EMPOWER YOUR ANALYTICS WITH OPERATIONAL DATA

Predictive Analytics

Neil Jelley, Digital Programme Manager, Genesis Energy

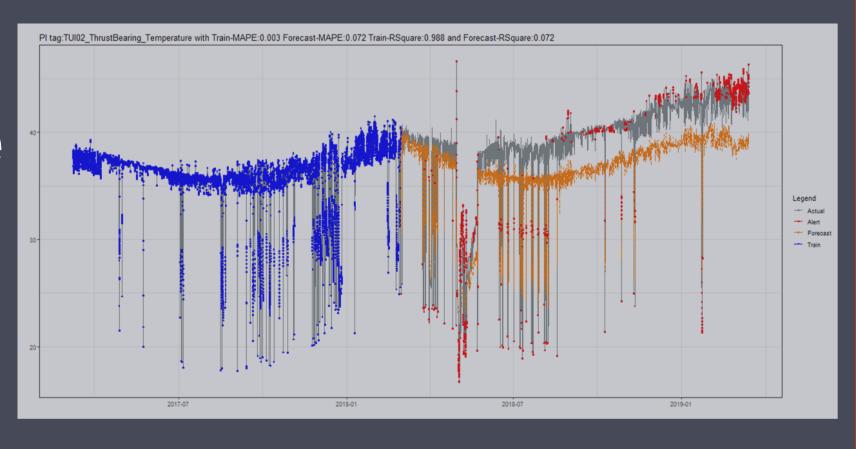
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Predictive Analytics



Neil Jelley
Digital Programme Manager
Genesis Energy



Genesis Energy

- Both a Generator and a Retailer of electricity
- Retail side ~ 500,000 customers

Genesis Energy

Energy Online

Generation side ~ 1600 MW

One thermal site (coal, gas – combined and open cycle)

Seven hydro stations (North and South island)

One wind site (plus a partnering one)









Genesis Journey

2017 – workshop to identify what data we have and how we can be more effective with it/assist with decision making identified the potential.

2017 through 2018 - recognised in-house data science capacity

2018 – data warehouse project – PI Integrator was a key

End of 2018 – investigate predictive analytic options (external software vs internal capacity)

2019 – decided to commit to in-house platform and focused BC Hydro resource on it

What resources we've relied on

- Open source software
- PI Integrator, Microsoft Azure Datawarehouse
- Data scientists, data architects/engineers, generation engineers











How did PI System fit in?

— PI Server Asset Framework (AF) and PI Integrator

- Data warehouse' project combining all high use generation related data into one location
- PI Historian was key dataset
 - existing method could give us 10 minute data
 - managed by IT consultant
 - have to request what tag, what type of calculation; average, total, point in time etc and there is a cost per request
- PI System has a product that can now do this process which we can then manage internally with much less constraint – PI Integrator
- Integrator requires PI Server Asset Framework so this was another necessary step to for us

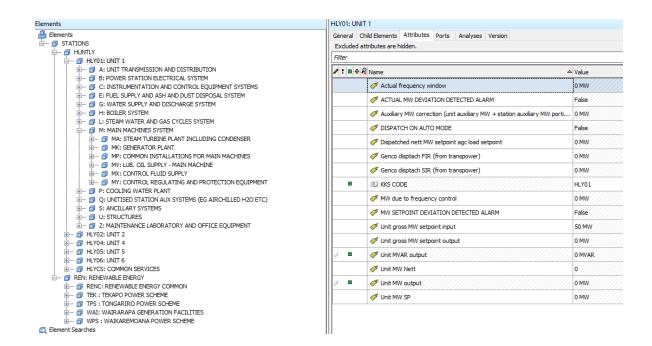




PI Server Asset Framework



- PI Server Asset Framework was necessary for the integrator – we hadn't used it before
- Duplicated existing Maintenance Management System (Maximo) hierarchy for the Asset Framework hierarchy
- Dimension Software aligned PI tags into structure
- PI Server Asset Framework also has a lot of potential that we are not using at this stage

