# TASS for Losses Reduction - LEAN Project Outcomes

LEAN | Low Energy Automated Networks

## Losses Strategy Consultation Event

9 December 2019

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Scottish & Southern Electricity Networks

# Plan for this Session

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We'll give:

- an overview of TASS - Transformer Auto Stop Start - and how the system has performed during the trials
- a summary of key project deliverables
- an understanding of the principles for identifying sites suitable for TASS
- a demonstration of the TASS Evaluation Tool used to assess the financial viability of applying TASS at primary substations

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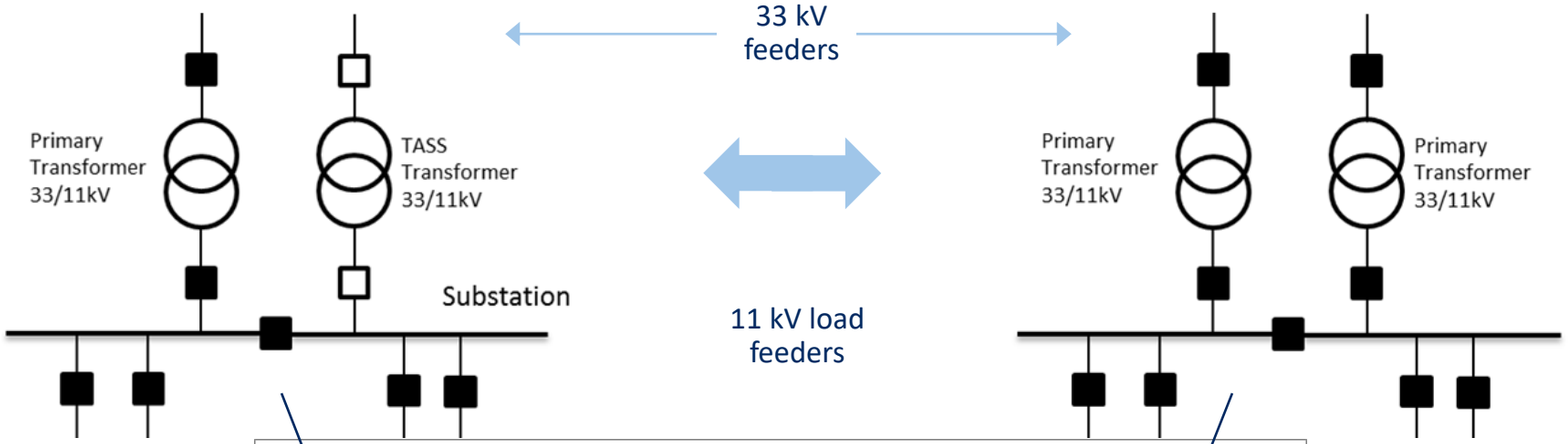
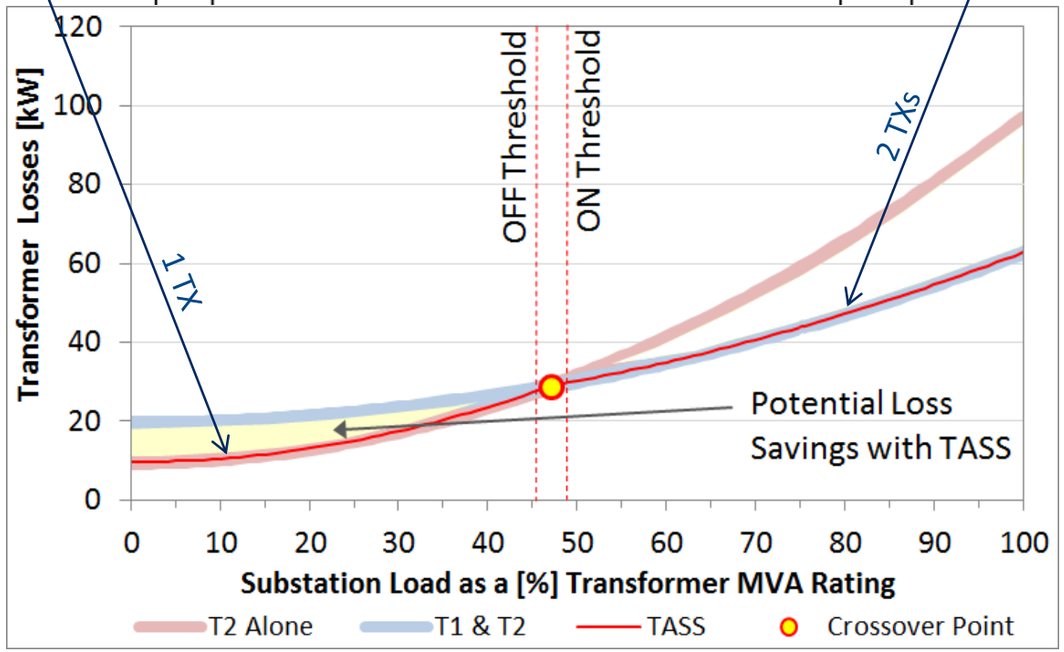
# TASS theory - Transformer Auto Stop Start

