

Using AI to Prevent Unplanned Faults in HV Networks

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CIGRE UK Data Science Conference, Arup, London

30th June 2023



cigre

For power system expertise

Overview

- **Pre-Fix Project Overview**
- **Common Disturbance Information Platform**
- **Trial Equipment Overview**
- **Data Analysis Approach**
- **Field Trial Results**
- **Next Steps**



Pre-Fix Project Overview

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What is Pre-Fix?

Enhancing Pre-Fault and Post-Fault location capability in HV networks

Key Enablers

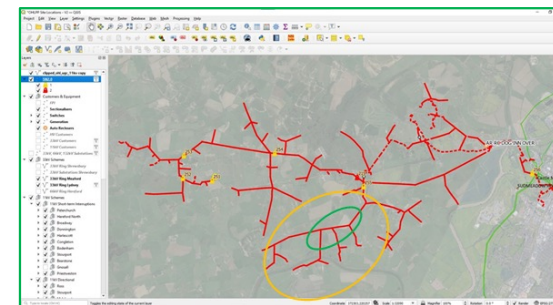
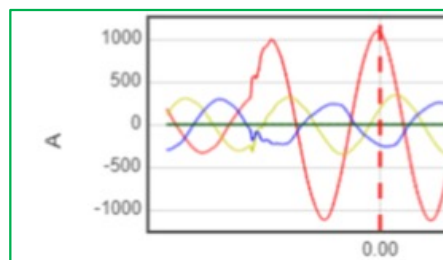
High resolution monitoring

Price Point

Automation

Operational information output

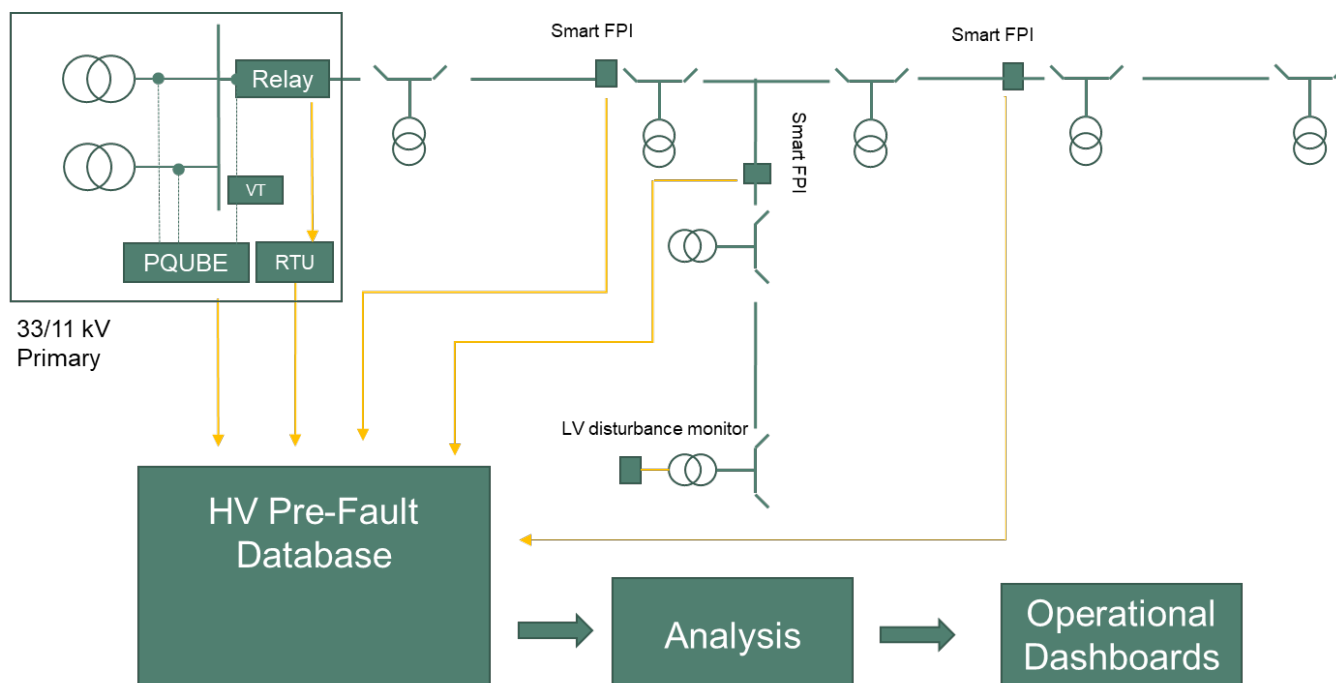
Stack value from existing equipment



Interoperability

Presented by: Samuel Jupe (samuel.jupe@nortechonline.co.uk)

