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Innovation Learning Event

Wednesday 4 July 2018

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RESPOND

Innovative Active Fault Management

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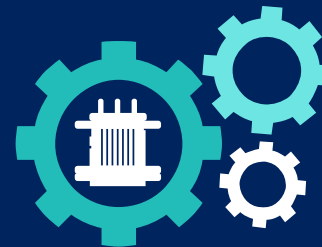
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RESPOND



Introduction

Project overview

Respond techniques



Trials & analysis

Customer

Next steps



Respond is the first UK demonstration of an active fault level management solution that avoids traditional network reinforcement



Competitive competition
Funded by GB customers
Learning, dissemination & governance
Fourth of our five successful Tier 2 / NIC projects



Investment

£5.5
million

Project Starts
Jan 2015

Site selection
May 2015

Design
Nov 2015

System installation & Go Live
May 2016

Post fault analysis
Apr 2018

Purchase FCL customer
Apr 2018

Safety case
Sep 2018

Closedown
Oct 2018



Financial benefits

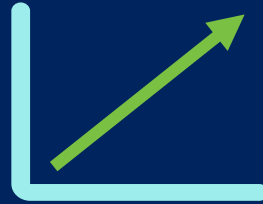
Up to £2.3bn
to GB by
2050

Project partners





Faster and cheaper to apply than traditional reinforcement



Will deliver a buy order of fault level mitigation solutions based on a cost benefit analysis



Facilitates active management of fault current, using retrofit technologies and commercial services



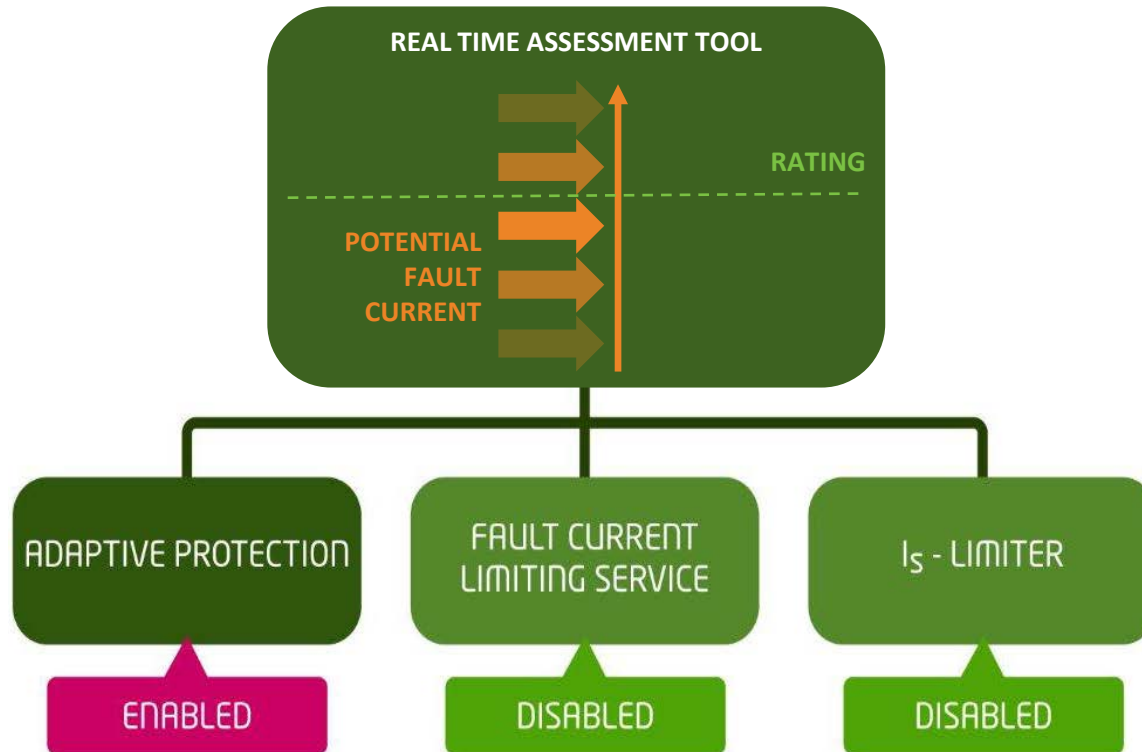
Enables a market for the provision of an FCL service



Uses existing assets with no detriment to asset health



Reduces bills to customers through reduced network reinforcement costs



- Real time fault current assessment
- Safe network operation
-



Network already designed to break fault current



Adaptive protection changes the order in which circuit breakers operate to safely disconnect the fault