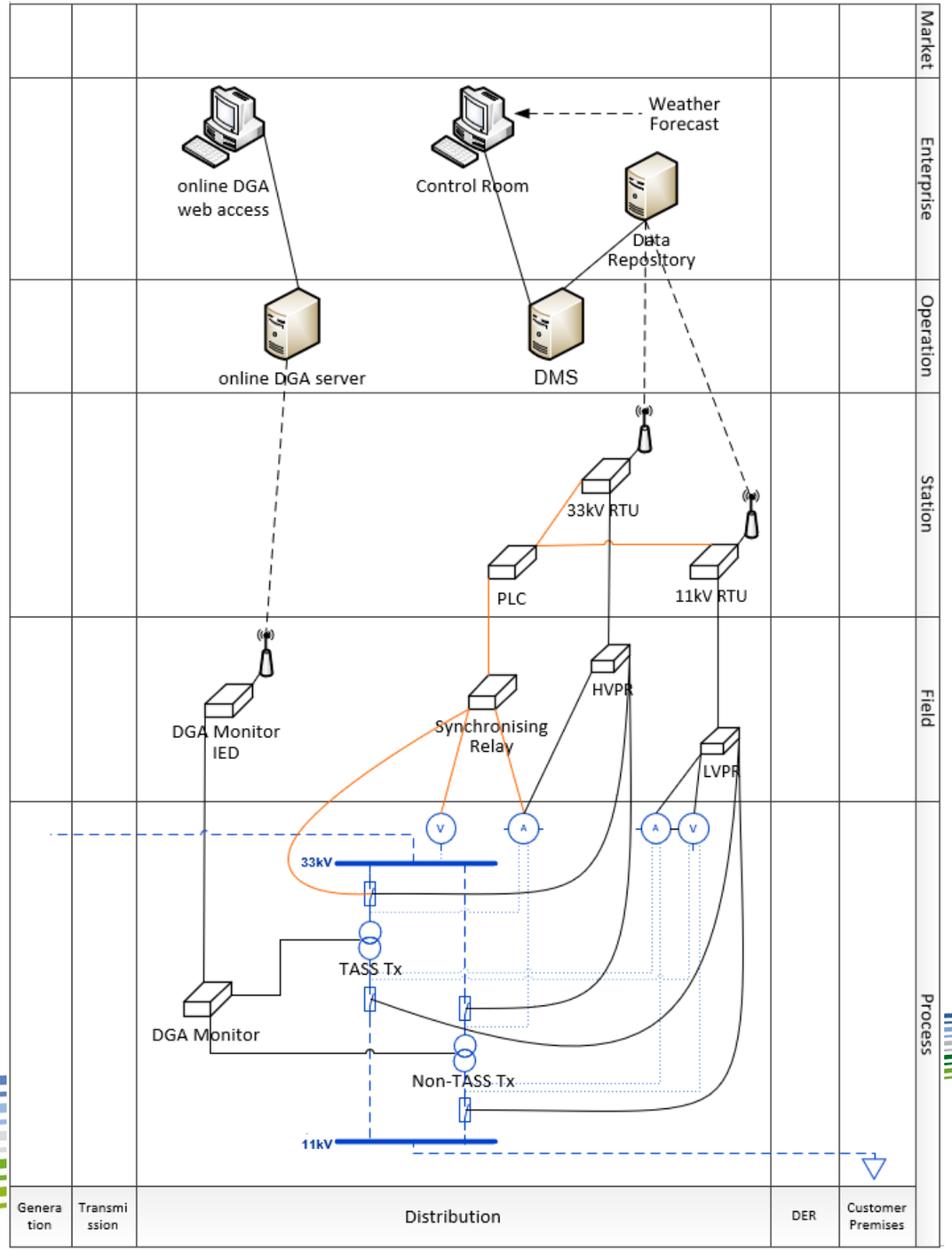



Source: Lean Report, S&C Electric Europe Ltd, prepared for Scottish & Southern Energy Power Distribution

# TASS system architecture

## SGAM
## Component Layer

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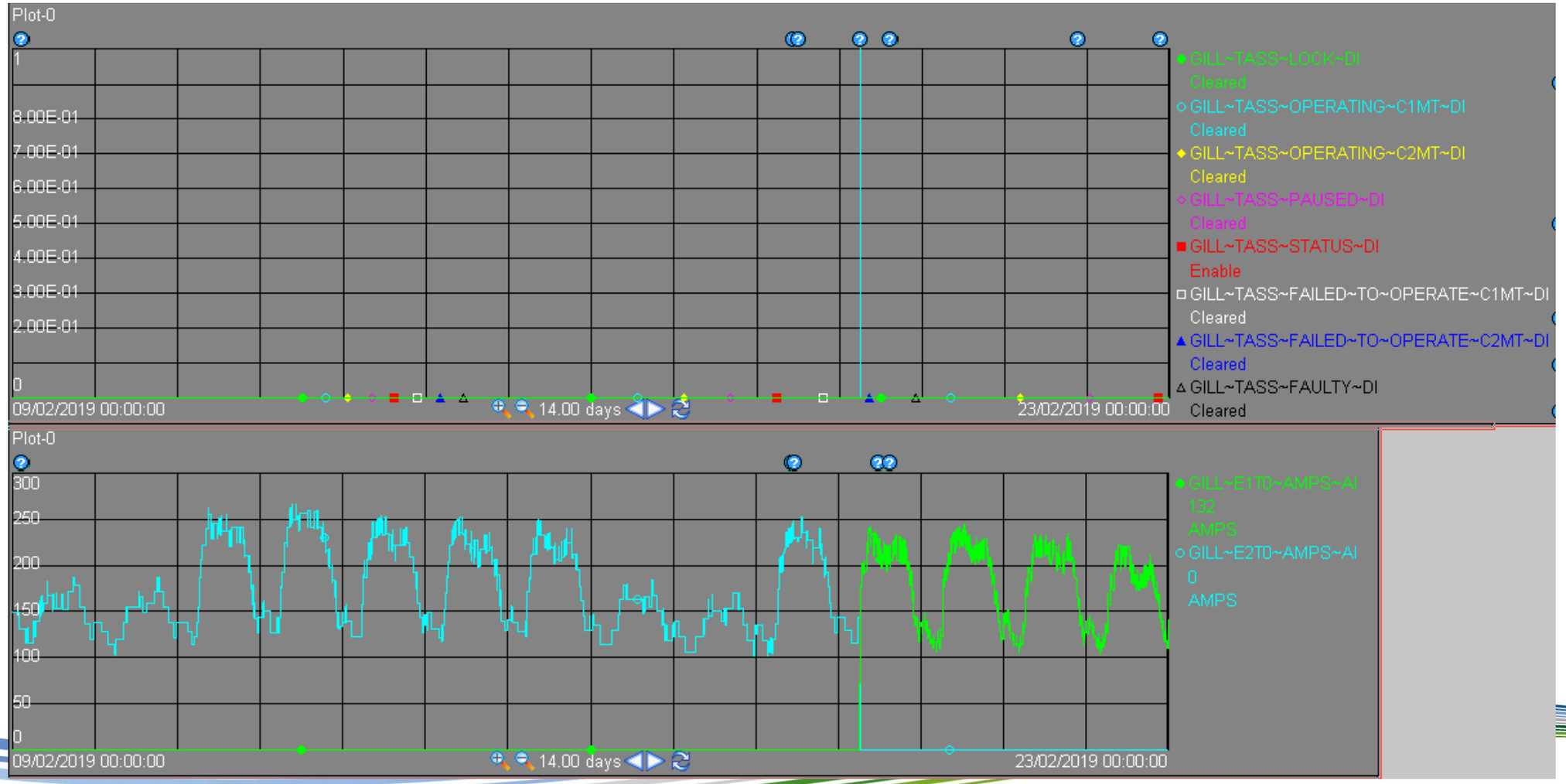
# TASS components