Project Information



Project details:

- NGED-led
- **Funding:** £1.65M of NIA funding
- **Duration:** October 2021- March 2024
- **Scale:** 20 Primary Substation groups
- **Locations:** Coventry and South Devon

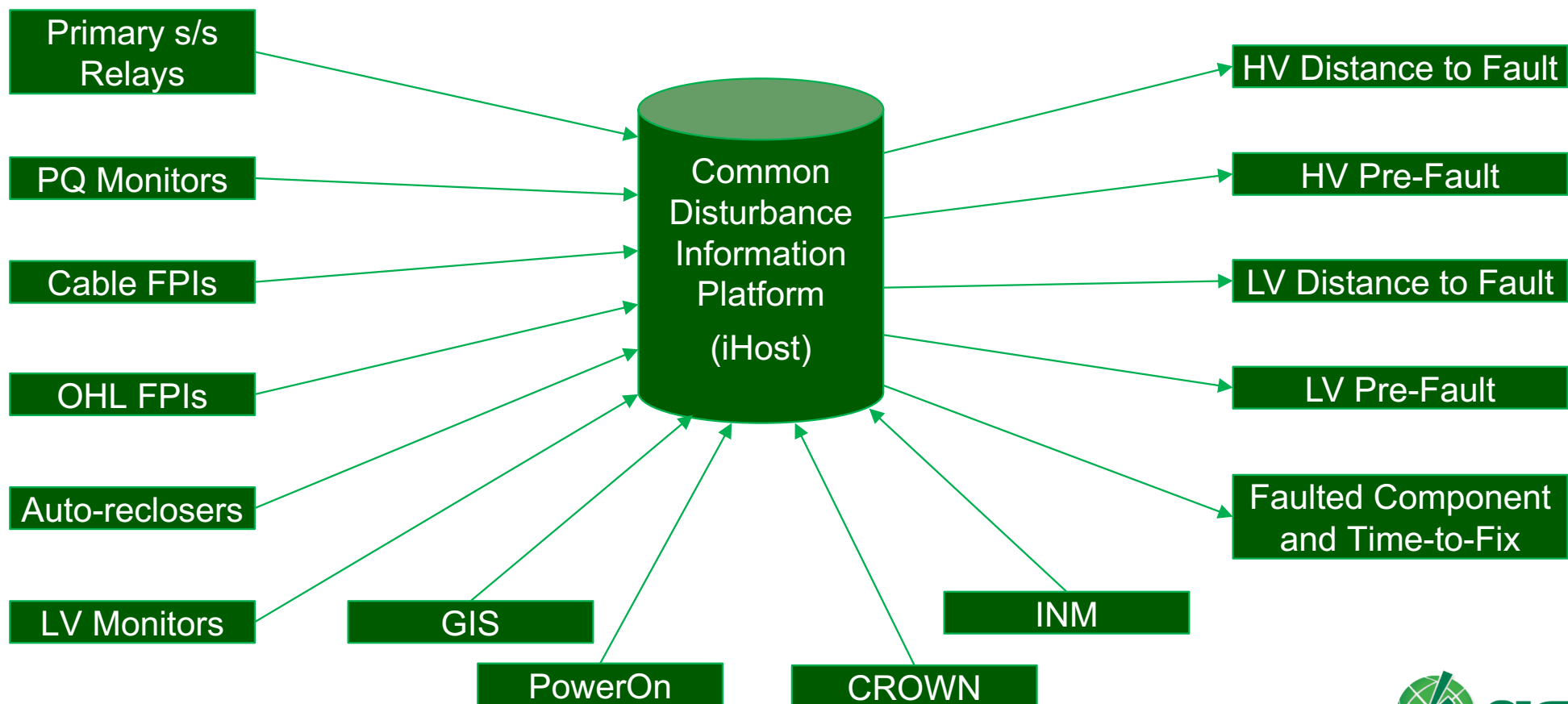
Common Disturbance Information Platform

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Solution Architecture



