SP Electricity North West

Network Innovation Allowance (NIA)

DeltaDetect: HV Fault Detection Using Existing LV Infrastructure

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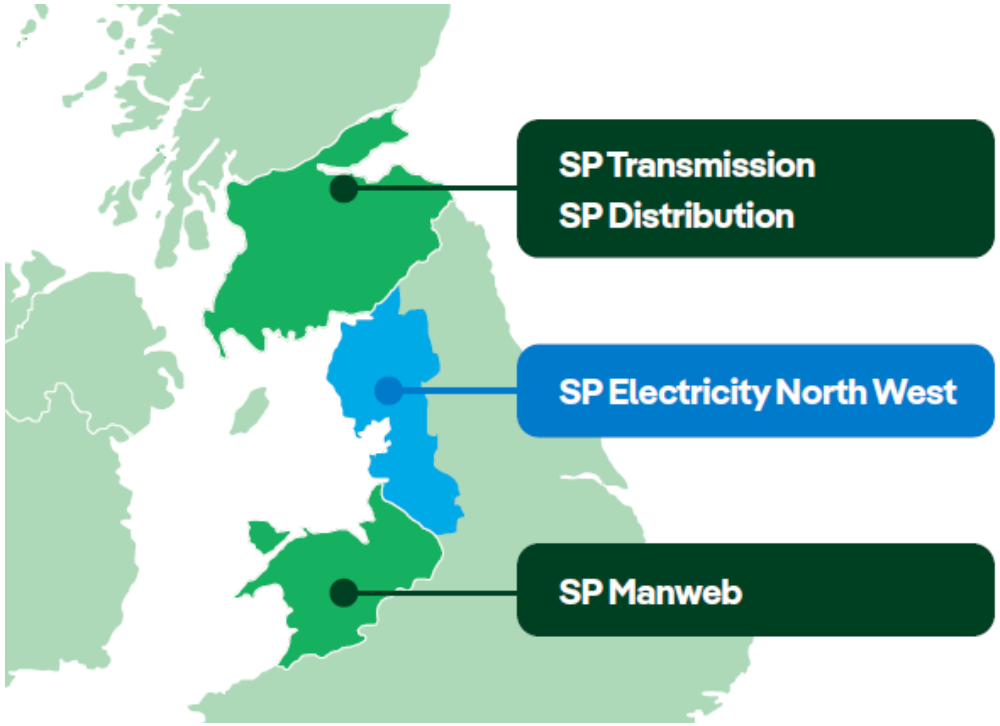
Overview

- SP Electricity North West is one of Great Britain's 14 electricity distribution network operators.
- We maintain and invest in our network of 61,000km of underground cables and overhead lines, plus thousands of substations and innovative technology.
- We deliver a safe and reliable power supply to 2.4m homes and businesses from Cumbria to Cheshire, supporting electrification and clean growth.



£2.6bn
Investment from 2023-2028

£20bn
Cost to replace our entire network in the North West

2,287
Employees

48,000km
Underground electricity cables

13,000km
Overhead power lines

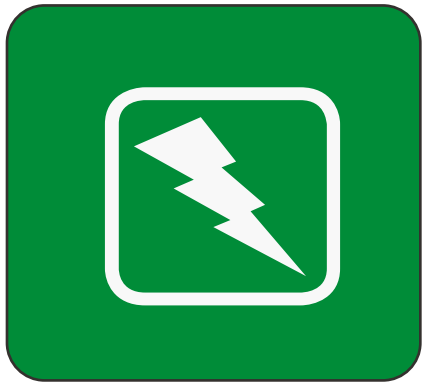
5m
Number of people we supply power to across 2.4 million homes & businesses.

- Global energy leader, Iberdrola, acquired an 88% shareholding in Electricity North West in 2025 through it's UK arm, ScottishPower. The network has now rebranded as SP Electricity North West.
- Iberdrola and ScottishPower are committed to building smarter, greener electricity networks and now distributes electricity to 12 million people in the UK through its 170,000km network.