- TASS wall box with Schneider T300 RTU
- SynchroTeq MV POW relay



# TASS operation - 2 weeks - 9th to 23rd February

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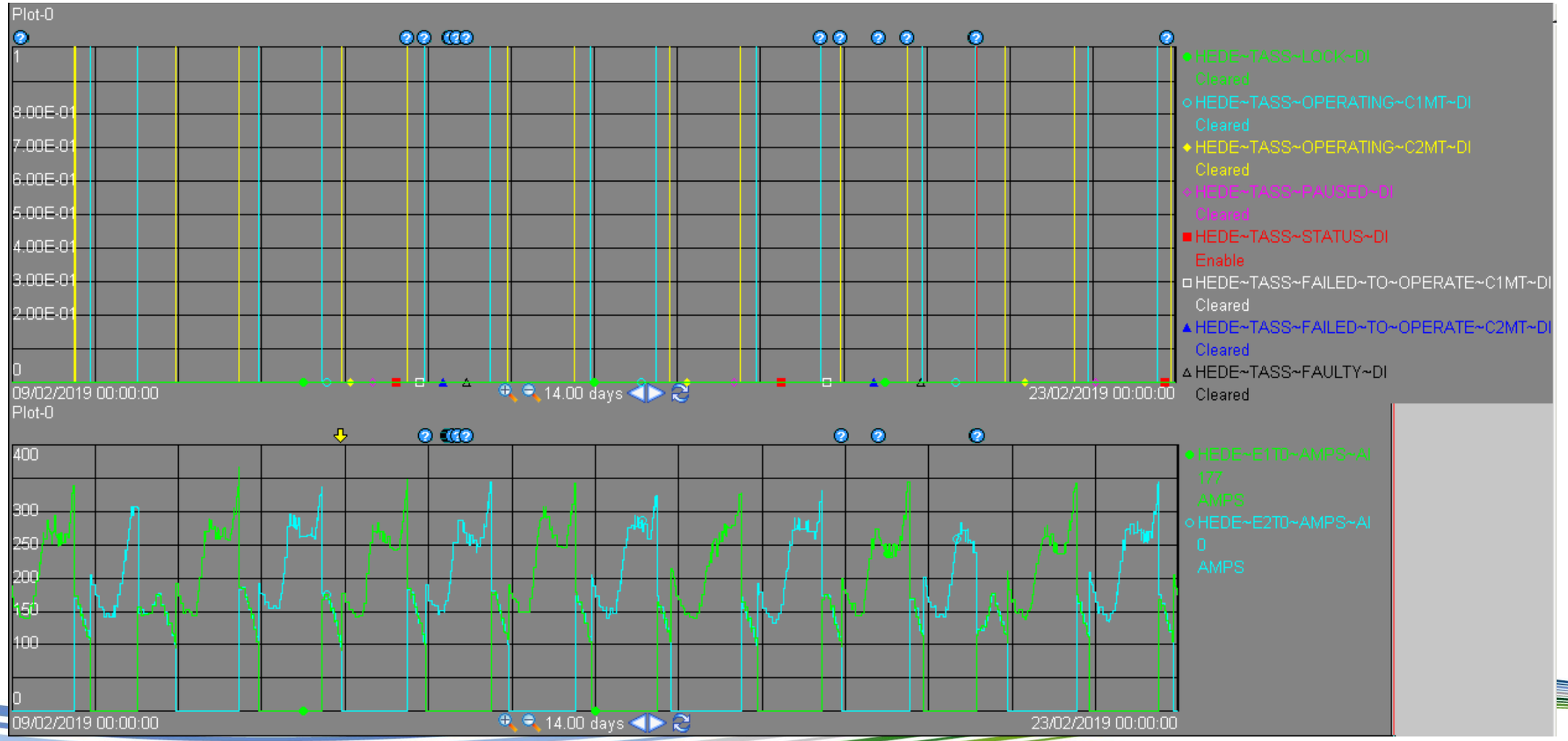