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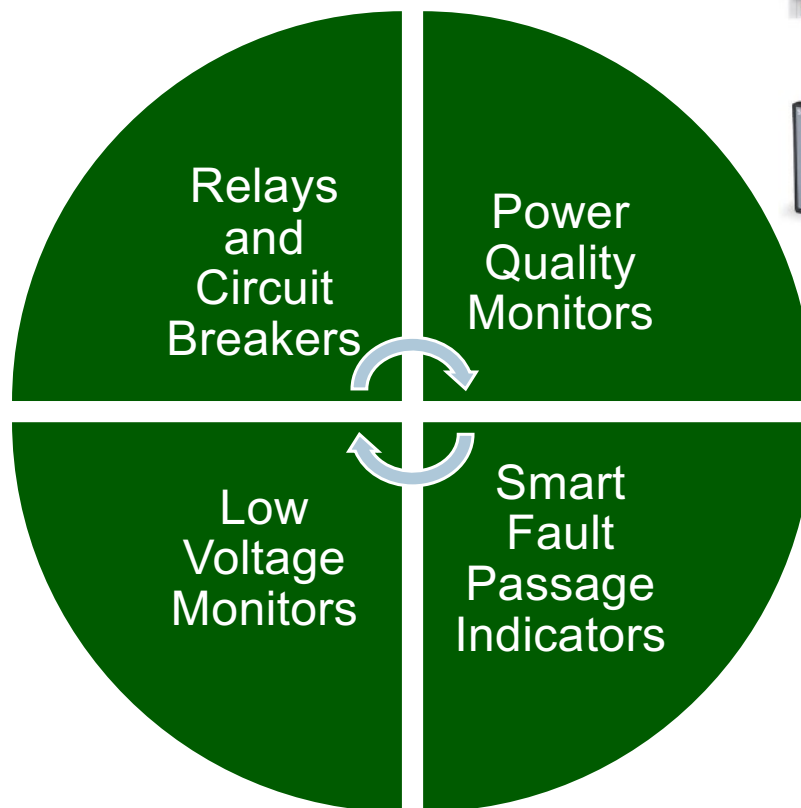
Trial Equipment Overview

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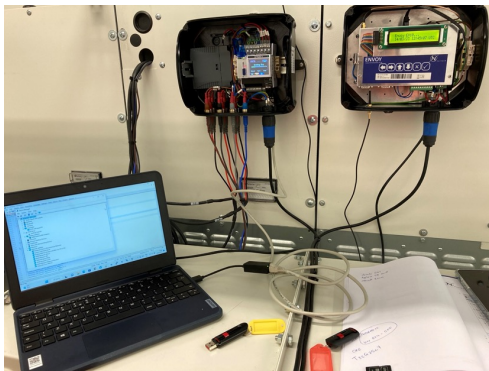


Trial Equipment



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Trial Equipment (In Situ)



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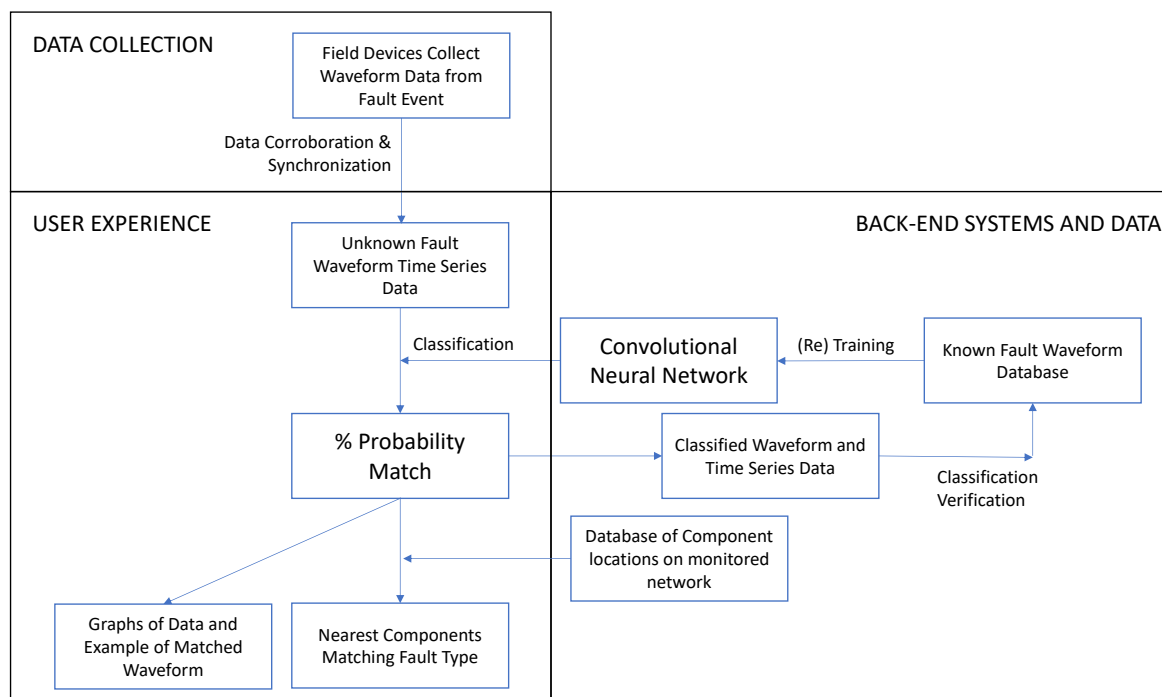
Data Analysis Approach