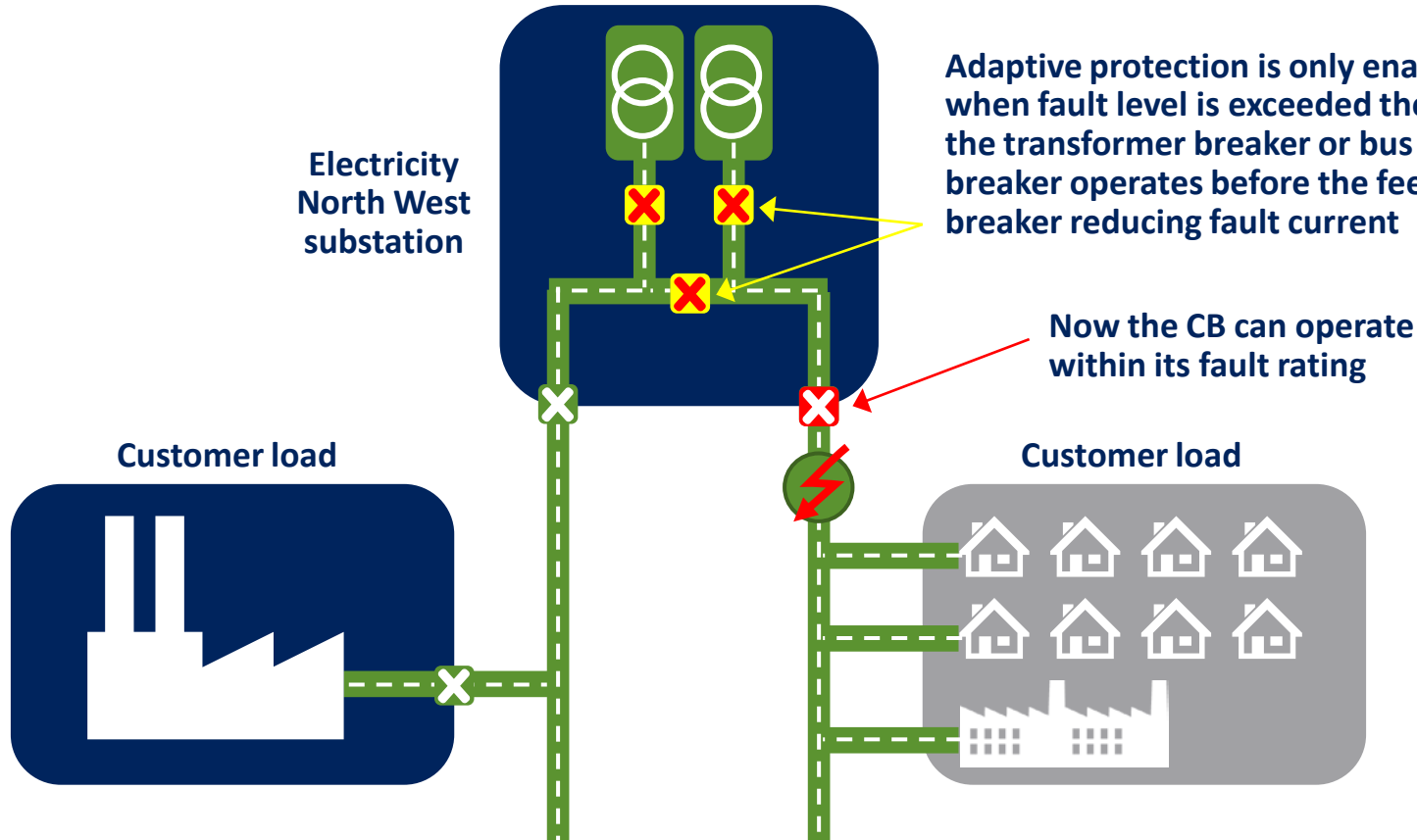


Using redundancy in the network ensures no other customers go off supply

Adaptive protection

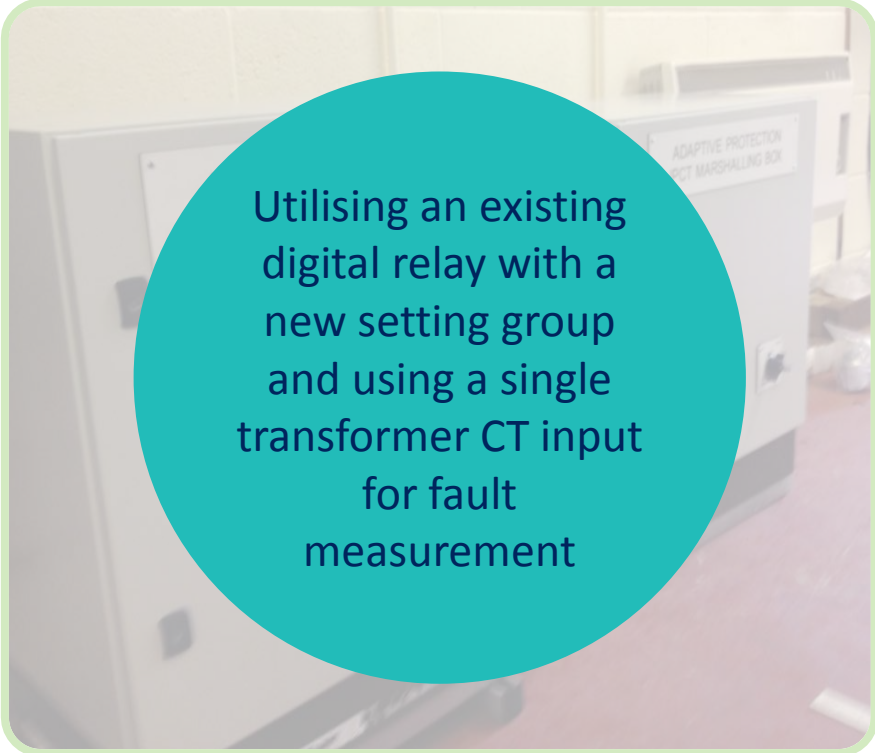


Adaptive protection

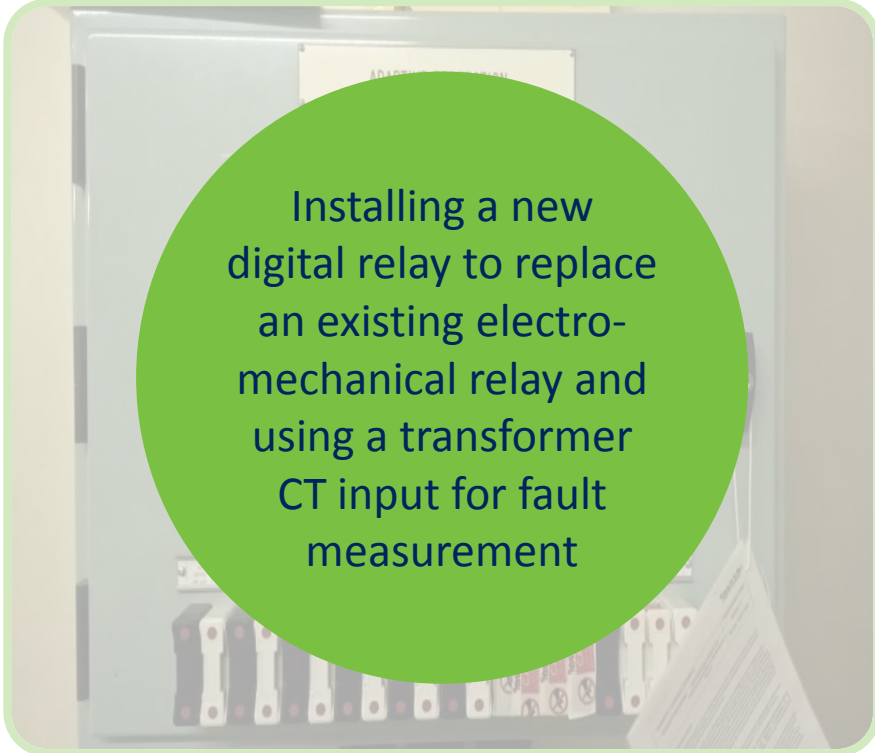




Alternative installation methods have been designed and installed to demonstrate that Adaptive Protection can be implemented by:



Utilising an existing digital relay with a new setting group and using a single transformer CT input for fault measurement



Installing a new digital relay to replace an existing electro-mechanical relay and using a transformer CT input for fault measurement

