Live Performance Modelling of Energy from Waste (EfW) Facilities' ACCs to Optimise Cleaning Regimes and Maximise Electricity Generation

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Process Optimisation

31/07/2024

suez

Summary

1. **SUEZ R&R UK**
2. **Technical Team**
3. **Energy from Waste**
   Introduction to the process
4. **Air Cooled Condensers**
   EfW impacts & variations in the fleet
5. **ACC Efficiency Model**
   The concept, development, and visualisation with site case study
6. **Roll-Out to Fleet**
   Alternative waste management technologies
7. **Challenges**
   Operational variation & instrumentation inaccuracies
8. **Future Applications**
   Decarbonisation of EfWs & predictive monitoring

SUEZ recycling & recovery UK

- We are a **RESOURCE MANAGEMENT** company - not a power generation company
- **OPERATE & MAINTAIN** EfW facilities for municipal customers (e.g. Local councils)
- **11** UK Energy from Waste Plants
- Turn **WASTE** into local source of **RENEWABLE ENERGY**
- Plant waste processing capabilities range from **55kT** to **500kT** per annum
- Electrical generation capability ranging from **4MW** to **50MW**
- SUEZ UK **TOTAL** EfW generating capacity is **233 MW**
- Circa **2.5MT** of household & commercial waste processed per annum
- **>1.4 MILLION MWh** electricity generated every year

SUEZ recycling & recovery UK

TECHNICAL TEAM provide technical support to all operational sites within the business – both processing & energy

ASSET MANAGEMENT

- Life cycle analyses
- Root cause analyses
- Implementation of universal asset management standards