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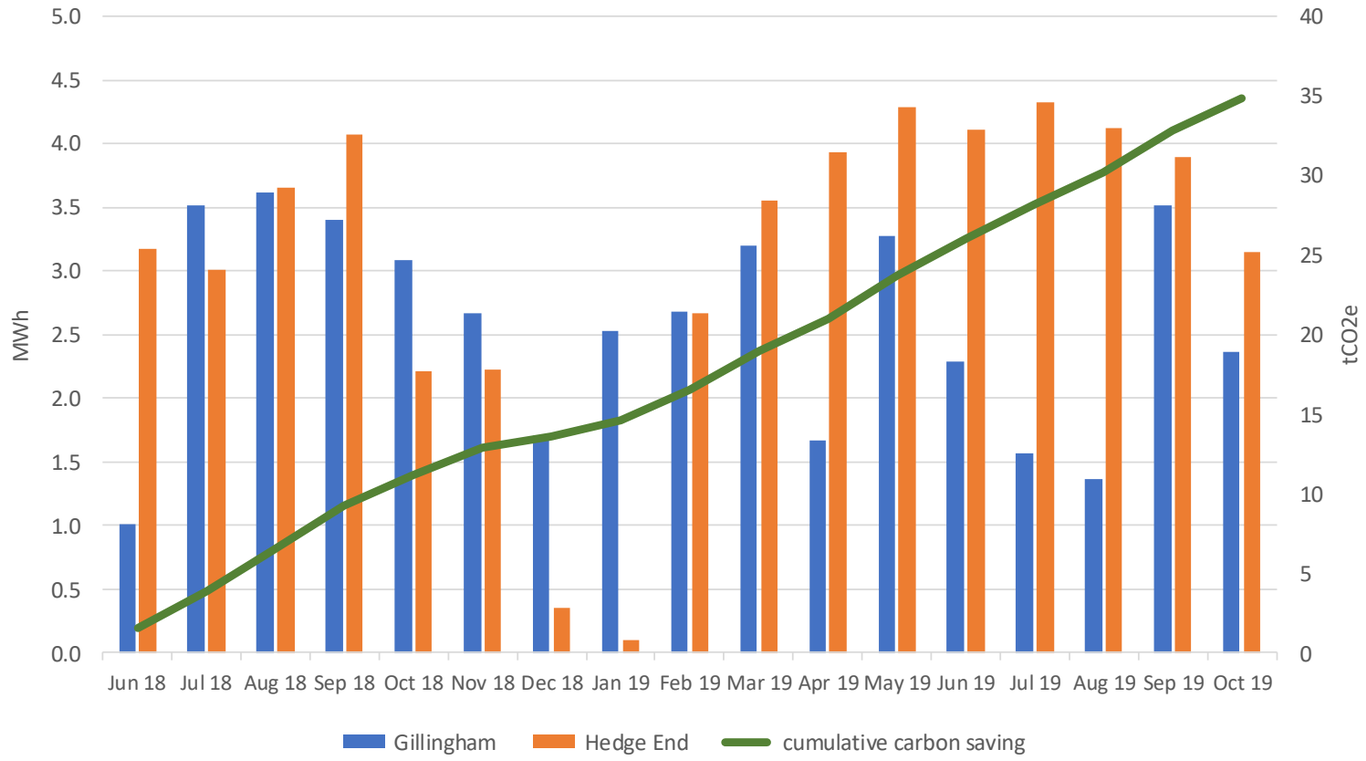
# Losses Savings

- total losses saved since commissioning TASS = **~96 MWh** (June 2018 to October 2019)
- full TASS operation reduces overall transformer losses by **~25-30%**

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# Asset Health

A range of approaches have been used to assess any potential impacts on asset health
- to date, no impacts on asset health due to TASS operation are apparent


- Visual Inspections during site surveys
- Partial Discharge (PD) surveys
- Transformer Condition Assessment Tests:
  - Sweep Frequency Response Analysis (SFRA)
  - Winding Resistance tests
  - Magnetising Current tests
  - Winding Capacitance & Power Factor tests
  - Dielectric Frequency Response (DFR)
- Oil Sampling
- Online Dissolved Gas Analysis (DGA) monitoring
- Power Quality Monitoring

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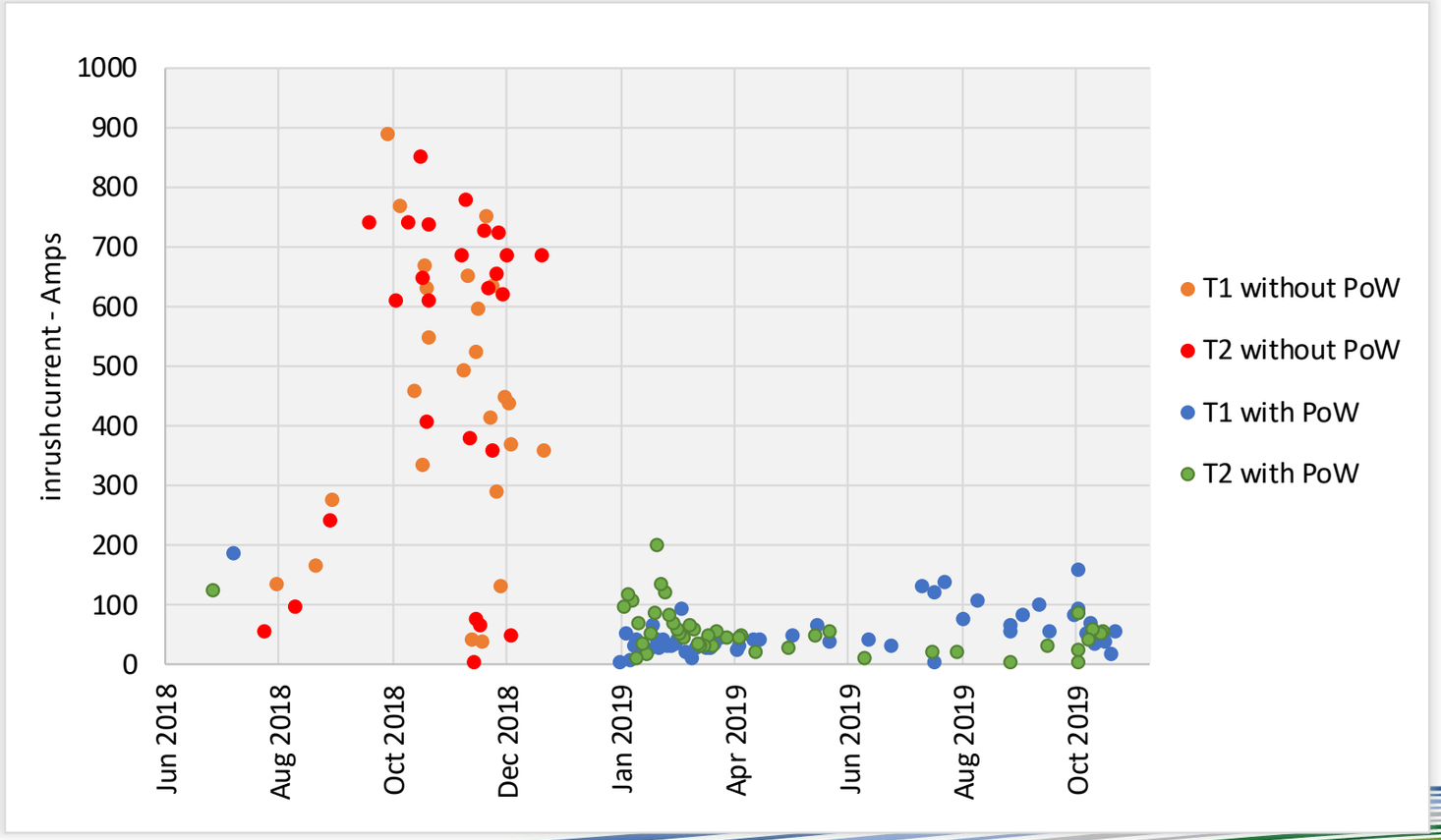
# Power Quality & Point on Wave switching