I_s-limiters – two sites and five sensing sites



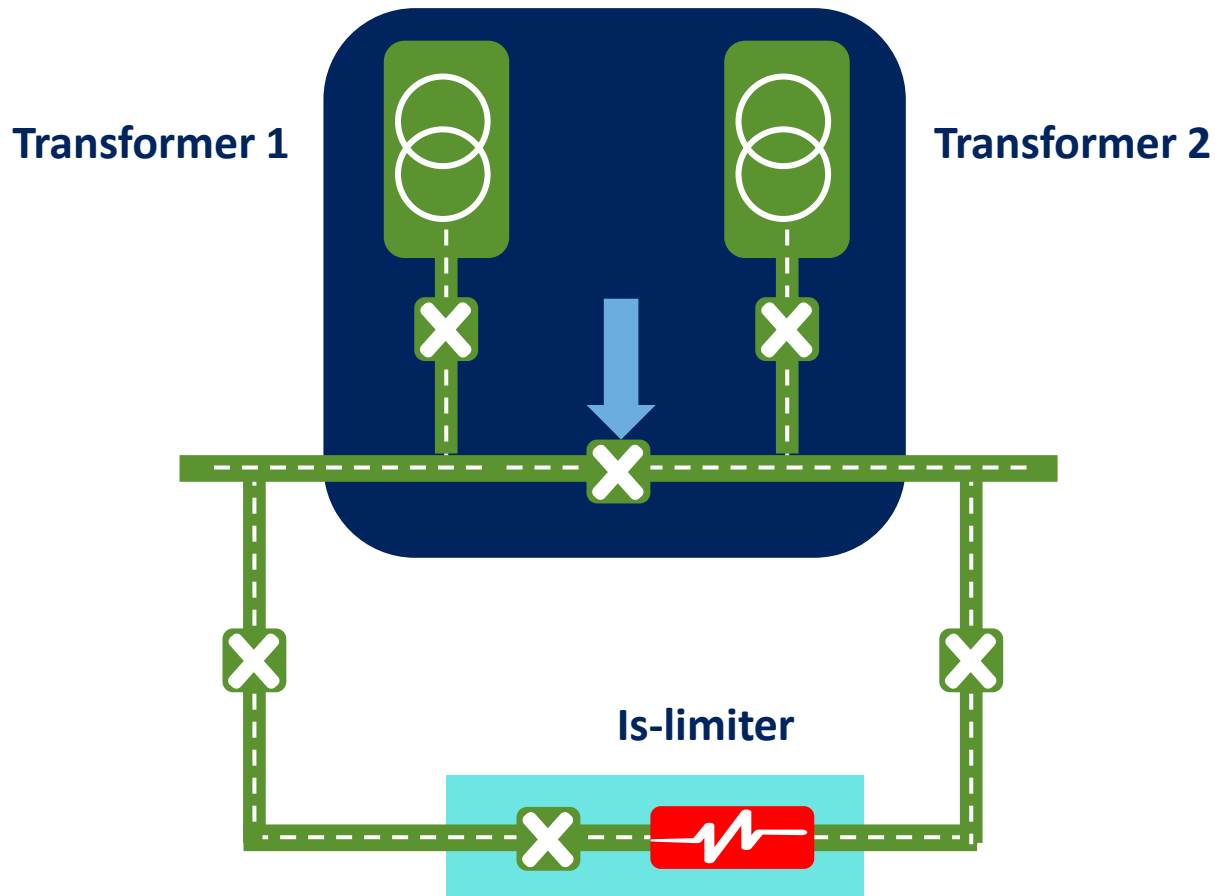
Operates within
5 milliseconds or
1/200th of a second

