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Breakout Session 4.3
Dealing with faults

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Engineering & Technical Director

LCNI Conference
Thursday 7 December 2017

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Agenda

Respond	Powerful-CB and Fault Forecasting	SINE Post: Fault location through power quality measurements
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Paul Marshall	Laura Daniels	Mourad Khaddoumi

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RESPOND
Active Fault Management

Paul Marshall

Innovation Project Manager

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Agenda

LCN Fund Low Carbon Networks	RESPOND	
Introduction	Project overview	Respond techniques
		
Trials & analysis	Customer	Next steps

Respond overview

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

LCN Fund
Low Carbon Networks

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**

Project partners

KELVATEK, WSP, ENER-G, ABB, Impact Research, United Utilities, ade

Financial benefits

Up to £2.3bn to GB by 2050

Respond project hypotheses

Faster and cheaper to apply than traditional reinforcement

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

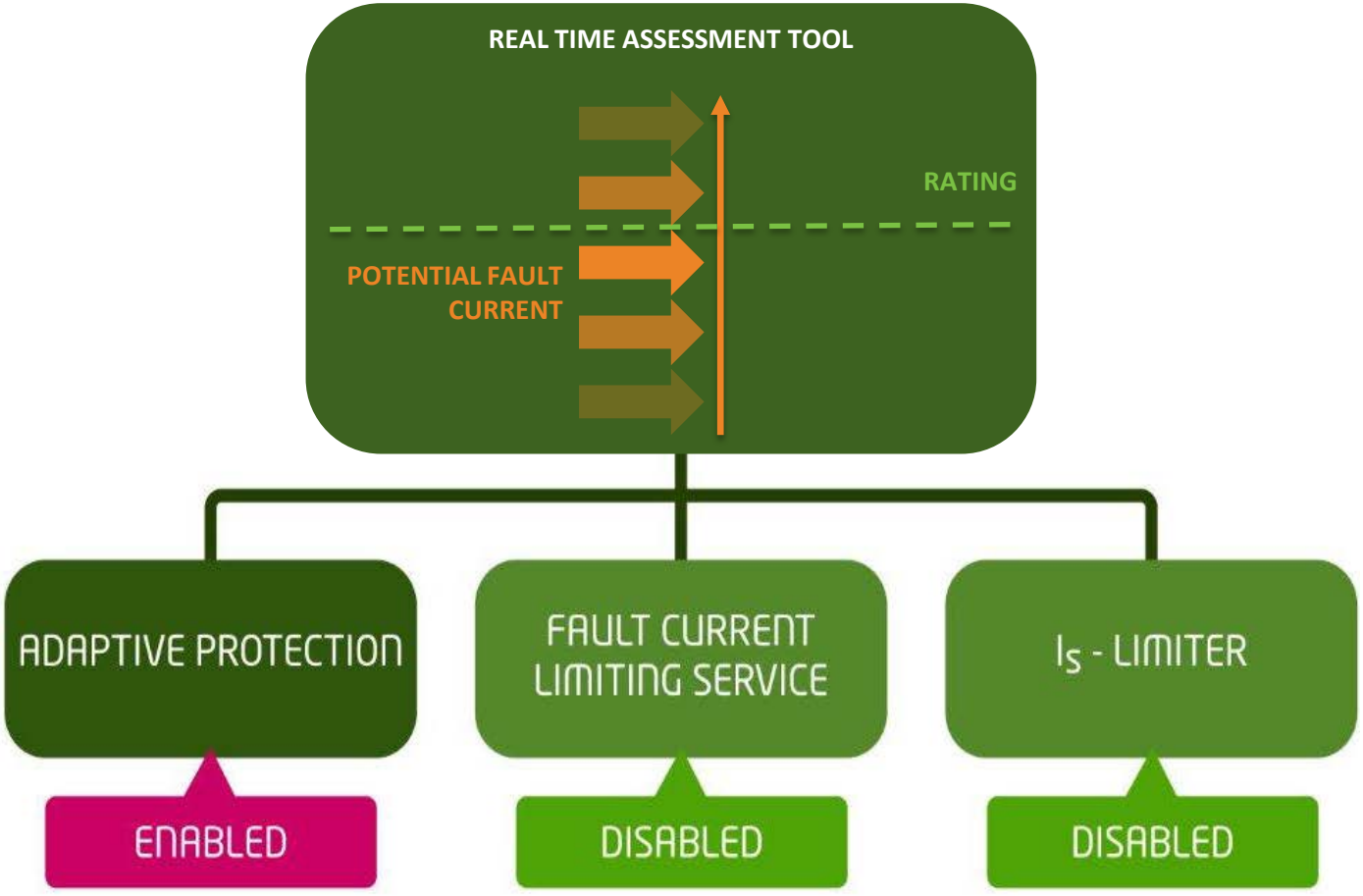
Facilitates active management of fault current, using retrofit technologies and commercial services