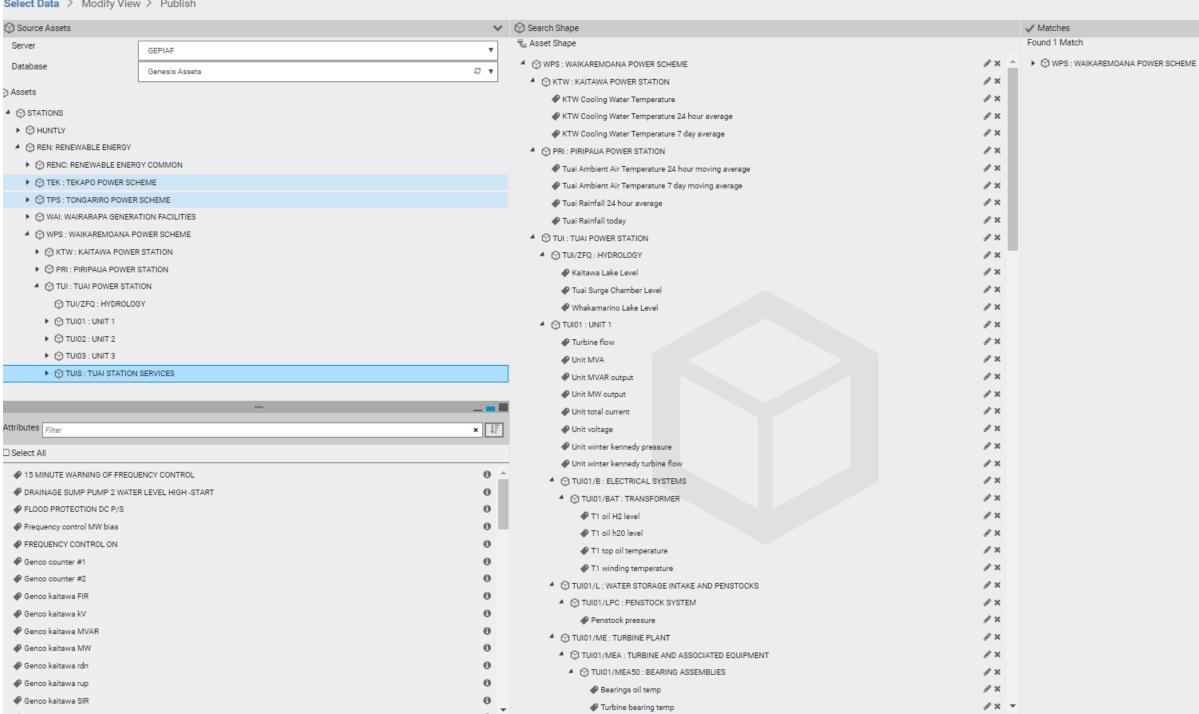


PI Integrator



- Utilises AF hierarchy
- Pull in necessary tags
- Define interval and data context (eg average, min, max)
- Writes data to Generation data warehouse
- Data can be scheduled or single load
- For us writes to Azure Datawarehouse but there are other options (Amazon, Microsoft, Oracle, flat file)

Select Data > Modify View > Publish Source Assets Server GEPIAF Database Genesis Assets