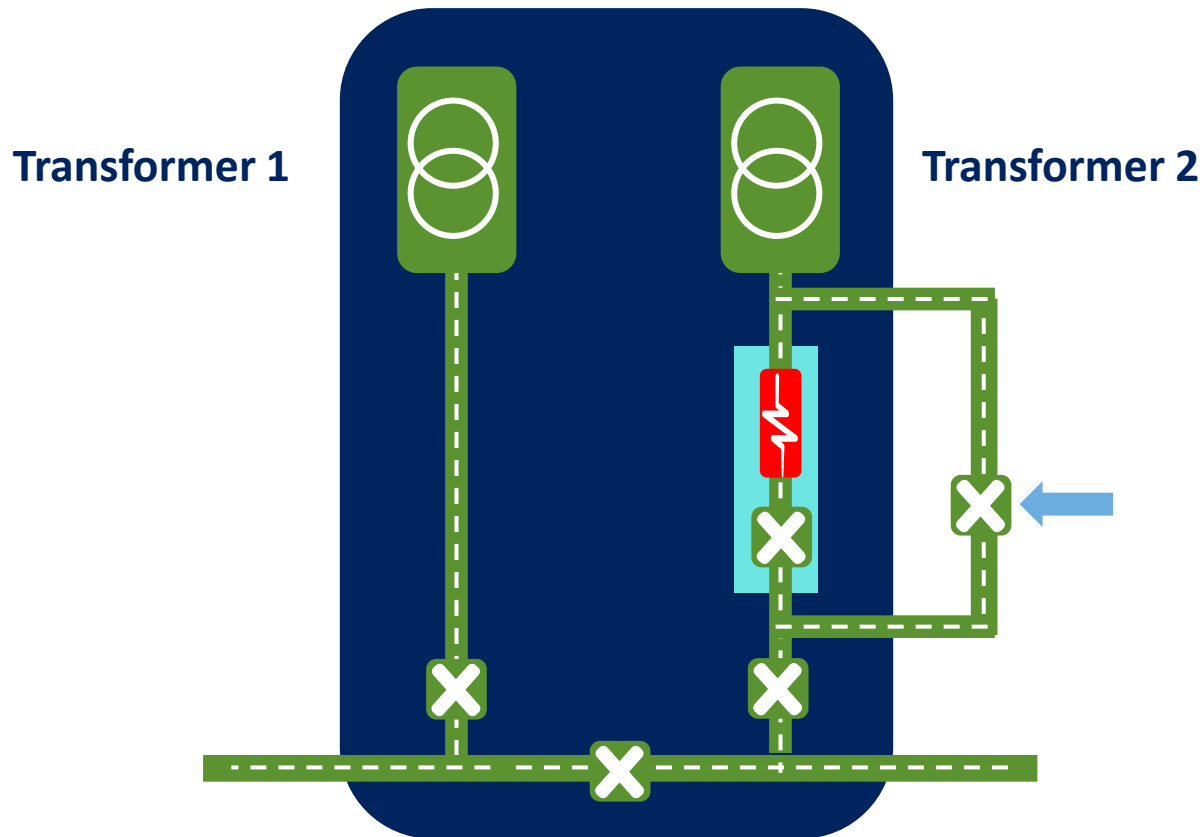


Detects rapid rise in current
when a fault occurs and
responds to break the
current



Respond will prove the
technology, review safety
case and deploy at two sites



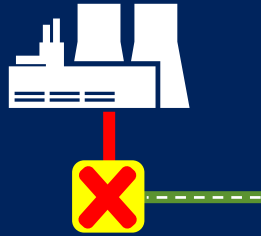






Fault Current Limiting (FCL) service

Two UU sites & three external sites



Fault current generated by customers can be disconnected using new technology



Financial benefits to customers taking part and long term to all customers



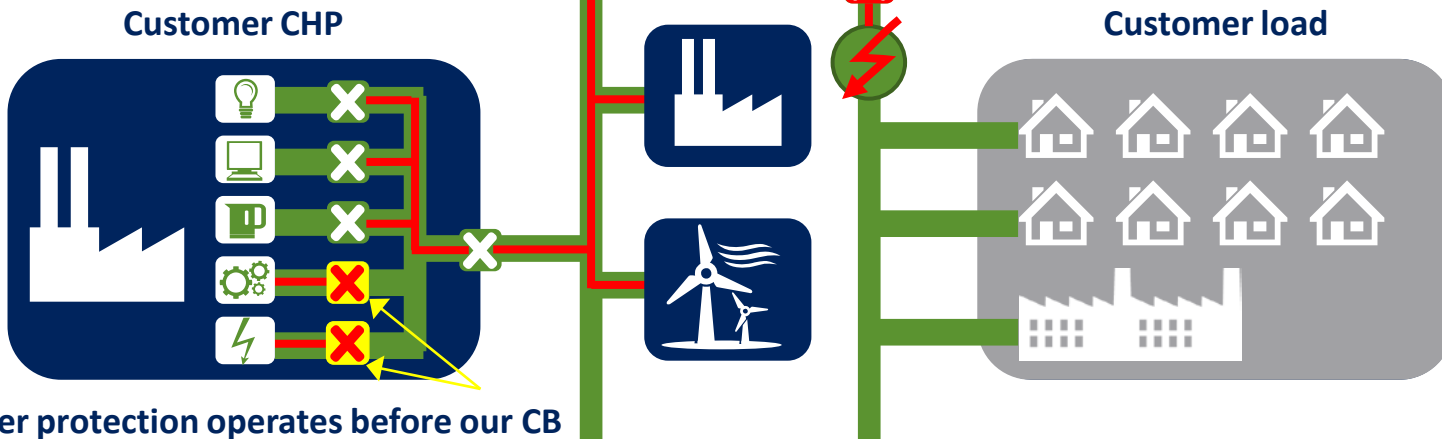
Challenge is to identify customers to take part in a trial of the FCL service

Fault Current Limiting service



FCL service is only enabled when fault level is exceeded then the customer's breaker operates before the feeder breaker reducing fault current