## Inrush Currents **with** and **without** Point on Wave Switching - Hedge End

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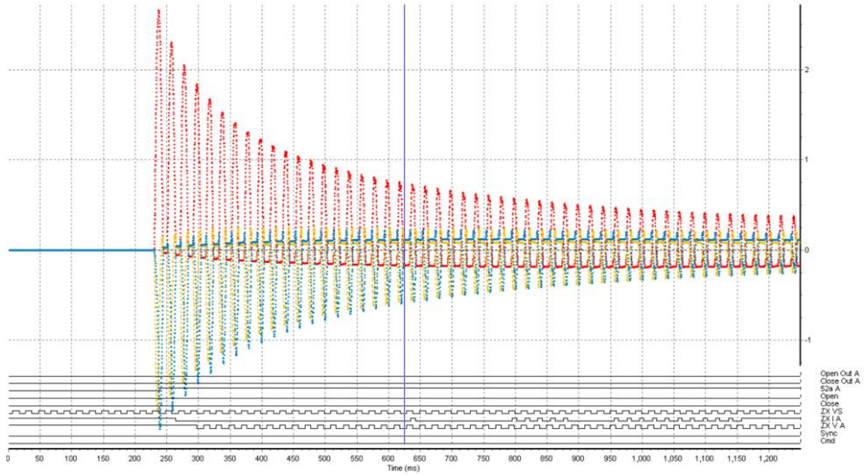
# Power Quality & Point on Wave switching

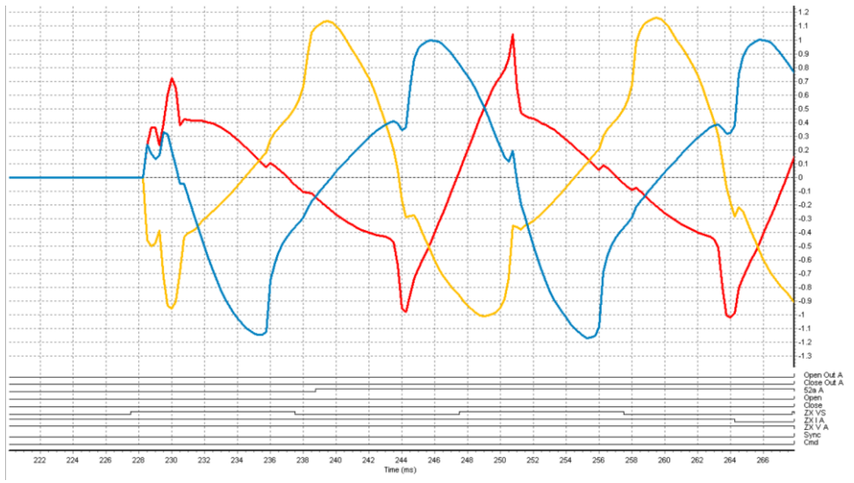
## Highest inrush current events - Gillingham