10.197

10.197

10.198

10.198

10.199

19.564

19.566

19.551

19.570

19.574

32.900

32.900

32.700

32.800

32.800

42.195

42.216

42.238

42.252

42.262

37.823

37.839

37.846

37.824

37.802

9.832

9.838

9.841

9.863

9.802

7.969

8.01

7.96

7.965

1/01/2016 4:30:00 PM 1/01/2016 5:00:00 PM

1/01/2016 5:30:00 PM

1/01/2016 6:00:00 PM

1/01/2016 6:30:00 PM

-2.234

-2.201

-1.834

-2.057

-2.3

11.235

11.236

11.236

11.237

11.238

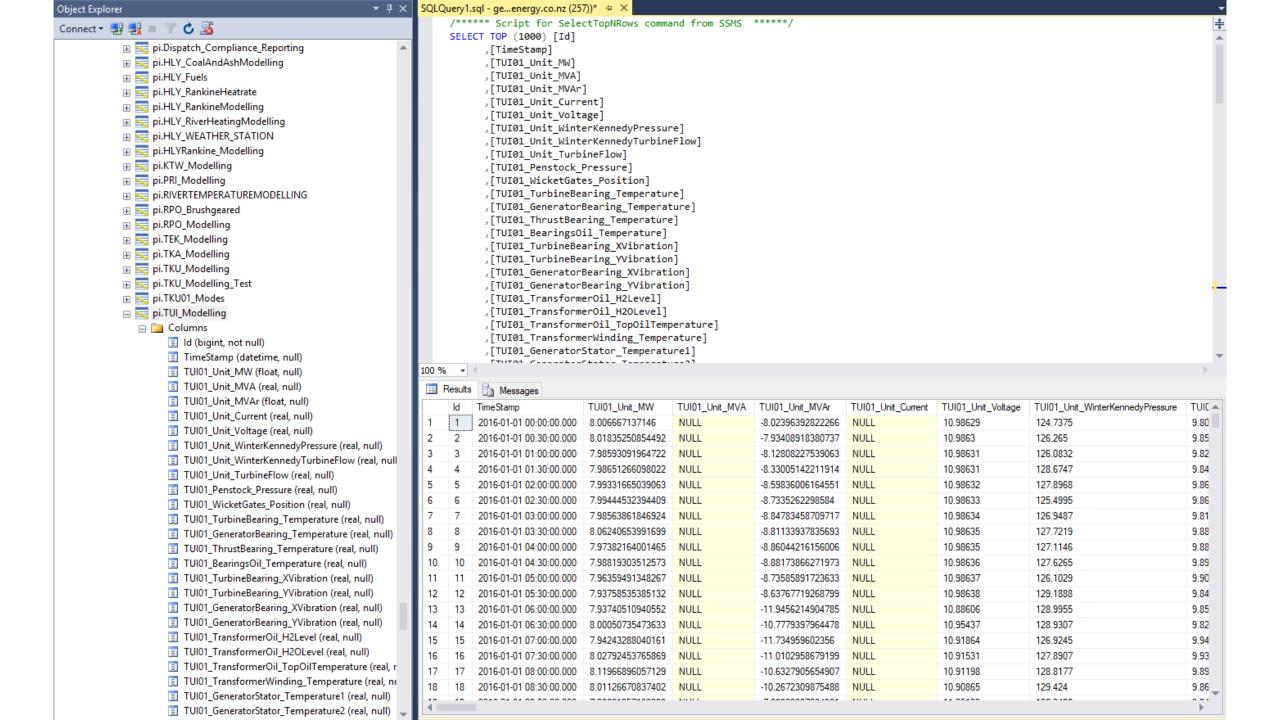
129.986

128.523

126.848

129.277

127.422



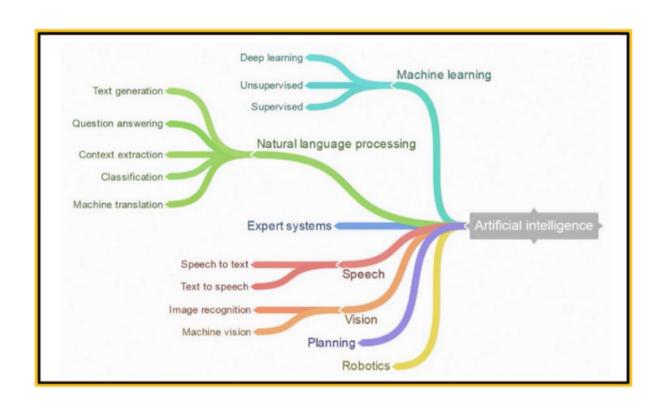
Artificial Intelligence, Machine Learning, Predictive Analytics