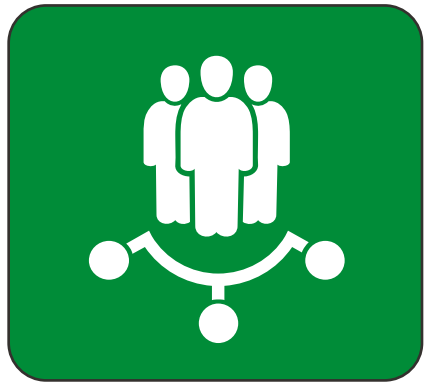
The Problem

SP Electricity North West

Our Growing Dependence on Electricity Networks



High Voltage (HV) Faults: A Hidden Risk



The Challenge: Reactive Approach

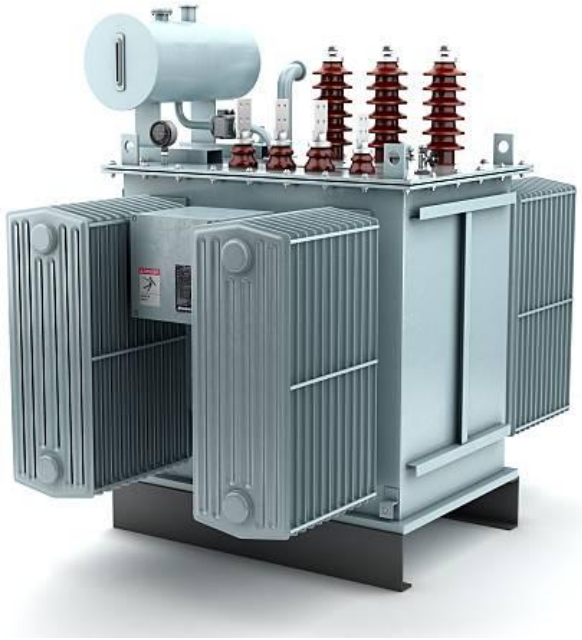
We Need Smarter, Scalable Solutions

The Concept

HV Fault Activity
Insulation Breakdown
Equipment Malfunction

Electrical Signals

Delta-Wye 11kV/0.4kV
Distribution Transformer

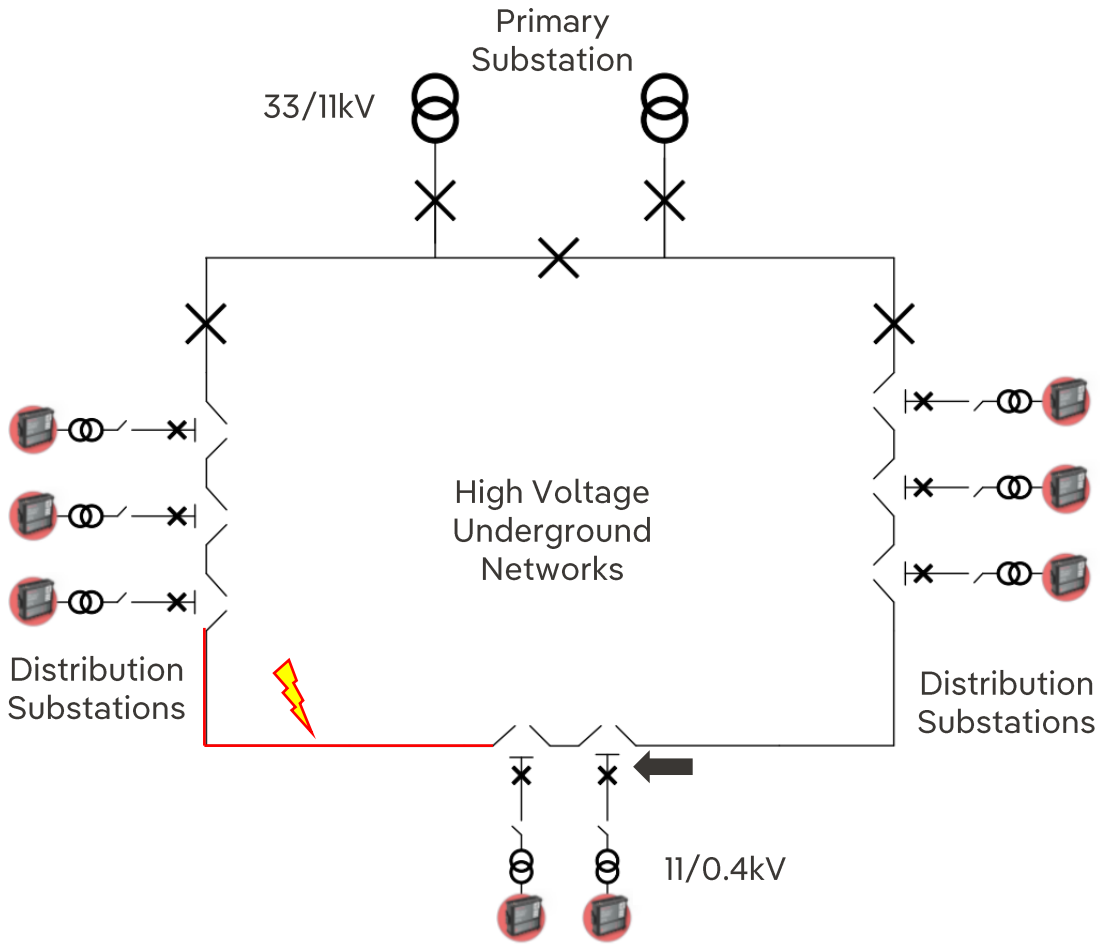