inrush current waveforms

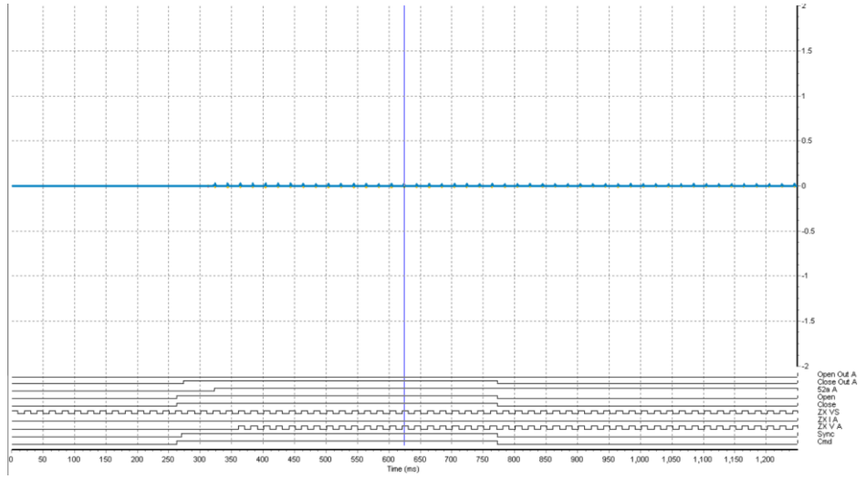
corresponding voltage waveforms

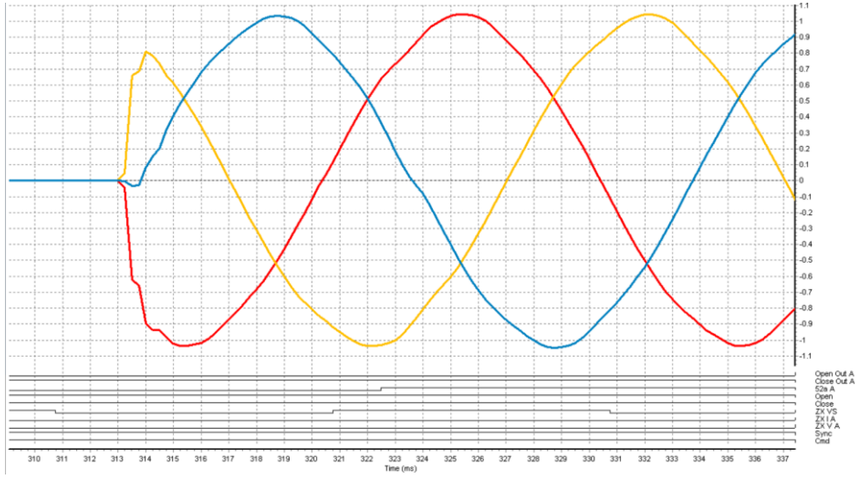
**without** PoW





**with** PoW





# TASS Trial Performance

## in summary…

- ✓ TASS has been successfully controlling automated switching events since June 2018 with energy savings of over 100 MWh from the two trial sites to date
- ✓ the system continues to operate as designed, demonstrating the ability to both reduce losses and respond appropriately to different network situations
- ✓ the scheme design developed through the project provides a streamlined system for integration with existing assets to deliver the TASS functionality
- ✓ no impacts on asset health due to TASS operation have been identified

TASS therefore offers a financially viable, as well as technically feasible, option for reducing losses on electricity distribution networks, and demonstrates a business case for applying TASS at specific sites

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# Project Deliverables - SDRCs

Five companion SDRCs detail the development & trial of TASS technology:

site visits welcome !

9.4 - Initial Learning from Trial Installation & Integration

comprehensive information on the technology developed, its integration with existing network assets, and the operational principles designed into the scheme

9.5 - Monitoring & Analysis

an appraisal of the techniques used to monitor the trial sites, and analysis of the data acquired to evaluate any potential asset health or power quality implications associated with TASS, and verify that the system operates as designed

9.6 - Site Performance to Date

a full review of the losses savings achieved through TASS, and evaluation of the benefits of the technology and costs of deployment to refine the business case

9.7 - Network Losses Evaluation Tool

the enhanced CBA tool created to assess the benefits of TASS, with a detailed description of the substation assessment process used to assess the financial viability and technical feasibility of applying the technology on a site by site basis

9.8 - Knowledge & Dissemination

the project closedown report, including a detailed review of the scalability & replicability of the system as a guide for wider deployment across other network areas

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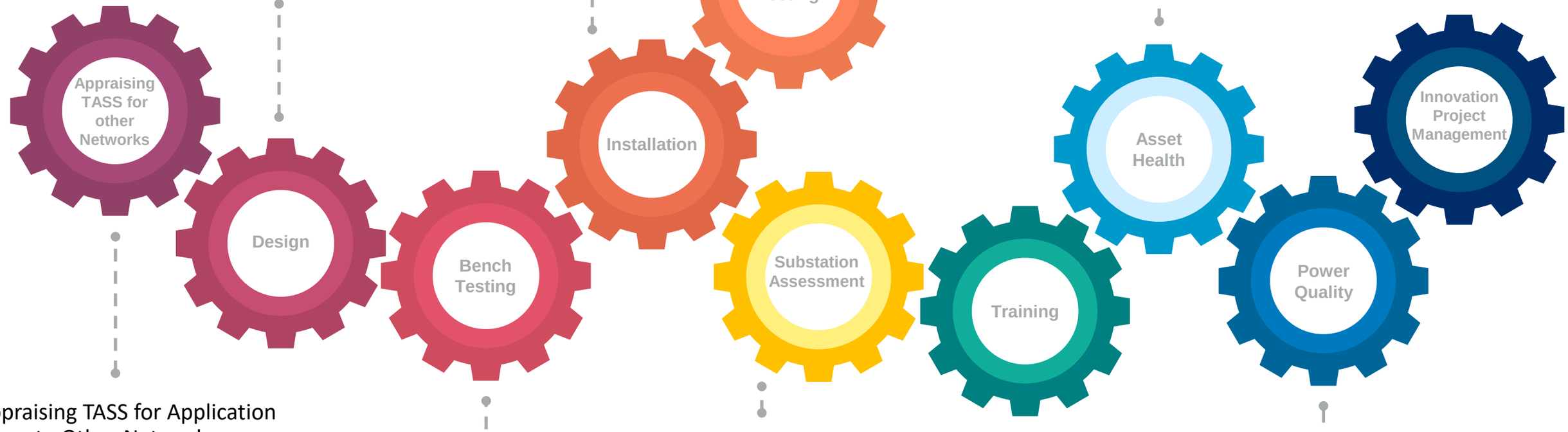
# Accompanying Material




## Appraising TASS for Application to Other Networks

- Risk Mitigation Strategy
- TASS Operational Principles
- Scalability & Replicability Assessment

## System Design

- SDRC 9.4 - Section 4
  'TASS System Design & Integration'
- SGAM for TASS Implementation
- TASS System and Algorithm Technical Specification
- SCADA Data & TASS Responses
- TASS Algorithm Flow Chart
- TASS Wall Box Design Drawings

## Bench Testing

- TASS Algorithm Testing Specification

## Installation

- SDRC 9.4 - Section 5
  'TASS Installation & Commissioning'
- Substation Signage

## Site Testing

- Commissioning Plan
- TASS Site Testing Specification

## Substation Assessment to Identify Suitable Sites

- TASS Evaluation Tool
- TASS Evaluation Tool User Guide
- TASS Technology Substation Assessment Guide

## Training

- Training & Briefing Material for Operational Staff
  - tailored to specific roles
  - inc. handouts & 'take-aways' for future reference
- TASS Evaluation Tool & Site Assessment Training

## Asset Health Monitoring

- SDRC 9.5 'Monitoring & Analysis'
- various asset health reports inc.
  - PD surveys
  - transformer condition assessment tests
  - SAPIENT reports
- online DGA data from the trial sites

## Power Quality

- Transformer Energisation Study report
- power quality data from TASS switching events