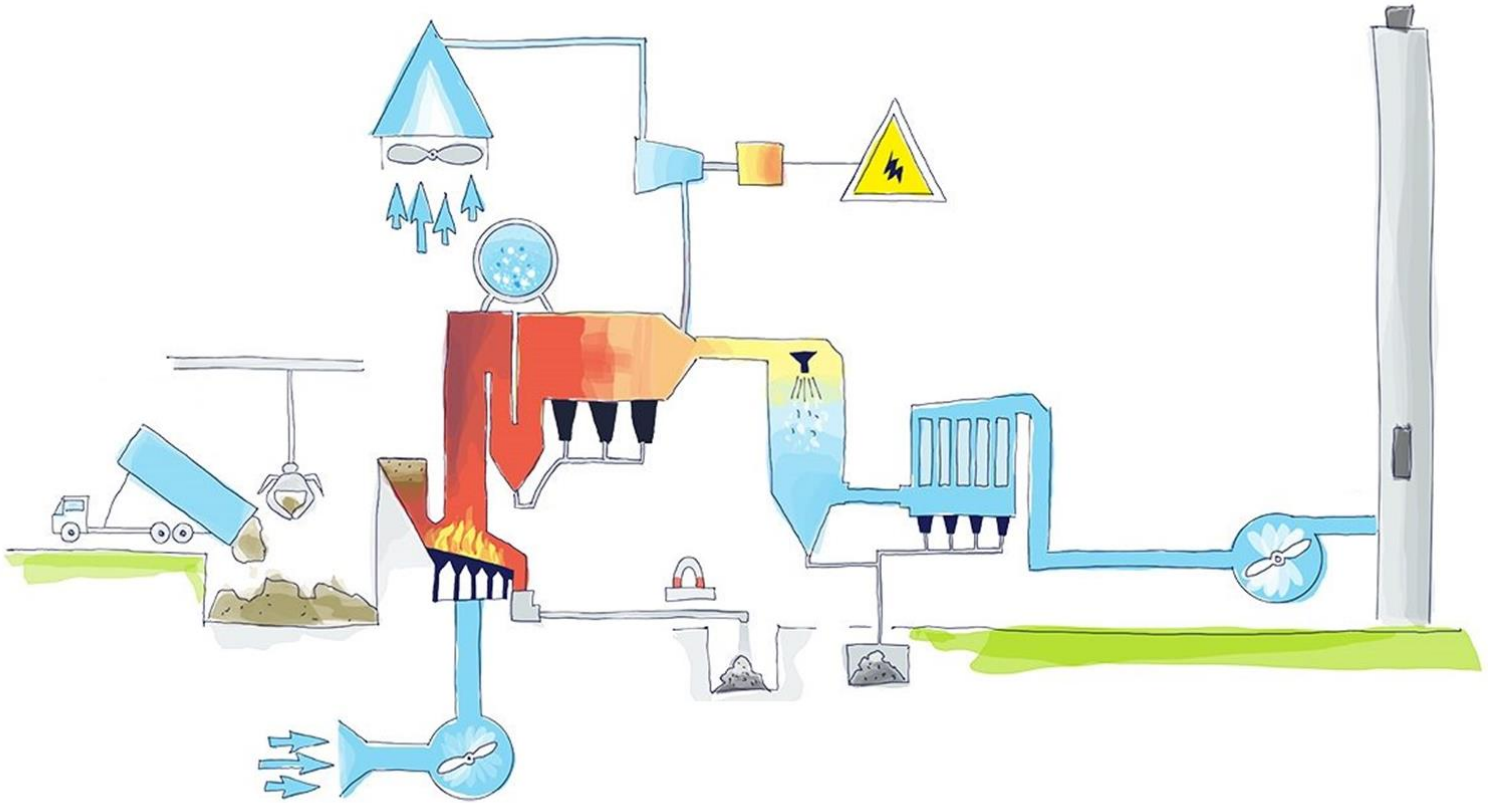
ENGINEERING

- Mechanical, electrical, control & instrumentation support
- Outage inspection & reviews
- Commissioning test procedures

PROCESS OPTIMISATION

- Process analysis & design support for existing and emerging technology
- Information visualisation & trending
- Troubleshooting of process issues