Electrical Signals

Low Voltage
Monitoring
Equipment

How It Works?

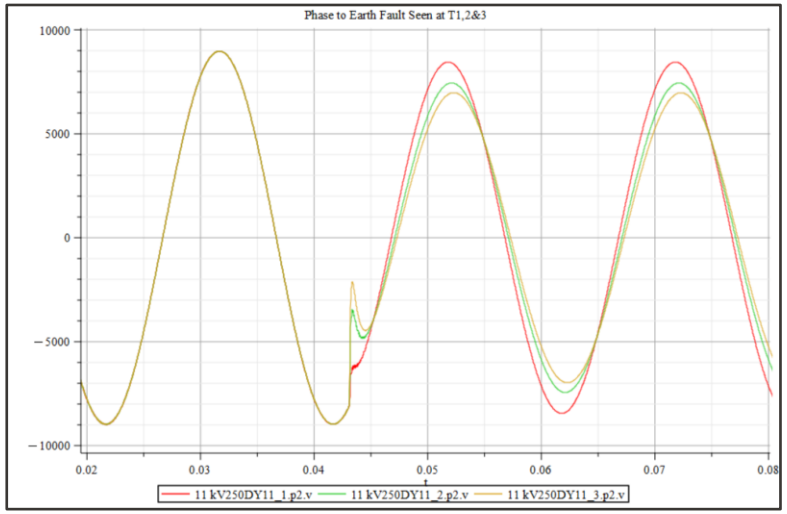
1. Low Voltage Monitoring
   - Continuously measuring
2. Detecting Early Fault Signatures
   - Voltage dip or distortions
3. Triggering and Data Capture
   - Novel undervoltage trigger
4. Reverse Transformation Algorithm
   - Transformer characteristics
5. Fault Localisation
   - Transgradient analysis
6. Proactive Network Response
   - Indication of faulty section