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Data Analysis Approach



Key Outputs:

- Distance-to-Defect
 - ✓ Post Fault (for cable and OHL networks)
 - ✓ Pre-Fault (for cable and OHL networks)

- Faulted Component Classification
 - ✓ Post Fault (for cable and OHL networks)
 - ✓ Pre-Fault (for cable and OHL networks)

- Continual Refinement of AI Algorithm
 - ✓ Re-training based on validated fault data



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Field Trial Results

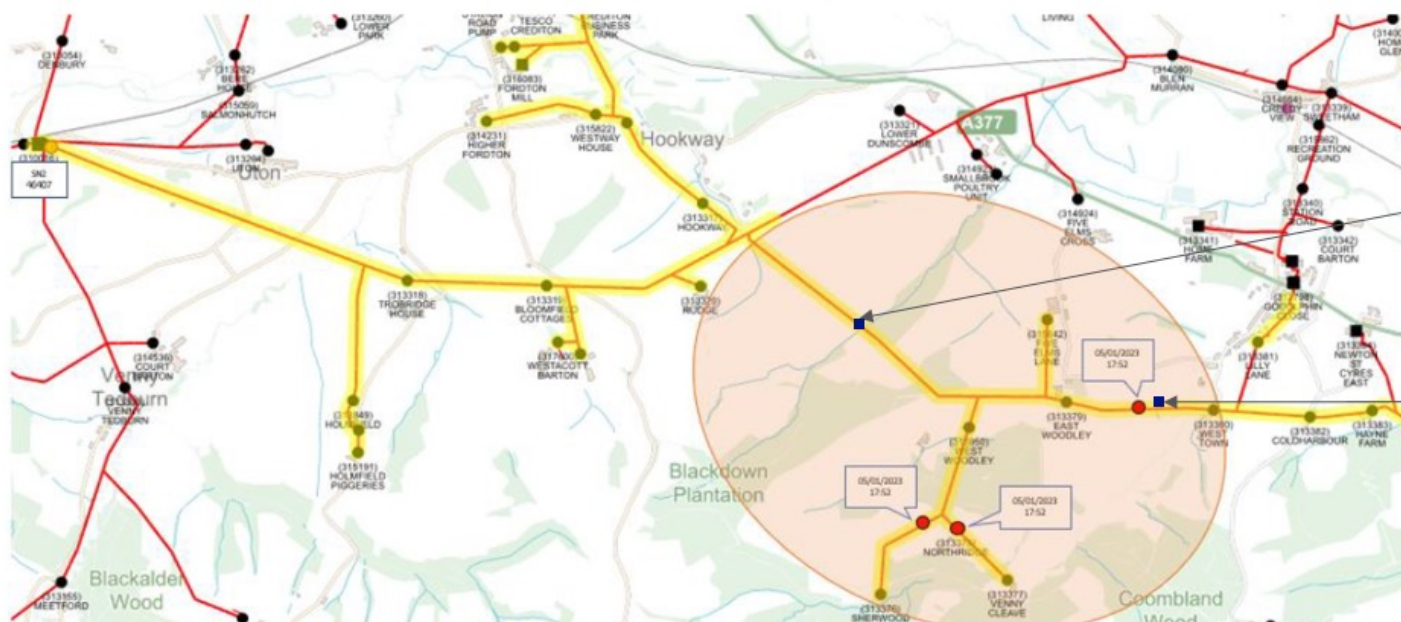
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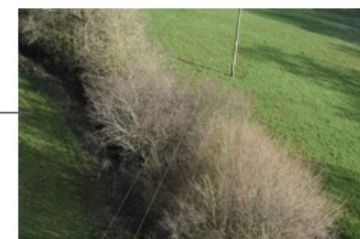