Electricity North West substation





Respond techniques

166 faults occurred across 14 Respond sites

11 successful operations of the Respond techniques

Eight adaptive protection operations at four different sites

Two I_s -limiter operations at Bamber Bridge and one I_s -sensing site

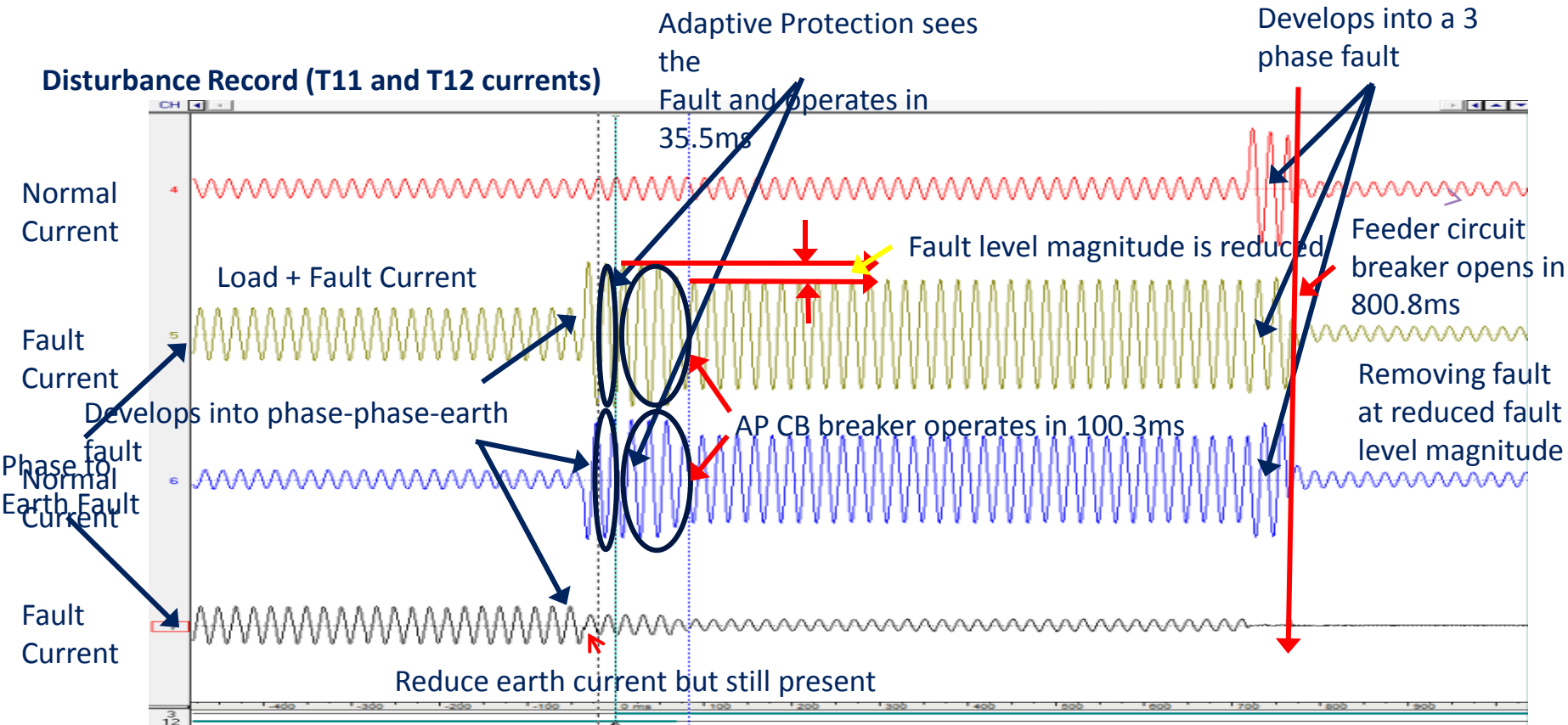
All techniques operated correctly as designed