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 mitigation techniques



● Real time fault current assessment ● Safe network operation ●

Adaptive Protection at seven sites

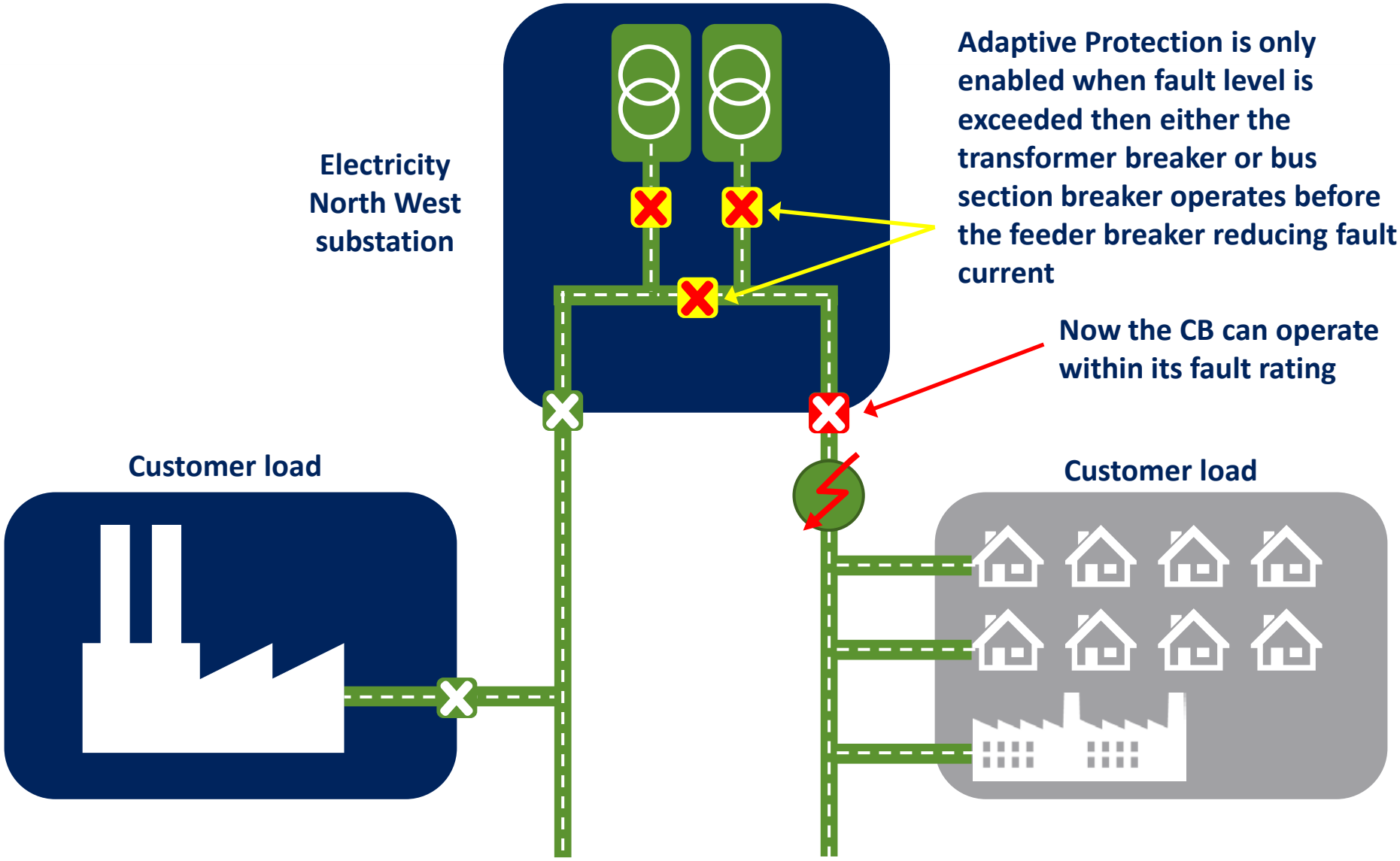
Network already designed to break fault current