Field Trial Results

Distance-to-Defect (Pre-Fault: Overhead line)



31BH84 – Tree Infringement - 19/01/23



31BH58 – Tree Infringement - 19/01/23

NGED helicopter deployed to validate predicted fault locations



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Field Trial Results

Distance-to-Defect (Pre-Fault: Cable)

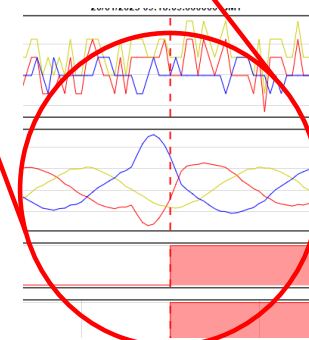
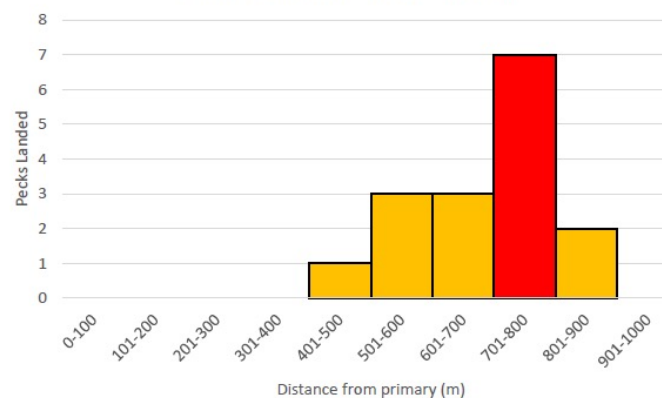


D2F calculations performed and results screened using FPI alarms to generate a search zone.

Distinct current disturbance



Pecks vs Distance from Primary

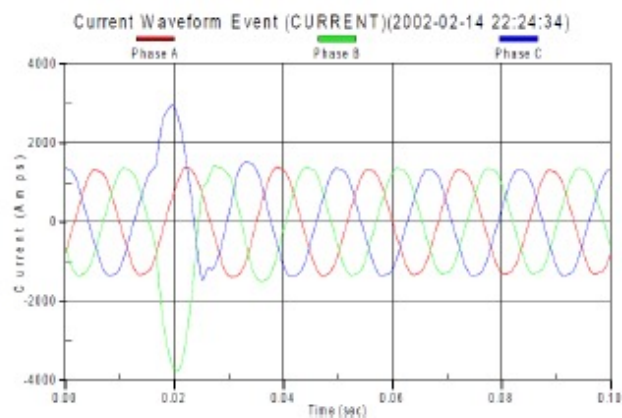


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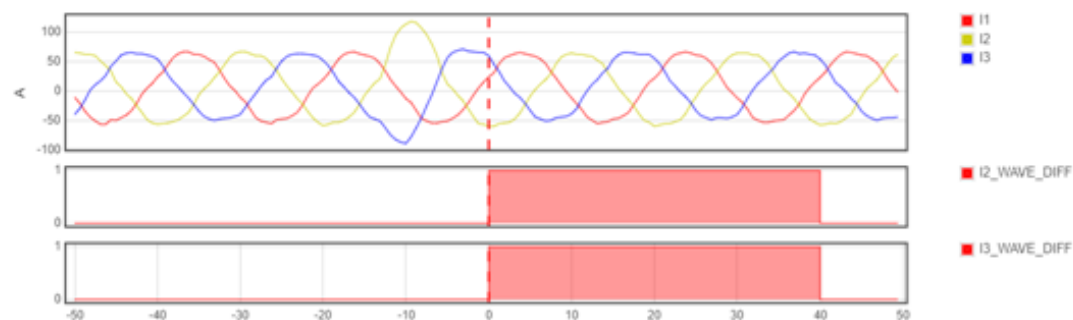
Field Trial Results

Faulted Component Classification (Cables)

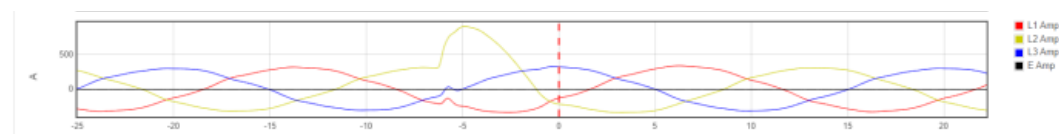
Incipient Cable Joint Failure



Signature (from IEEE PES TR73)