- Artificial intelligence (AI) Ability to <u>make decisions</u> through interpreting information
- Machine Learning fancy name for data science.
 Learning from data to create a relationship/algorithm.
 Think y = mx + c. Is a subset of AI
- Predictive Analytics Genesis Energy take on machine learning focused on enhancing our maintenance management

Requirements

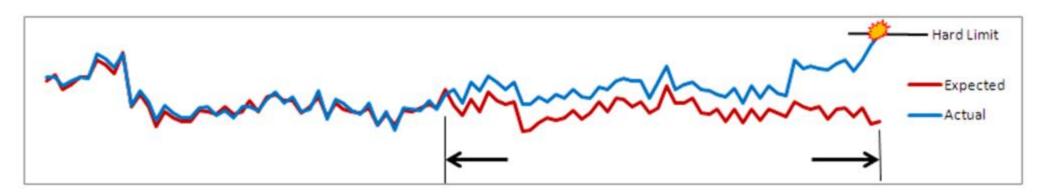
- Data warehouse/historian key
- Other data possibilities CMMS, software diagnostics, market data, weather
- 'Sandbox'/platform to model data/develop algorithms



Predictive Analytics



— Proactively monitoring asset health to reduce cost and increase plant reliability



Benefits/Targets

Reduced Preventative Maintenance Moving from Calendar based to Analytics triggered

It is not...

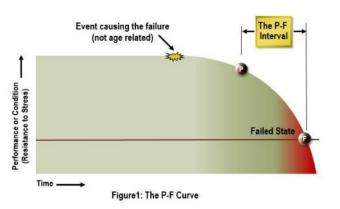
- Replacing DCS/SCADA alarming
- Real time alerting

Reduced Defects

Picking up on defects before they escalate.

Reduced Forced Outages

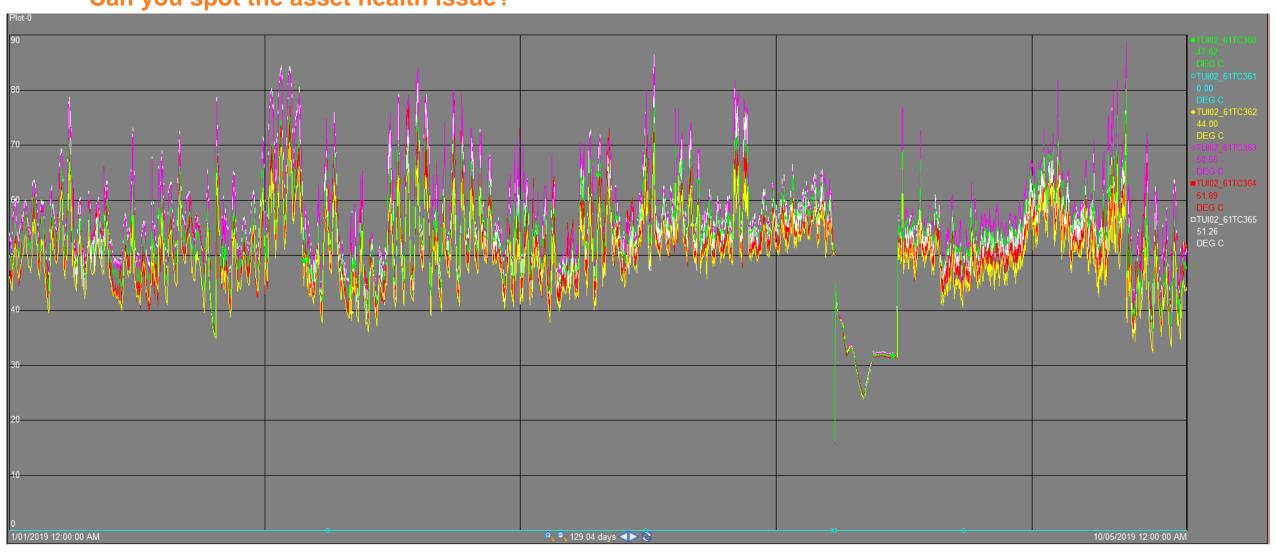
Picking up on issues before they escalate to forced outages.