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



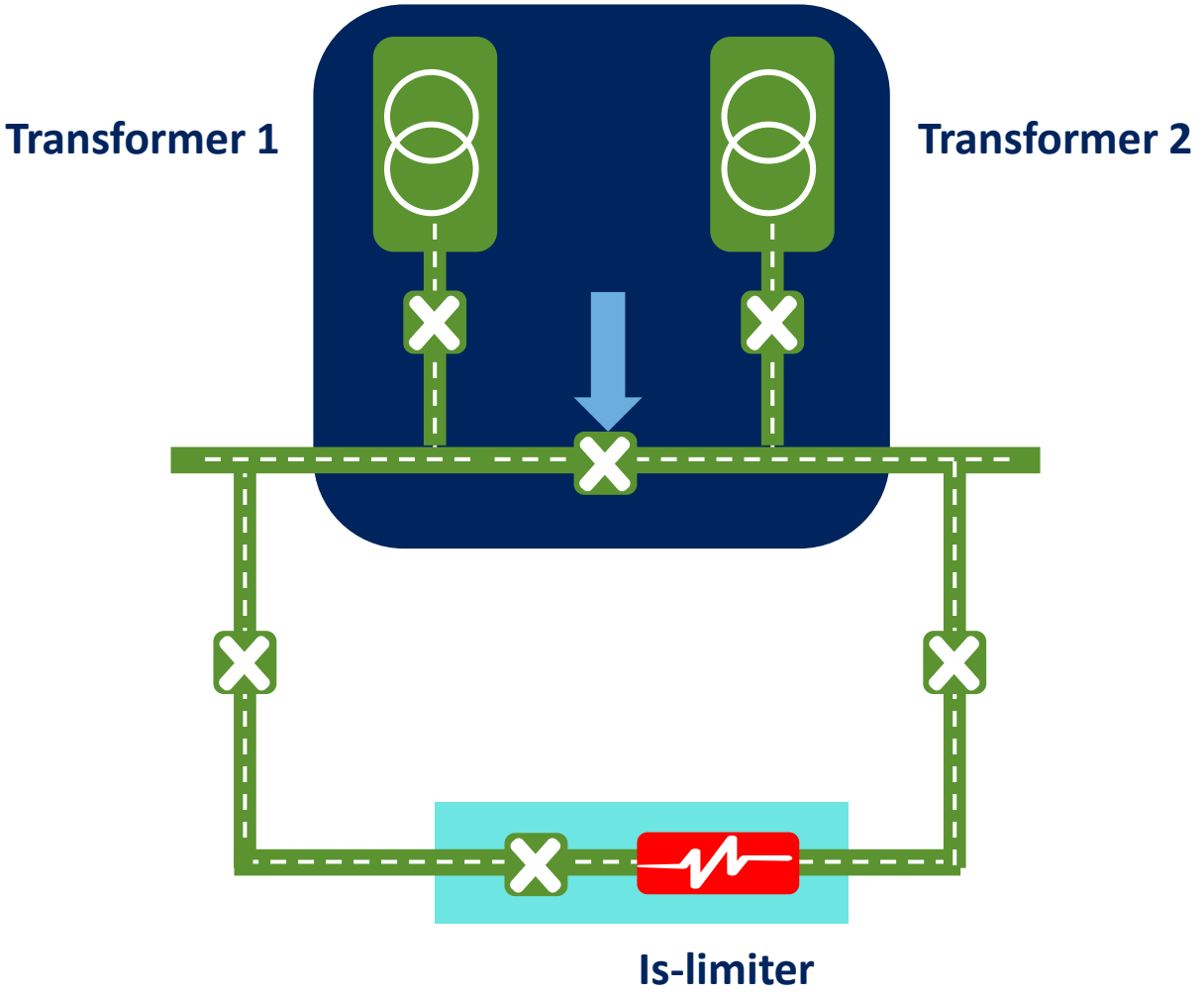
I_S-limiters – two sites and five sensing sites