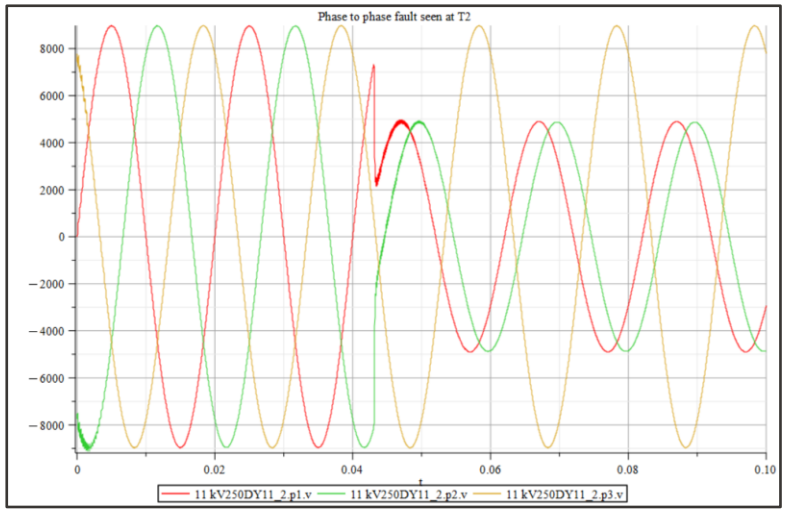


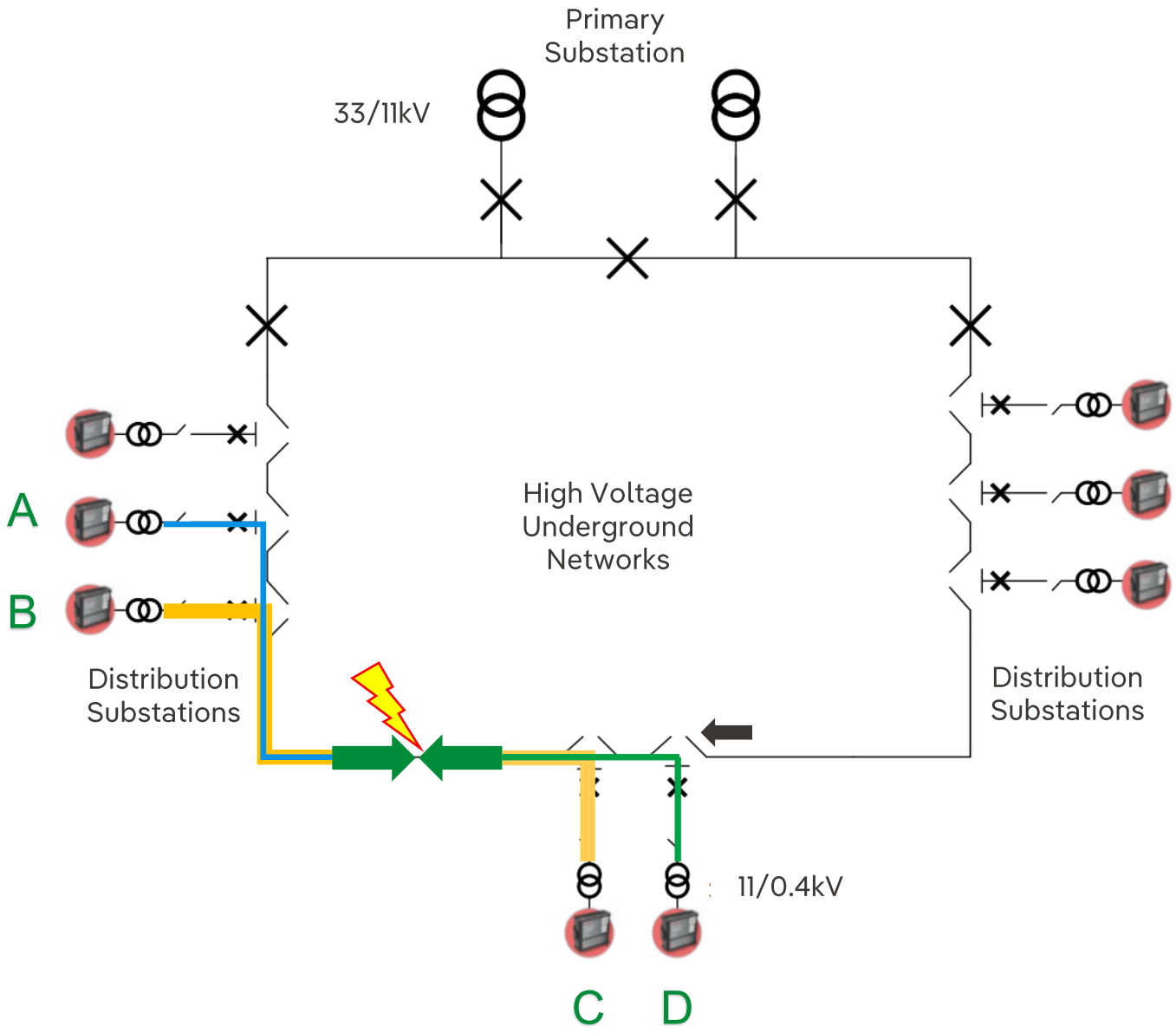
Each LV monitor connected to the HV ring captures an abnormal voltage event

How It Works?