Incipient cable joint Ph-Ph fault (captured by Pre-Fix cable FPIs, 95.4% confidence)



Incipient cable joint Ph-E fault (captured by Pre-Fix cable FPIs, 82.1% confidence)

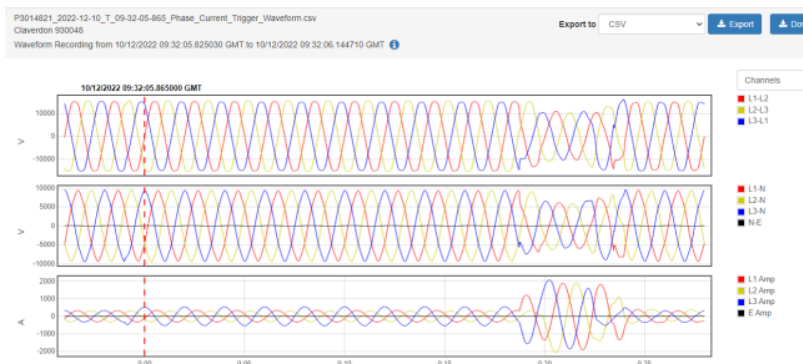


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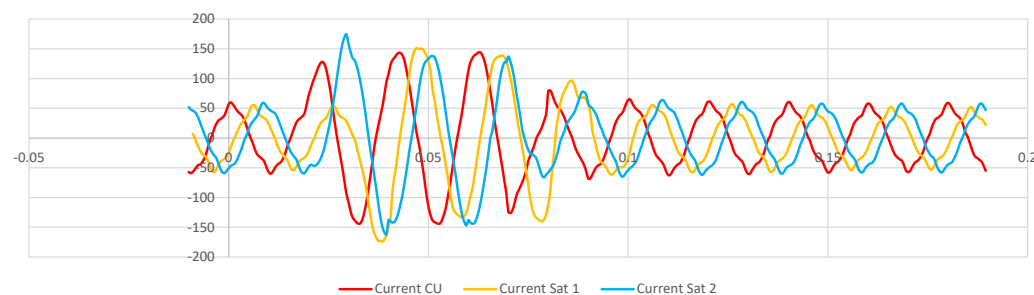
Field Trial Results

Faulted Component Classification (Overhead lines)

Overhead Line Failure



New Signature (from Pre-Fix)



Overhead Line Failure (captured by Pre-Fix OHL FPIs, 87.9% confidence)

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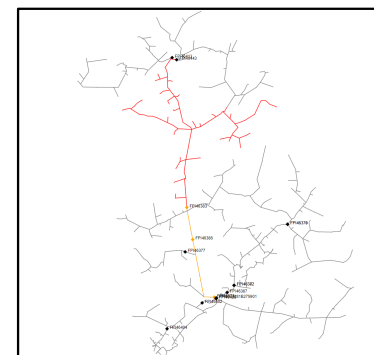
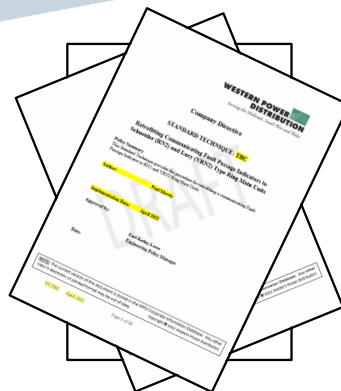
Next Steps

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Pre-Fix: Next Steps



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References

- [1] National Grid, 2021, "Pre-Fix", Available on-line at:
<https://www.nationalgrid.co.uk/projects/pre-fix>
- [2] IEEE Power and Engineering Society, 2019, Technical Report 73 Electric Signatures of Power Equipment Failures, IEEE, USA, 1-78.
- [3] P. Morris et al., 2023, "Delivering the Benefits from a Common Disturbance Information Platform to Prevent Unplanned Outages", Proceedings 27th CIRED Conference, AIM, Paper 10751
- [4] P. Morris et al., 2023, "Applying Machine Learning to Power Quality Signals to Detect Component Failure Signatures and Prevent Unplanned HV Outages", Proceedings 27th CIRED Conference, AIM, Paper 10747

For more information contact...

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Thank you for listening!

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