PI Historian example of tracking Stator Temp

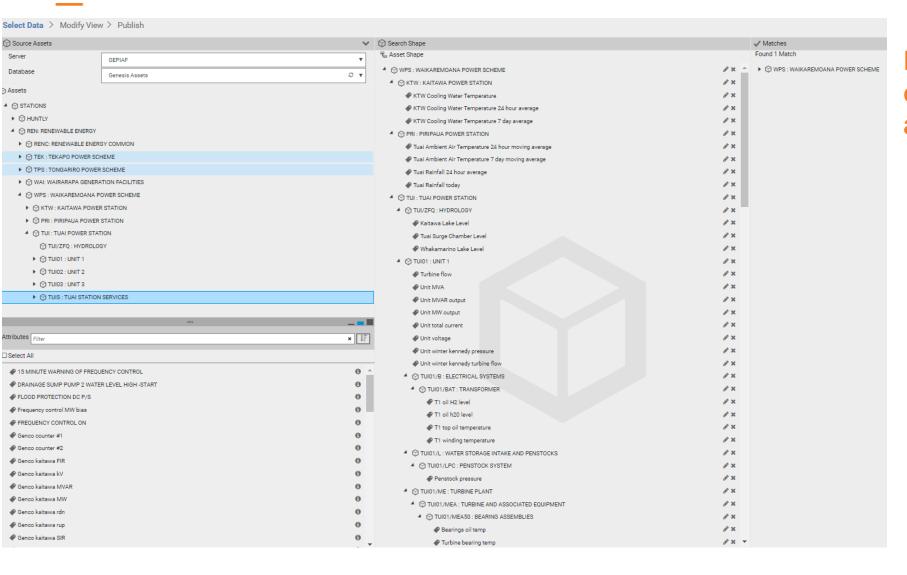


— Can you spot the asset health issue?