Trans gradient analysis the events are localised to a section of the ring







Benefits & Impact

SP Electricity North West

Technical Benefits

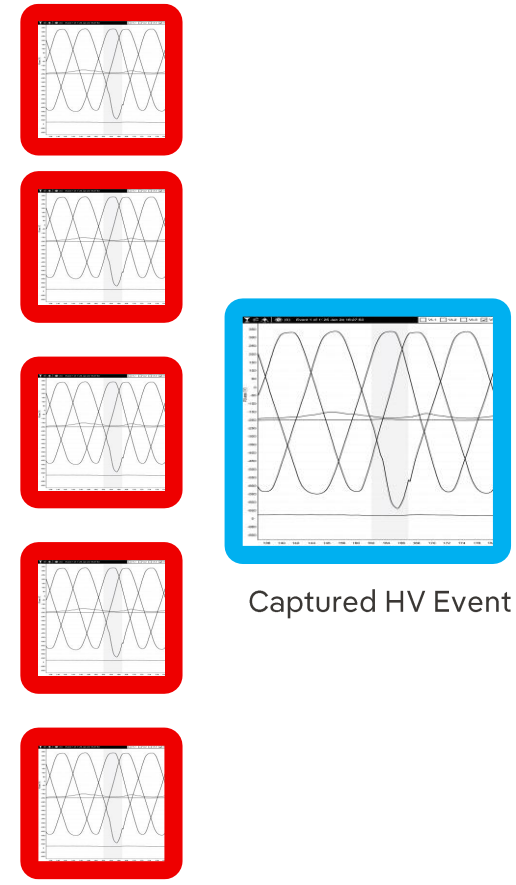
- **Cost-Efficient Deployment**
  Uses existing LV monitors—no need for expensive HV-side sensors
- **Scalable Architecture**
  Can be rolled out across SP ENW and other DNOs
- **Predictive Fault Detection**
  Identifies developing faults before outages occur
- **Improved Fault Localisation**
  Pinpoint's fault location using LV data and transgradient analysis.

Consumer & Operational Impact

- **Reduced Downtime**
  Faster fault response means fewer outages
- **Enhanced Reliability**
  Proactive maintenance improves service continuity.
- **Safety Improvements**
  Early detection reduces risk of equipment failure.
- **Support for Vulnerable Customers**
  Minimises disruption in critical areas.