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

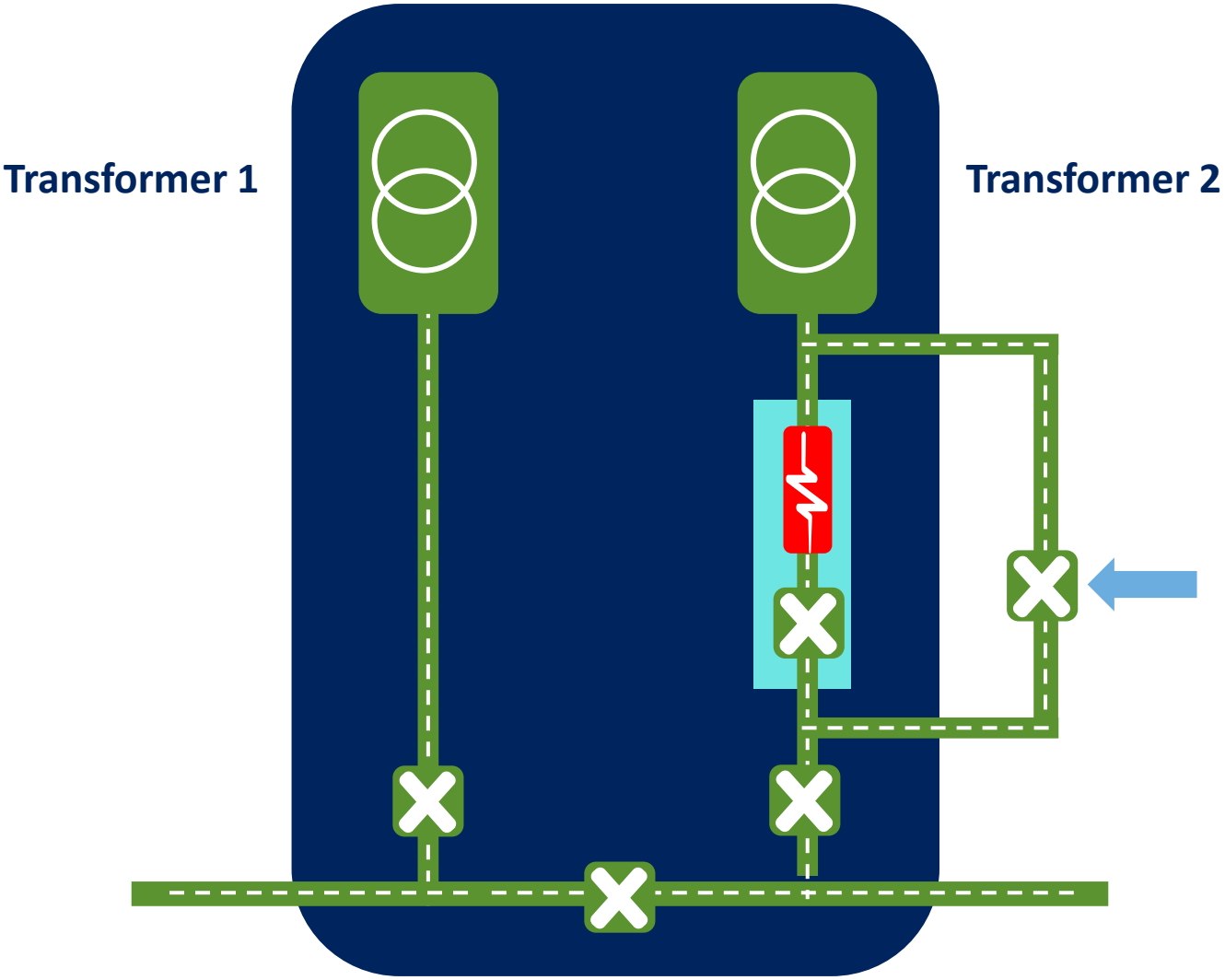
Detects rapid rise in current when a fault occurs and responds to break the current