## Innovation Project Management

- LEAN Phases Two & Three Scope of Works
- TASS Operational Training Evaluation Form
- SSEN Control Engineers TASS Feedback Form

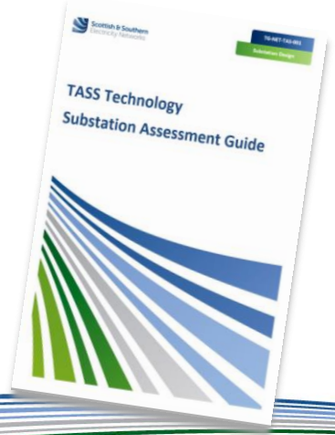
# Substation Assessment Process - technical feasibility

This gives a framework around the TASS Evaluation Tool to identify sites suitable for TASS based on both the financial viability and technical feasibility of deployment

Five key steps:

- Step One:  TASS Evaluation Tool CBA - generic cost assumptions
- Step Two:  establish whether the shortlisted substations have dedicated 33 kV circuit breakers
- Step Three:  review the transformer and switchgear condition at each of these substations
- Step Four:  undertake a detailed protection and control study for TASS implementation
- Step Five:  TASS Evaluation Tool CBA - with site specific costs

➡ this process supports decisions on the application of TASS at individual primaries

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# TASS Evaluation Tool - financial viability

CBA tool which quantifies the benefits of applying TASS at individual substations

- Excel spreadsheet with VBA macros
- simulates TASS operation using site specific load profiles
- assigns financial values to the energy saved to determine the environmental and social benefits of reducing losses & $CO_2$ emissions
- consistent with the RIIO CBA approach

Sites with a positive discounted net benefit can be considered for TASS deployment

➡ the tool is available to GB DNOs to enable them to assess the potential for deployment of TASS technology on their own networks on a site by site basis

**TASS Evaluation Tool**

**Hedge End (HEDE-EN) CBA Results Sheet**

| TASS Switching Analysis | | | |
|---|---|---|---|
| SiteTag | HEDE-EN | Capacity (MVA) | 30 |
| No. Transformers | 2 | Firm Capacity(MVA) | 15 |
| No. TASS Transformers | 2 | TASS Installation Date | 2019 |
| Age of Oldest TASS Tx. in 2020 | 13 | Start / End of CBA Study | 2019 / 2081 |
| [Remaining Life] | [62] | [User Defined Return Period] | [2019 - 2044] |

| TASS Switching per Annum: Automatic CoP (6.69 MVA) | | | No. Switching Events due to |
|---|---|---|---|
| Load Scenario | Energy Saving (MWh) | No. Switching Events | Load / Tests / Changeovers* |
| Existing | 45.34 | 51 | 2 / 0 / 23 |

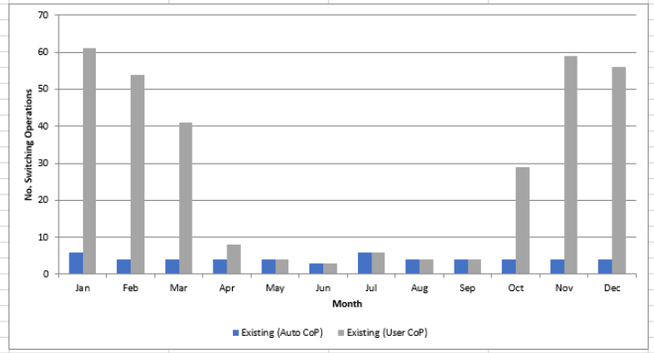
*one event in this column is equal to a full round of Tx switching (load based = off/on, time based = on/off)

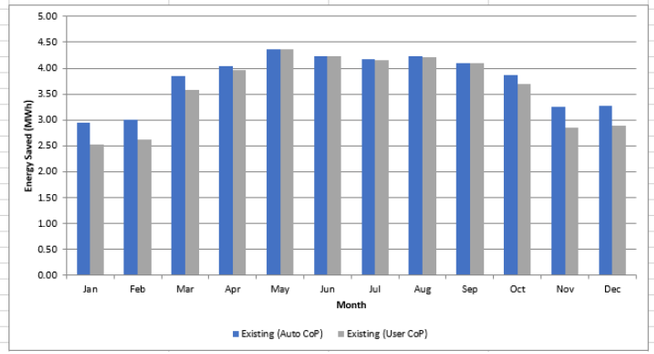
| TASS Switching per Annum: User Defined CoP (5.3 MVA) | | | No. Switching Events due to |
|---|---|---|---|
| Load Scenario | Energy Saving (MWh) | No. Switching Events | Load / Tests / Changeovers |
| Existing | 43.20 | 329 | 154 / 0 / 10 |

| Cost Benefit Analysis: Automatic CoP<br>Cumulative discounted net benefits at end of transformer life [after 25 years] | | | |
|---|---|---|---|
| Load Scenario | Case 1 (£k) | Case 2 (£k) | Case 3 (£k) |
| Existing | 54.8 [38] | 34.6 [21.1] | |

| Cost Benefit Analysis: User Defined CoP<br>Cumulative discounted net benefits at end of transformer life [after 25 years] | | | |
|---|---|---|---|
| Load Scenario | Case 1 (£k) | Case 2 (£k) | Case 3 (£k) |
| Existing | 50.8 [35.4] | 30.7 [18.6] | |

| Total forecast $CO_2$ savings to end of transformer life [after 25 years] | | |
|---|---|---|
| Load Scenario | Automatic CoP ($tCO_2$) | User Defined CoP ($tCO_2$) |
| Existing | 267.3 [239.3] | 254.7 [228] |