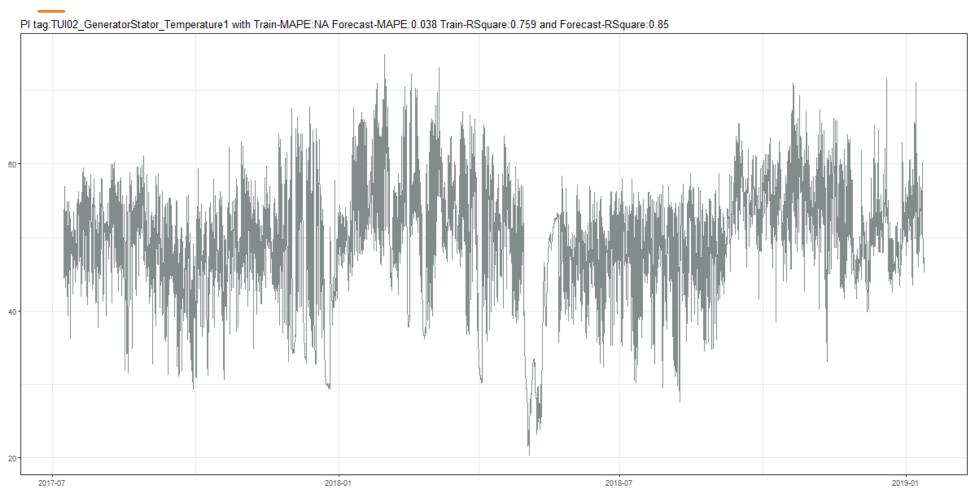




PI Integrator makes the data accessible for analytics in our tool

Our In-house Tool



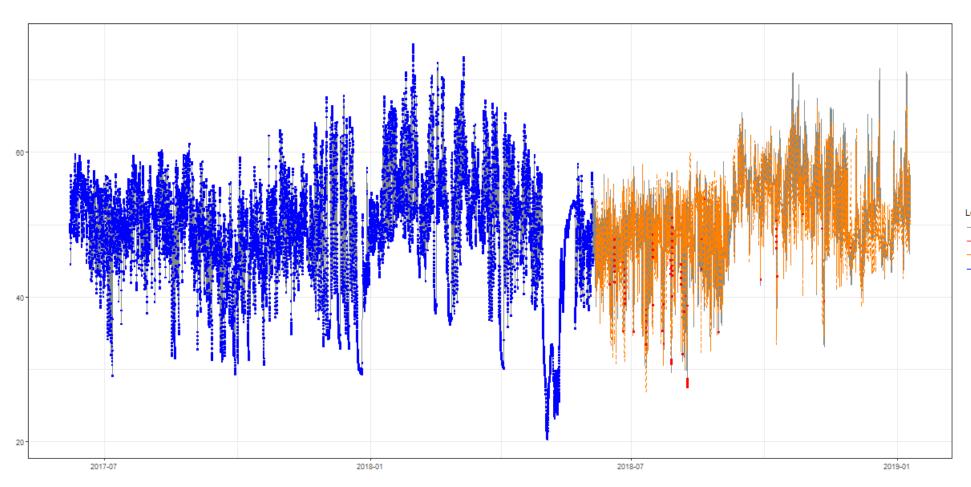


Ability to select input variables, remove unrelated data (eg plant in outage), training periods and forecasting check to validate model

Legend

Generator Stator Temperature

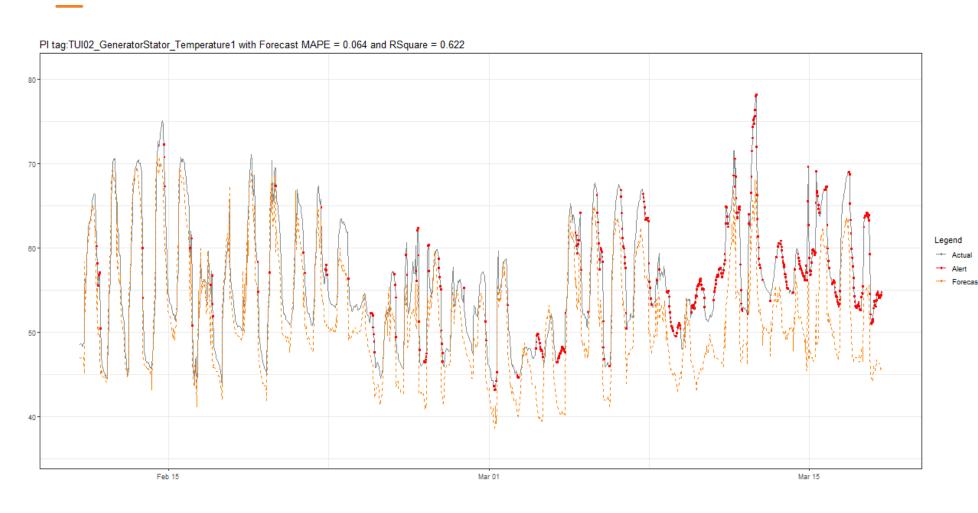




This shows an example of a training period (blue), forecasted period (orange) with a good model fit (3.8% error)