No false operations or failures to trigger occurred

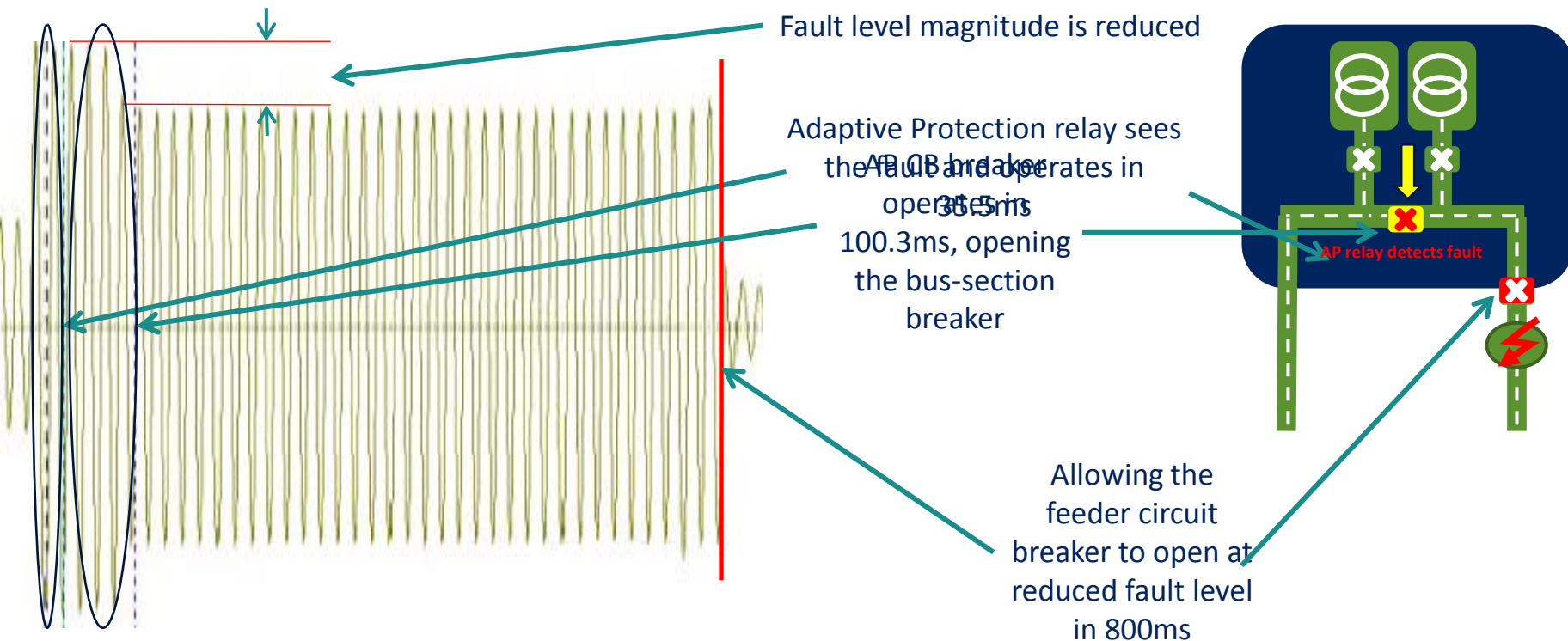
Supports the reliability of the techniques for the safety case



Disturbance Record (T11 and T12 currents)