# Comparison of modelled & actual losses saving

| Gillingham | | | | |
|---|---|---|---|---|
| | TASS Evaluation Tool assessment MWh | losses saved during the trial MWh | comparison | comments regarding trial operation |
| June 2018 | 3.53 | 1.01 | 29% | TASS operation commenced 22 June 2018 |
| July | 3.70 | 3.52 | 95% | *full TASS operation* |
| August | 3.63 | 3.61 | 100% | *full TASS operation* |
| September | 3.33 | 3.40 | 102% | *full TASS operation* |
| October | 3.05 | 3.09 | 101% | *full TASS operation* |
| November | 2.58 | 2.67 | 104% | *full TASS operation* |
| December | 2.90 | 1.70 | 59% | TASS operational for ~15 days in December |
| January | 2.46 | 2.53 | 103% | *full TASS operation* |
| February | 2.61 | 2.67 | 103% | *full TASS operation* |
| March | 3.19 | 3.20 | 100% | *full TASS operation* |
| April | 3.39 | 1.67 | 49% | TASS operational for ~15 days in April |
| May 2019 | 3.65 | 3.27 | 89% | TASS operational for ~28 days in May |

| Hedge End | | | | |
|---|---|---|---|---|
| | TASS Evaluation Tool assessment MWh | losses saved during the trial MWh | comparison | comments regarding trial operation |
| June 2018 | 4.23 | 3.18 | 75% | TASS operation commenced 8 June 2018 |
| July | 4.16 | 3.01 | 72% | TASS operational for ~25 days in July |
| August | 4.22 | 3.66 | 87% | TASS operational for ~27 days in August |
| September | 4.09 | 4.07 | 99% | *full TASS operation* |
| October | 3.69 | 2.22 | 60% | TASS operational for ~21 days in October |
| November | 2.85 | 2.22 | 78% | TASS operational for ~24 days in November |
| December | 2.88 | 0.36 | 12% | TASS operational for ~4 days in December |
| January | 2.52 | 0.11 | 4% | TASS operational for ~2 days in January |
| February | 2.63 | 2.66 | 101% | *full TASS operation* |
| March | 3.58 | 3.55 | 99% | *full TASS operation* |
| April | 3.97 | 3.93 | 99% | *full TASS operation* |
| May 2019 | 4.37 | 4.29 | 98% | *full TASS operation* |

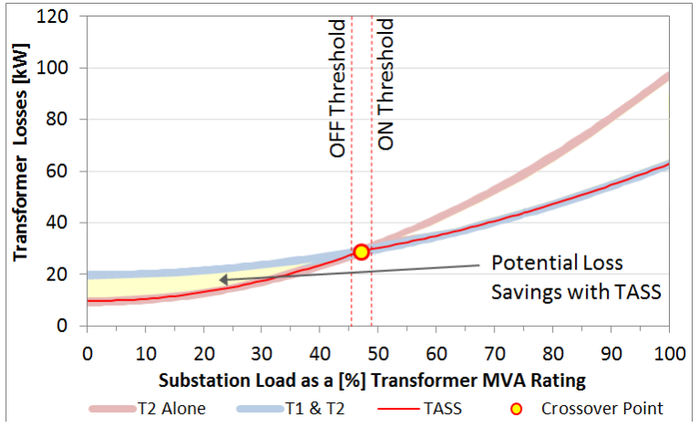
# TASS Evaluation Tool

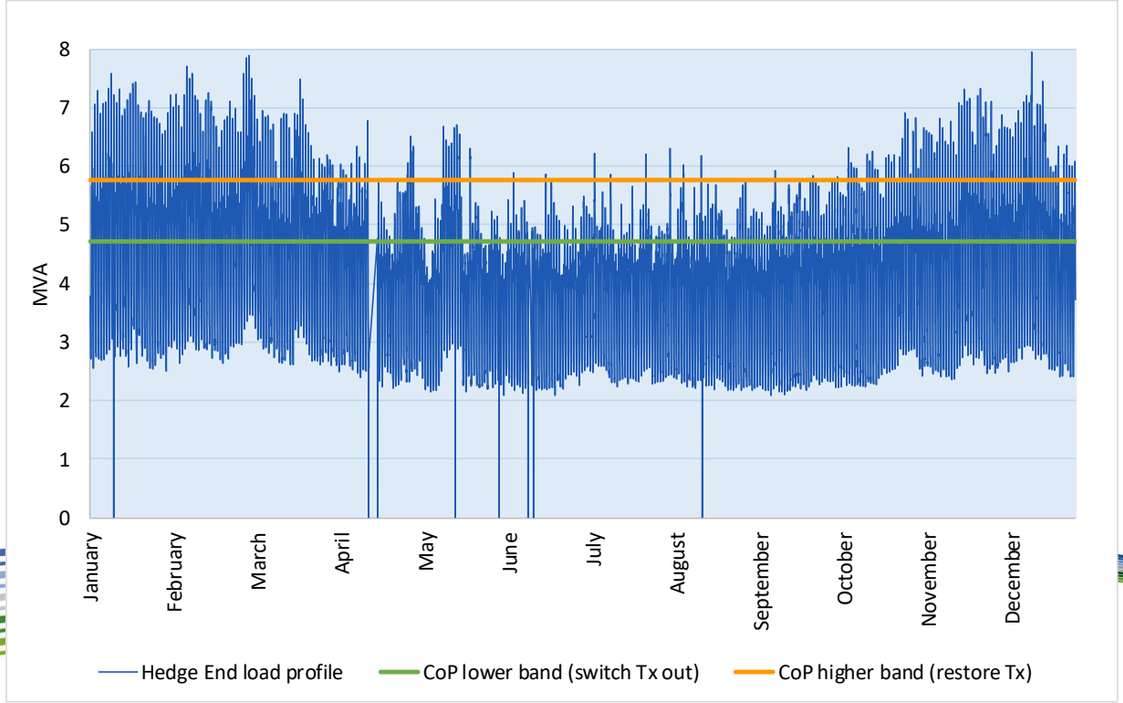
*worked example*

- WPD sites / workshop with attendees

data required to assess each primary substation of interest:

- no. transformers
- ONAN ratings for each transformer (MVA)
- iron & copper losses for each transformers (W)
- transformer ages
- 1 years' worth of substation load profile data
- cost assumptions - current / future



thank you

For more detail on any aspect of TASS and to request material available from the project, please contact Sarah Rigby - sarah.rigby@sse.com

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