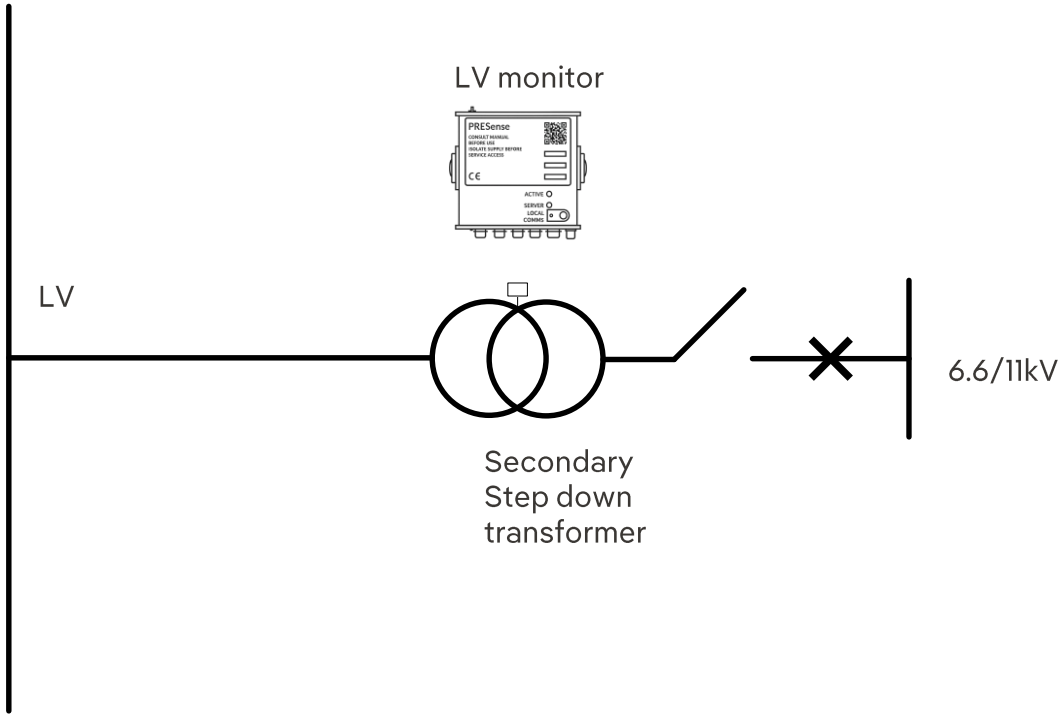
Challenges

1. • Trigger Sensitivity & Accuracy
   • False positives
2. • Data Volume & Processing
   • Overwhelm analytics & storage
3. • LV-HV Signal Interpretation
   • Transformer & network variability