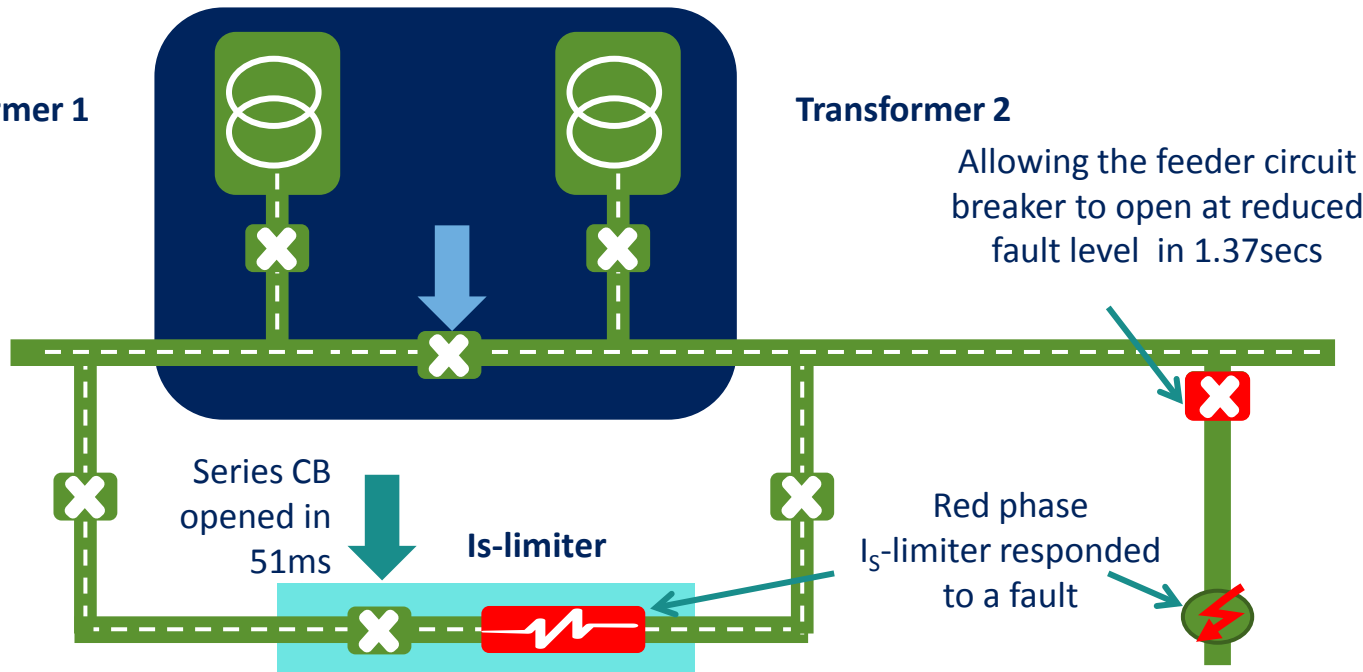
Waveform vs Sequence





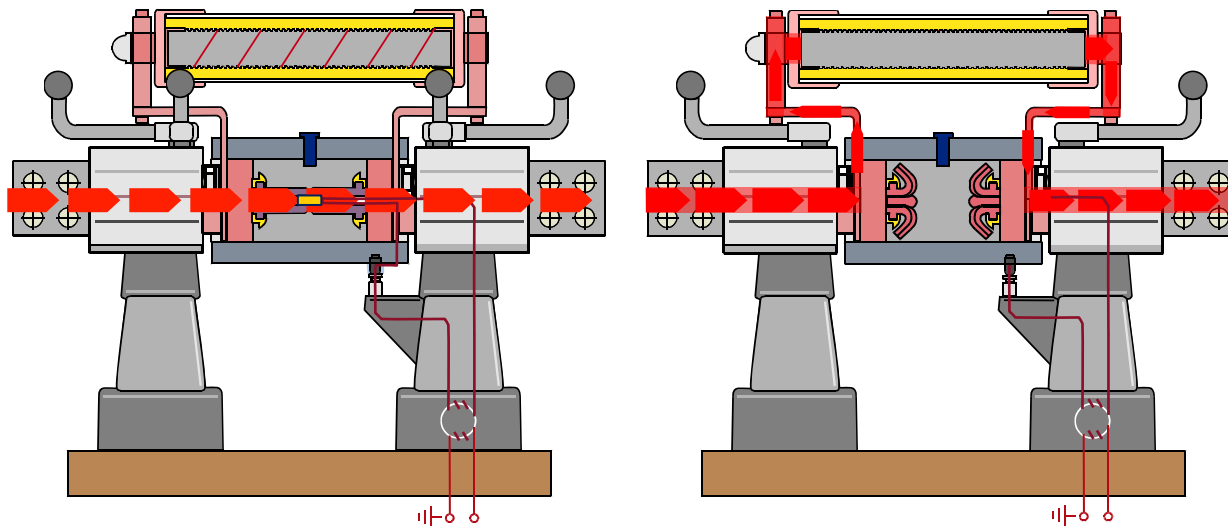
No waveforms are available due to the speed of operation of the I_s -limiter

Transformer 1





Function: Insert-holder with insert



Bamber Bridge red phase fuse



Bamber Bridge yellow phase fuse





Survey analysis
'appeared to prove'
the hypothesis that the

**Respond method enables a
market for an FCL service**



A target market was
identified of customers from
**non-manufacturing
industries** and those
**'able to constrain their motor
or generator'**
for up to 10 minutes, without
significant impact



Risks - barriers to transitioning from interest to agreeing terms



Essential to have electricity available 24/7 or a 10 minute constraint would have significant impact
Connection not within project timescale or not connected in parallel



Nervousness about the number of constraints
Long and short term impact on equipment / increased maintenance



Impact on operation of their business & loss of export ability
Breach of service level agreements (Triad & capacity market) & reputation



Unease at relinquishing control of equipment
Arrangements for re-closure / having staff on standby



Financial incentive = key driver for target market
But only if sufficient to offset all risks AND the revenue from other commercial arrangements

Prototype built to demonstrate a FCL service modules

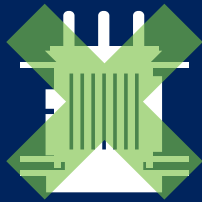


External view of the RTU and AP panel used to communicate and control with the FCL service installation

Internal view of the RTU

Internal view of the FCL service protection Adaptive Protection panel





Decommission the Respond assets



Health study review based on condition monitoring analysis



Carbon impact study on Respond vs traditional approaches



Complete and peer review the safety cases for each of the Respond techniques



Update our policy and procedures to use the Respond techniques



Closedown report