information and artificial intelligence with human insight, AVEVA enables teams to use their data to unlock new value. We call this Performance Intelligence. AVEVA's comprehensive portfolio enables more than 20,000 industrial enterprises to engineer smarter, operate better and drive sustainable efficiency. AVEVA supports customers through a trusted ecosystem that includes 5,500 partners and 5,700 certified developers around the world. The company is headquartered in Cambridge, UK, with over 6,500 employees and 90 offices in over 40 countries.

Learn more at [www.aveva.com](https://www.aveva.com)

“Quotes really stand out on backgrounds like this.  
Lorem ipsum dolor sit amet, consectetur  
adipiscing elit, sed diam nonummy tincidunt ut  
laoreet dolore magna aliquam volutpat.”

Quote Credit