Energy from Waste



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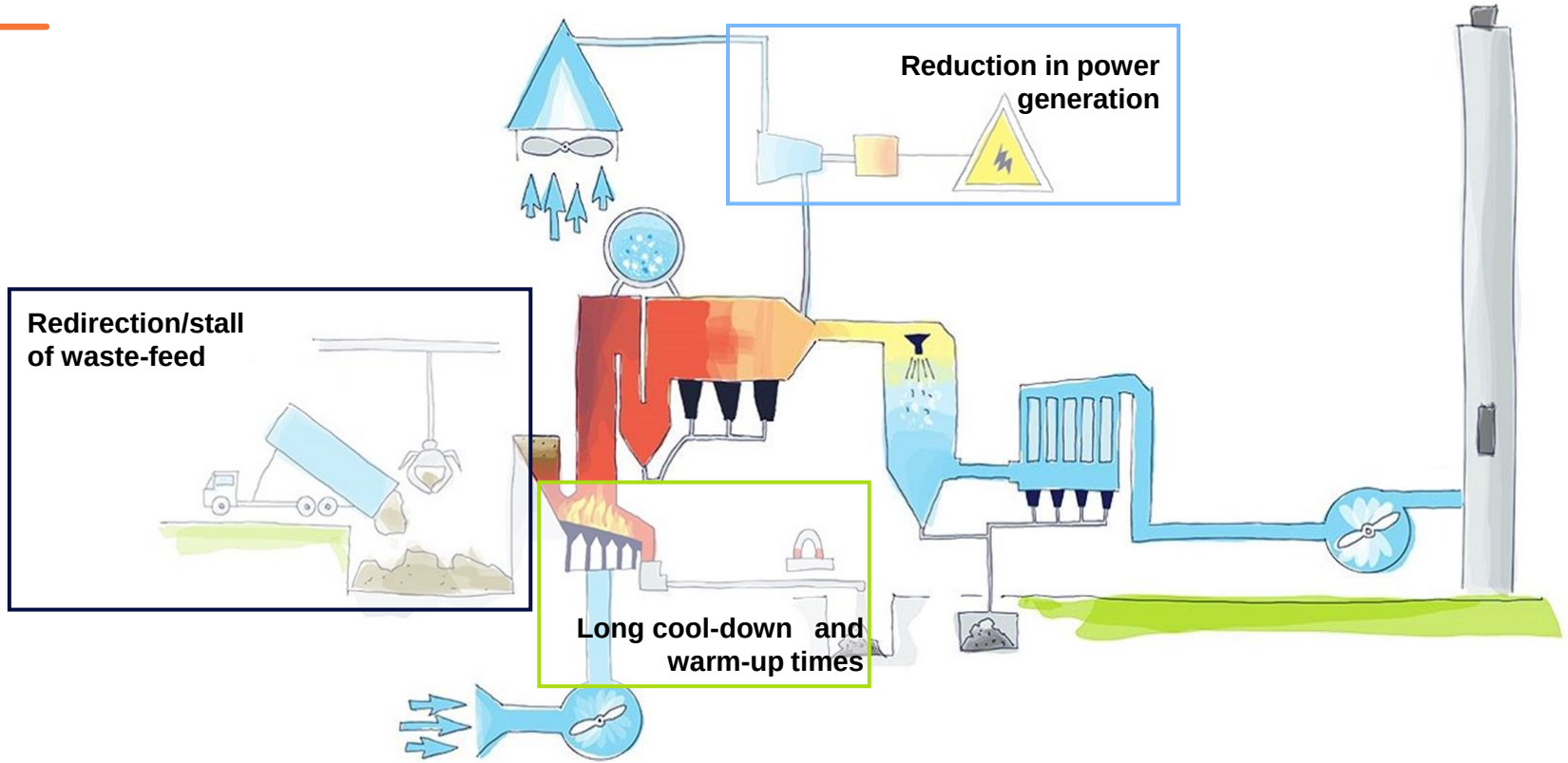
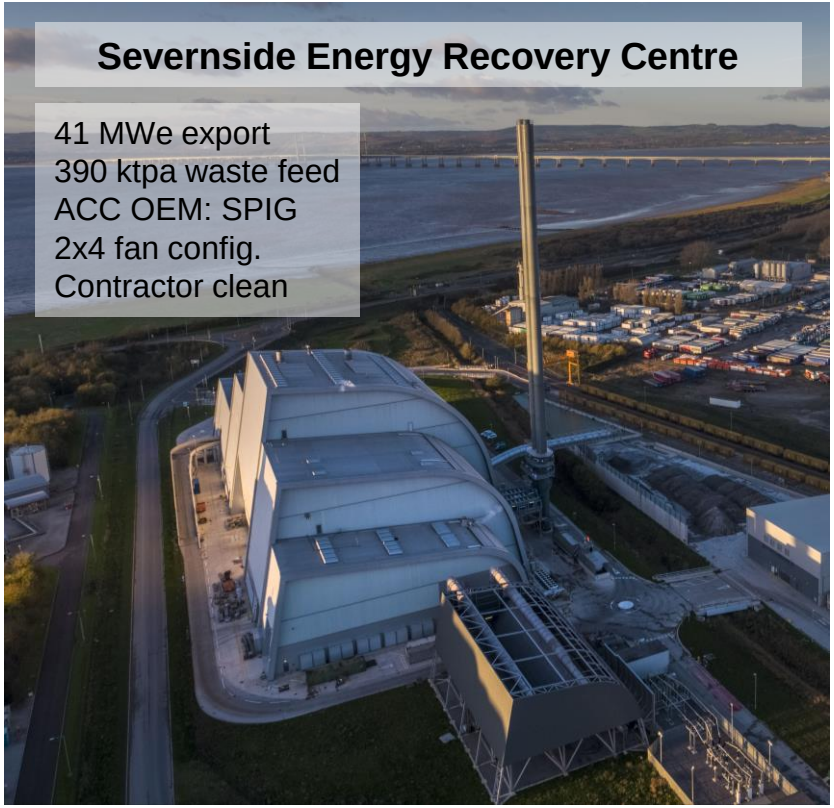