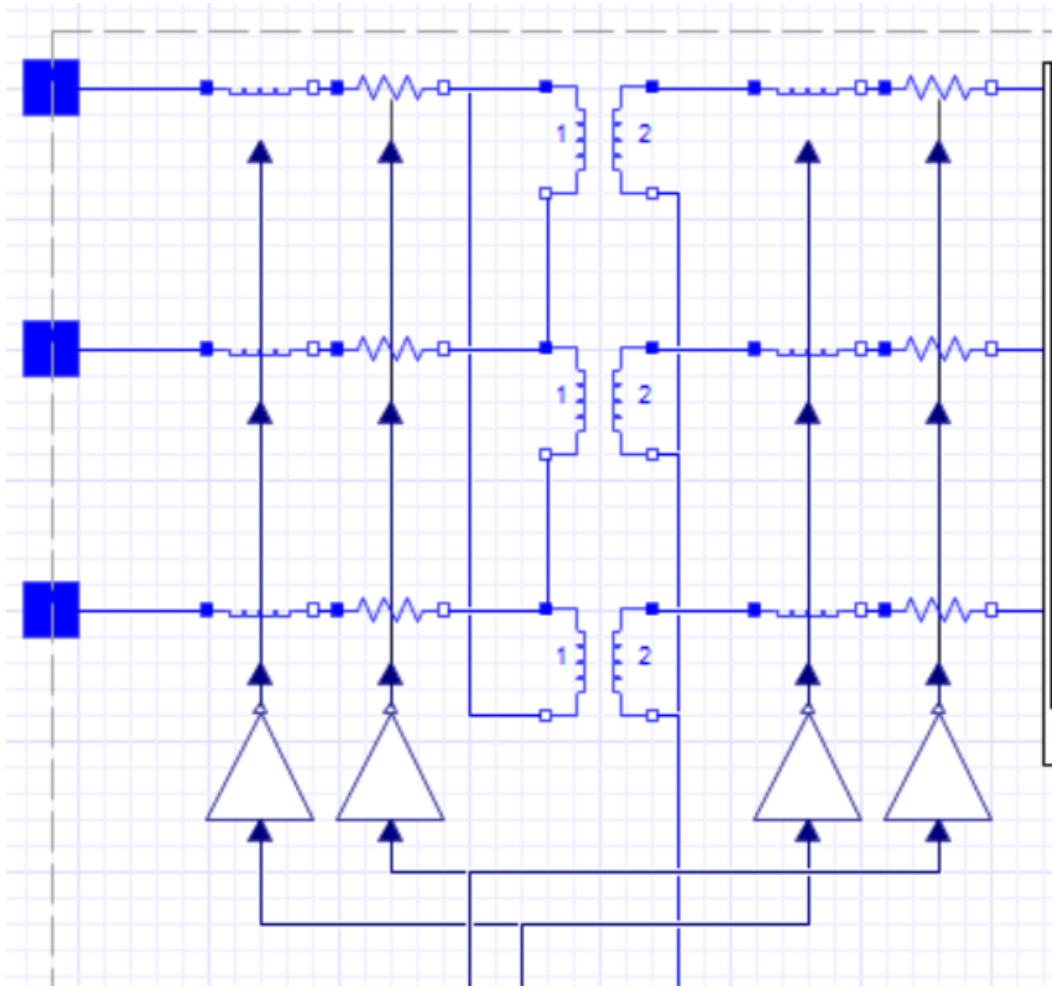


Discarded Events

Captured HV Event

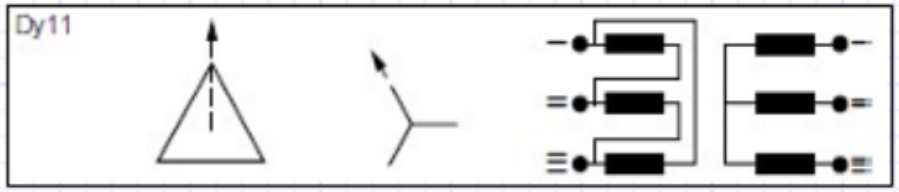


Challenges – Transformer Models



SIZE (kVA) (Three Phase)	R(Ω)	jX(Ω)	R%	jX%
25	0.1917	0.245	11 090	14 190
50	0.0807	0.1327	4 670	7 680
100	0.0342	0.0746	1 980	4 320
200	0.01456	0.0374	843	2 170
300	0.00874	0.0259	506	1 499
315	0.00830	0.0247	481	1 429
500	0.00469	0.01576	271	912
750	0.00288	0.01060	166.9	613
800	0.00268	0.00986	155.2	571
1 000	0.00202	0.00795	116.8	460
1 250	0.0015	0.0062	80.0	357
1 500	0.0012	0.0067	64.0	331

Impedance and % values referred to 415/240V



Who's Involved?

SP Electricity North West (SP ENWL) – Project sponsor, network data, deployment support, governance

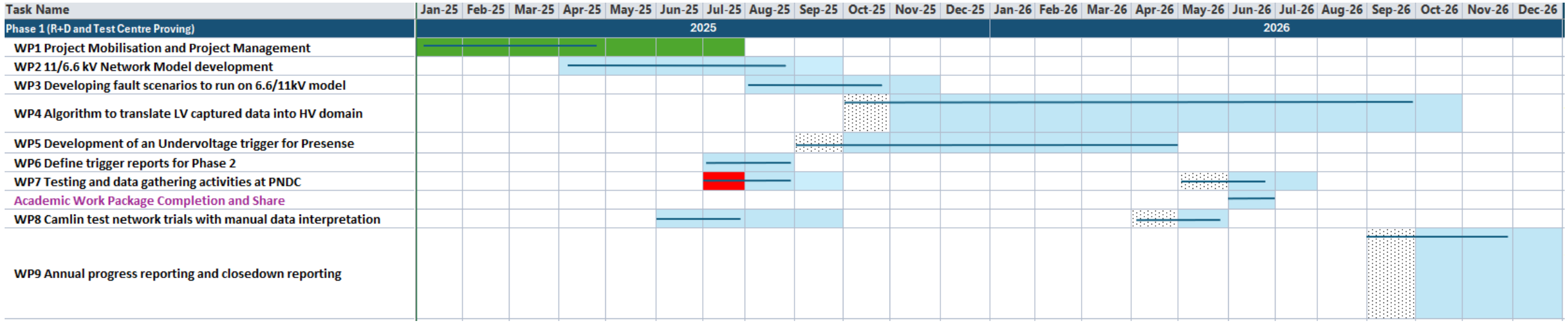
Kelvatek – Lead delivery partner, R&D, algorithm & trigger development, PRESense firmware