Generator Stator Temperature – With Model



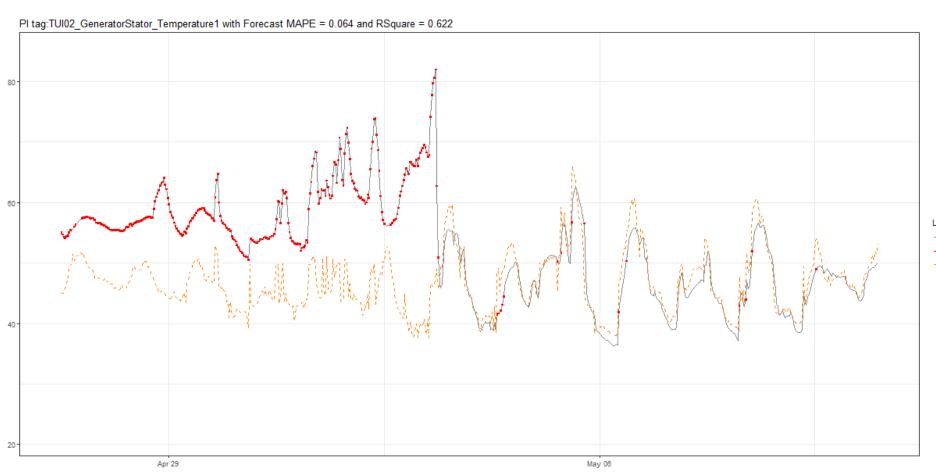


This is the start of the divergence of the actual temperature to the model.

They both start out in sync then the actual temperature starts to rise.

Generator Stator Temperature – With Model





Here the issue was resolved. There was a particularly blocked air filter which meant cooling was limited.