Variation & Challenges in ACCs within our Fleet



DESIGN VARIATION

- Different ACC OEMs
- Cooling requirement differs site to site
- Array determined by site layout

CLEANING/FOULING OPTIONS

- Semi automated clean systems or contractor cleaning
- No means of evaluating efficacy of cleans

RELAYING OPERATIONAL KNOWLEDGE/CONCERNS TO MANAGEMENT

- Identifying performance degradation
- Identifying efficacy of preventative maintenance routines

Variation & Challenges in ACCs within our Fleet

Suez Tees Valley 4&5 (STV4&5)

26 MWe export
386 ktpa waste feed
ACC OEM: SPIG
1x4 fan config.
Semi-automatic clean

Kirklees EfW

12.5 MWe export
136 ktpa waste feed
ACC OEM: Howdens/Lurg
1x2 fan config.
Contractor cleaning

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ACC EFFICIENCY MODEL

Modelling ACC Performance to:

- **Improve cleaning schedules**
- **Identify unit defects**
- **Increase MW generated**

31/07/2024

Tees Valley 4&5 (STV45) – Case Study

MODELLING ACC PERFORMANCE

Across the fleet, fouling of ACC units leads to poor turbine vacuum.

Modelling performance degradation of ACC can improve efficacy of cleaning schedules, and MW generated by the turbine.

⇛ MODEL FUNCTION

Plotting turbine power *drop* via a two-way linear regression model

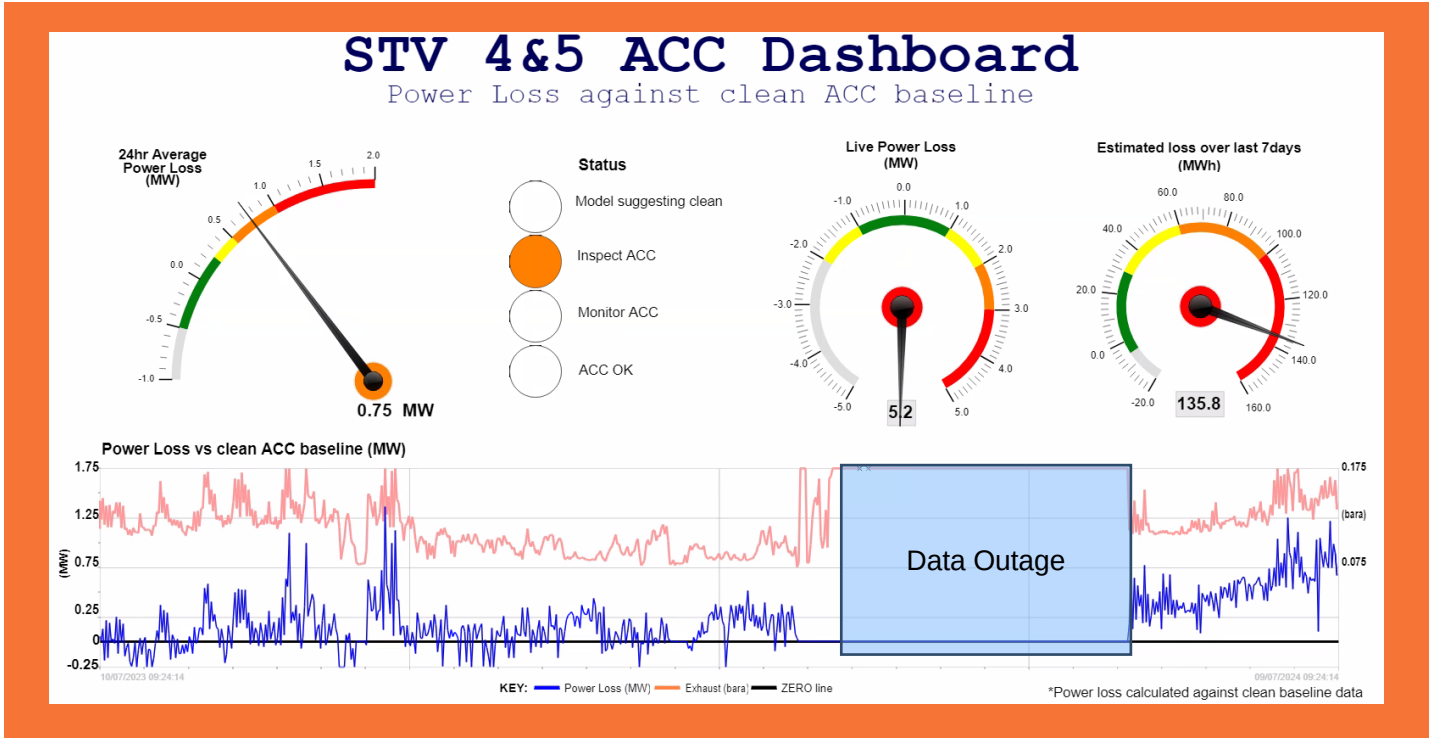
- Model normalised against **external ambient temperature** & **turbine steam flow**
- Output is compared to a best performance baseline – relating to the most successful historic ACC clean