University of Strathclyde – HV switching event modelling and validation

PNDC (Power Networks Demonstration Centre) – Controlled testing environment

Phase 1 Work Packages

WP1: Mobilisation & Project Management - Set up team, resources, governance, and reporting structure.
WP2: HV Network Modelling - Build simulation of 6.6/11kV ring network with transformer and fault modelling.
WP3: Fault Scenario Development - Simulate various fault types to understand HV-LV voltage behaviour.
WP4: LV-to-HV Algorithm Development - Develop algorithm to reverse LV data into HV fault profiles.
WP5: Undervoltage Trigger for PRESense - Create firmware trigger in PRESense to capture HV fault events via LV dips.
WP6: Trigger Report Design - Define metadata structure for captured events to support analysis.
WP7: PNDC Testing - Validate algorithms and triggers in a controlled HV test environment.
WP8: Field Trials with Manual Interpretation - Deploy firmware, capture real data, and manually validate fault localisation.
WP9: Reporting & Dissemination - Produce progress reports, closedown report, and support knowledge sharing.



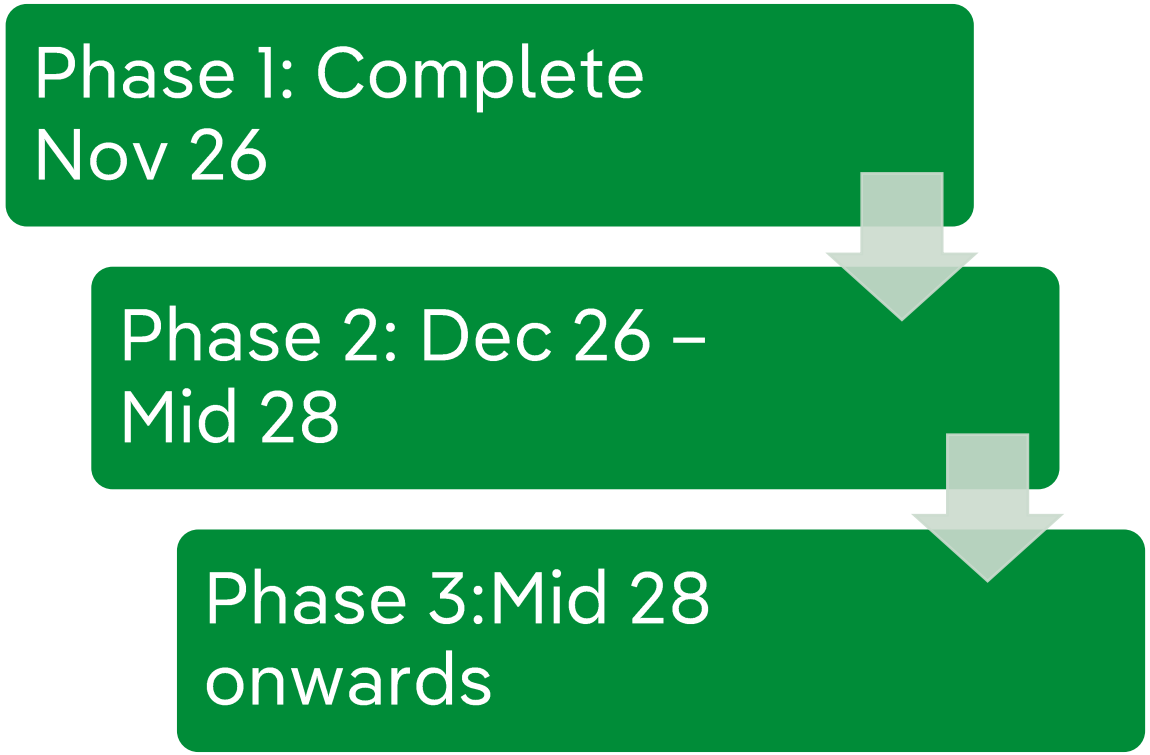
Future Phases & Timeline

Project Phases

Phase 1: Research & Proof of concept
Focus: Modelling, triggering, algorithm development, PNDC testing

Phase 2: Live Network Trials
Validate algorithms and triggers in real-world conditions
Fine-tune based on field data

Phase 3: Production Deployment
Scalable rollout across ENWL and other DNOs
Integration with BAU systems



Thank You

Any Questions?

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