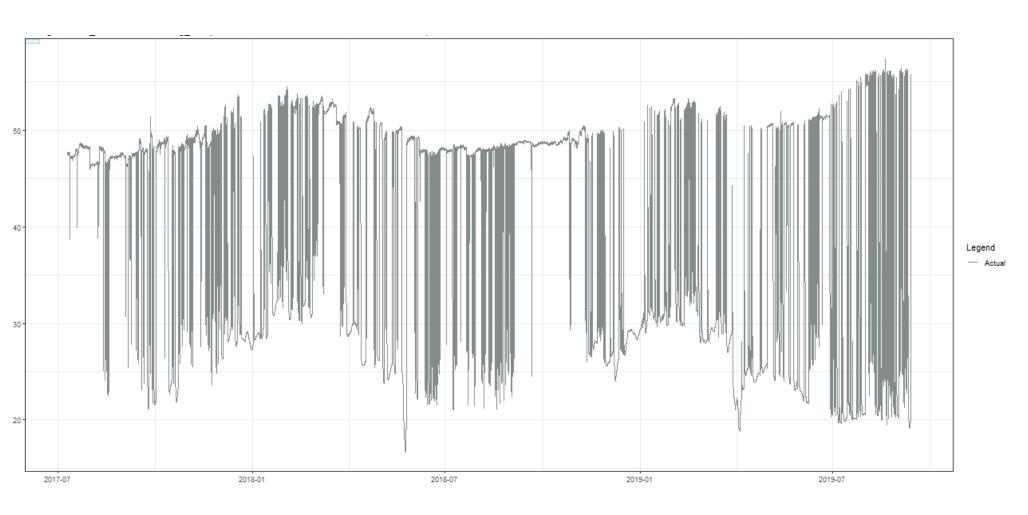
Post repair you can

** Forecast see the model and actual match well

again

Lower Guide Bearing Temperature – Actual Data

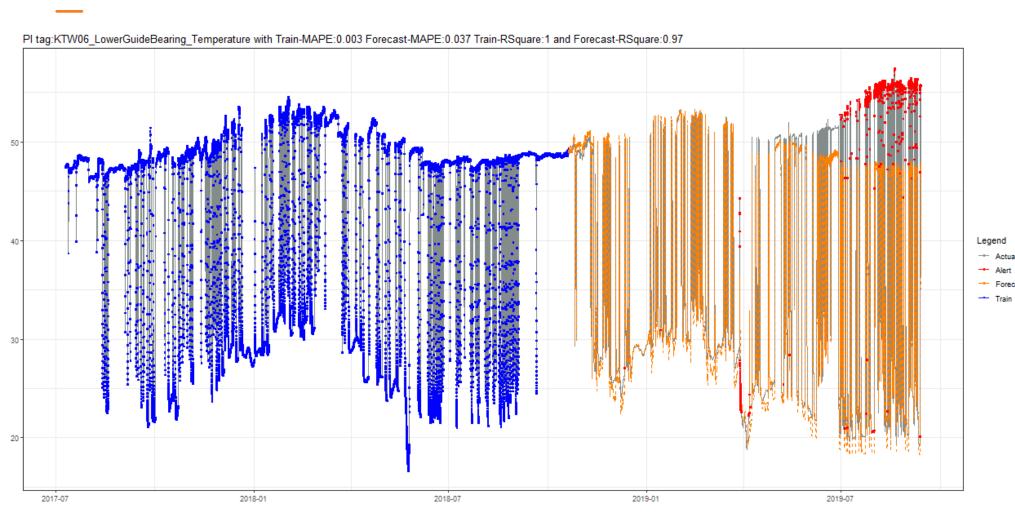




Actual data prior to modelling

Lower Guide Bearing Temperature





This shows an example of a training period (blue), forecasted period (orange), actual sensor data (grey) and alerting (red highlights)

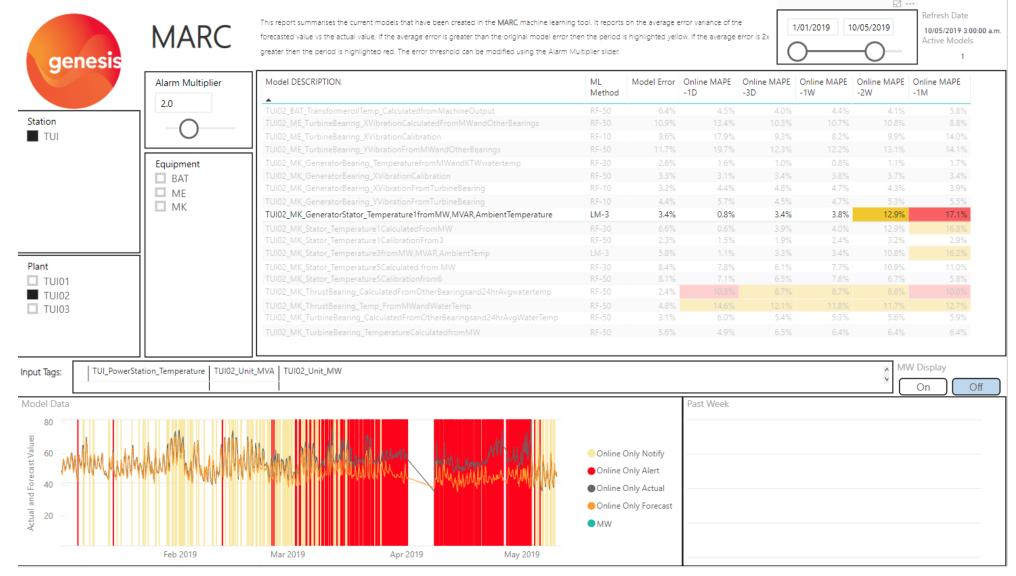












Achievements so far



- Since March built 550+ models
- This has been developed with 50% FTE and predominately internal resource costs
- 28 validated asset health deteriorations/performance monitoring
- Good engineering buy in for ones that have been involved with an issue
- Have a large backlog of potential models still to create

Going Forward



- Proven in-house platform is viable and working for us
- Aiming for 1000 models in year 1 based on most critical assets, historical failures and current work stream of maintenance reviews
- Building the business process on how to manage Model 'alerts' and cultural engagement
- Engaging the Engineering and Operations teams
- Confidence that modelling can replace time based maintenance
- Install more sensors to capture data and fill current data/modelling gaps









Organiser



Co-host