ACC Model - Q2/Q3 2022 STV4&5

Tees Valley 4&5 (STV45) – Live Trending & Visualisation

Data dashboard:

- Visualisations for site engineers
- Separate to DCS
- Empowering data-backed conversations with operations team

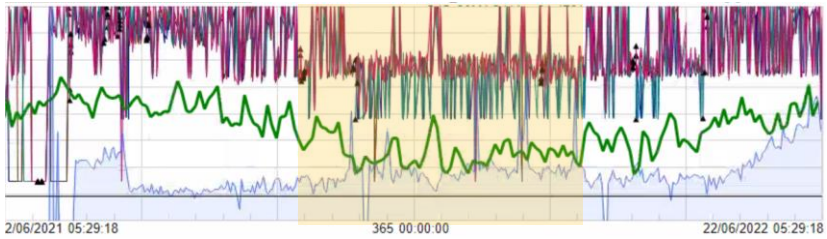


Model development – Iterations & Application

COLD WEATHER OPERATION

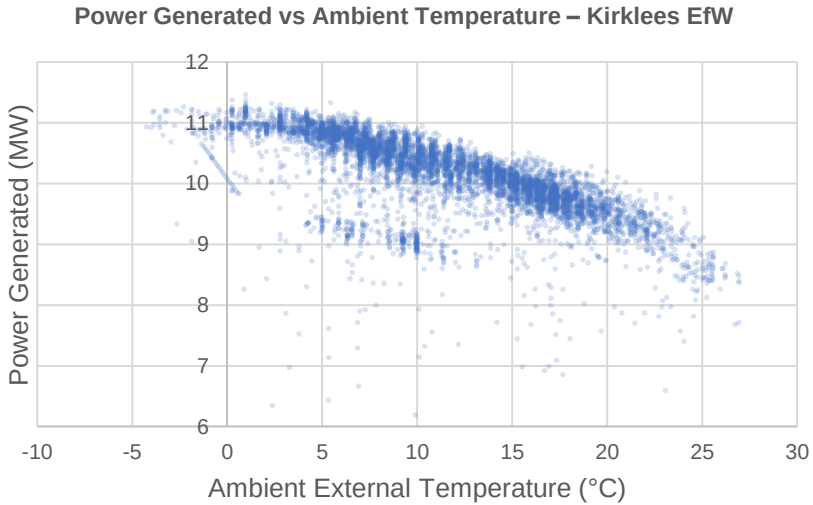
Switch in chosen baseline data, used for:

- ACC motor current ramp down in low ambient temperatures (e.g. STV4&5)
- Clear limit to ambient temperature impact on MW (e.g. Kirklees)



5-WAY LINEAR REGRESSION

- Introducing wind speed, live steam conditions, fan currents
- Application of Gram Schmidt method of six-by-six matrix solving
- Instrumentation concerns for wind speed
- Weak linear relationship for additional parameters



Roll-Out to the Wider Fleet

EcoPark Surrey – Gasifier & Anaerobic Digester (AD)

ECOPARK SURREY GASIFIER

Model roll out to differing facility technology

ACC cleaning typically via contractor clean, with no existing monitoring of ACC performance

⇛ **SPECIFIC MODEL FUNCTION**

Identifying quality and efficacy of cleaning (semi-automatic vs contractor), despite:

- Intermittent operation of site
- Particulate dense environment (proximity to AD & Household Waste Recycling Centre)

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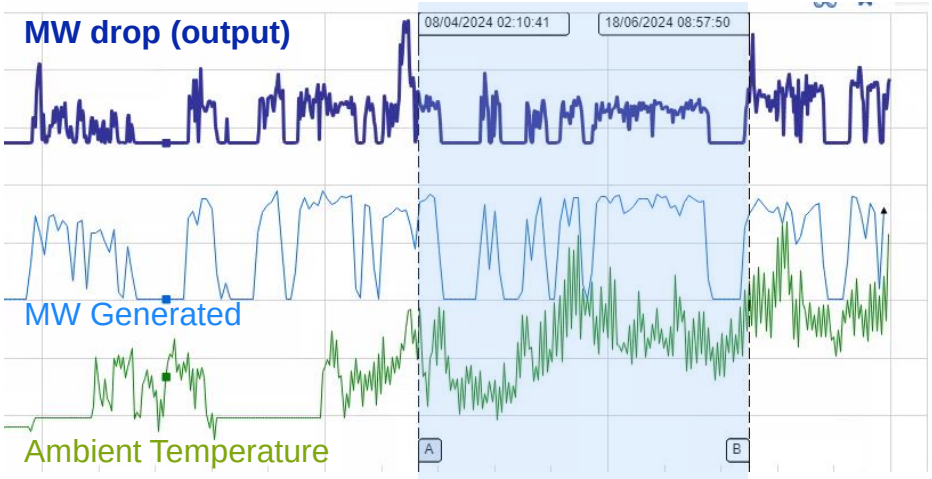

A) Semi-automatic clean system utilised

B) Contractor clean conducted (during outage)

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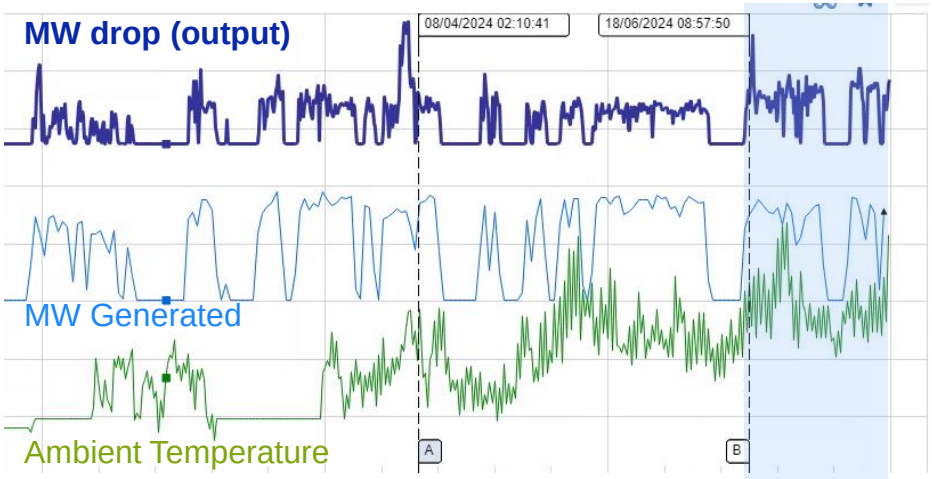

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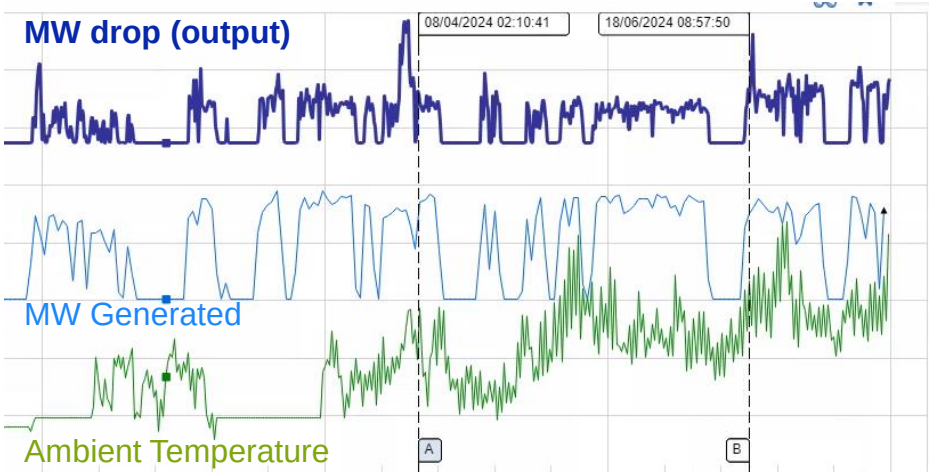

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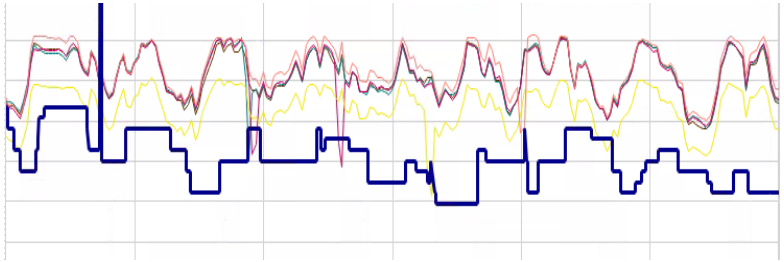
Challenges – Application to Different Modes of TGU Operation

Awaiting **turbine upgrades**, Suffolk Energy Recovery Centre would **change its turbine exhaust pressure set point** to mitigate overloading ACC



Blue: Turbine backpressure setpoint (summer 2023)
Pink/Purple/Yellow: ACC fan motor currents

- MW generated already at max output
- Modelling MW drop not an effective method – no drop occurring for increased fouling

- Turbine modifications now complete
- **Application of new model possible once ACC clean completed**

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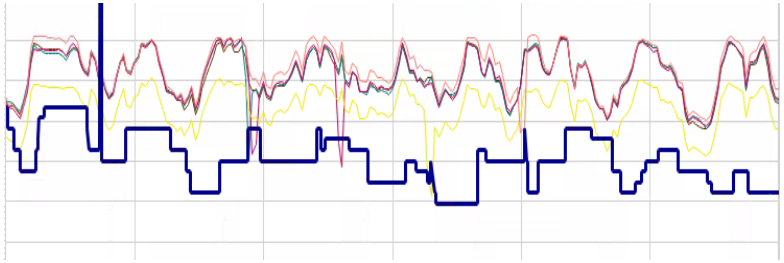

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Challenges – Instrumentation Inaccuracies

- Ambient temperature probes not typically on maintenance routines
- Not previously identified as control elements
- Not installed in appropriate locations (proximity to vents, sun spots, wind tunnels)

Variations of up to 15°C from local weather station readings

Future Applications at SUEZ R&R UK

DECARBONISATION – CARBON CAPTURE

Cooling duty of 1.5 - 1.8 MW/tCO2 required for retrofit carbon capture

- Water cooled condenser solutions **geographically limited**
- **Air cooled or hybrid solutions** preferred by legislators
- Deteriorating ACC performance has potential to impact future **environmental compliance**

NEAR FUTURE – PREDICTIVE MONITORING

- Monitoring of mechanical systems via **predictive clustering algorithms**
- In conjunction with process models
- Big picture of asset health – guiding preventative maintenance routines

THANK YOU

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