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

I_S –limiter – Bamber Bridge



I_S –limiter – Broadheath



I_S-limiter sites

I_S -limiter

Fault Current Limiting (FCL) service
Two UU sites and three external sites

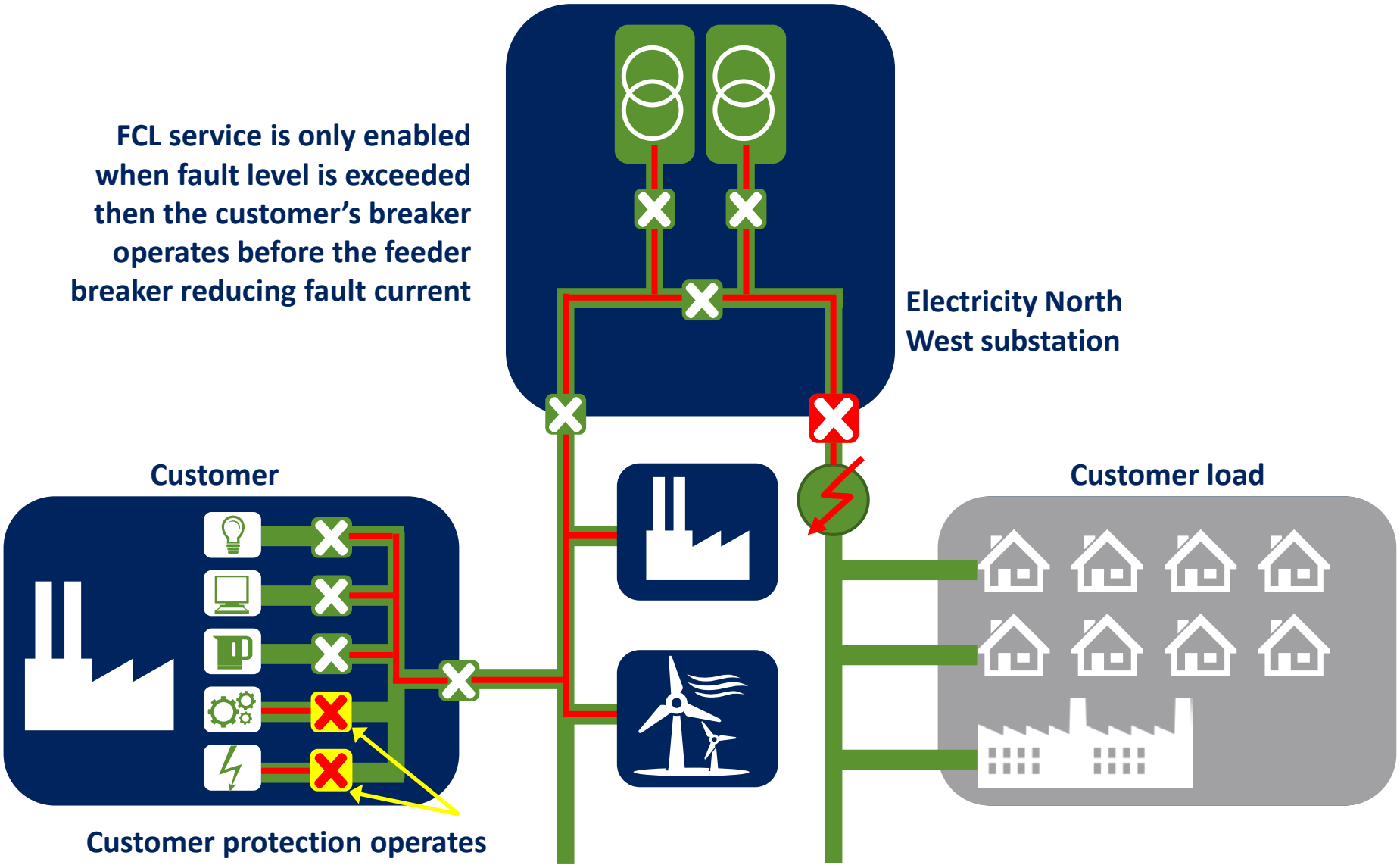
Fault current generated by customers can be disconnected using new technology

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

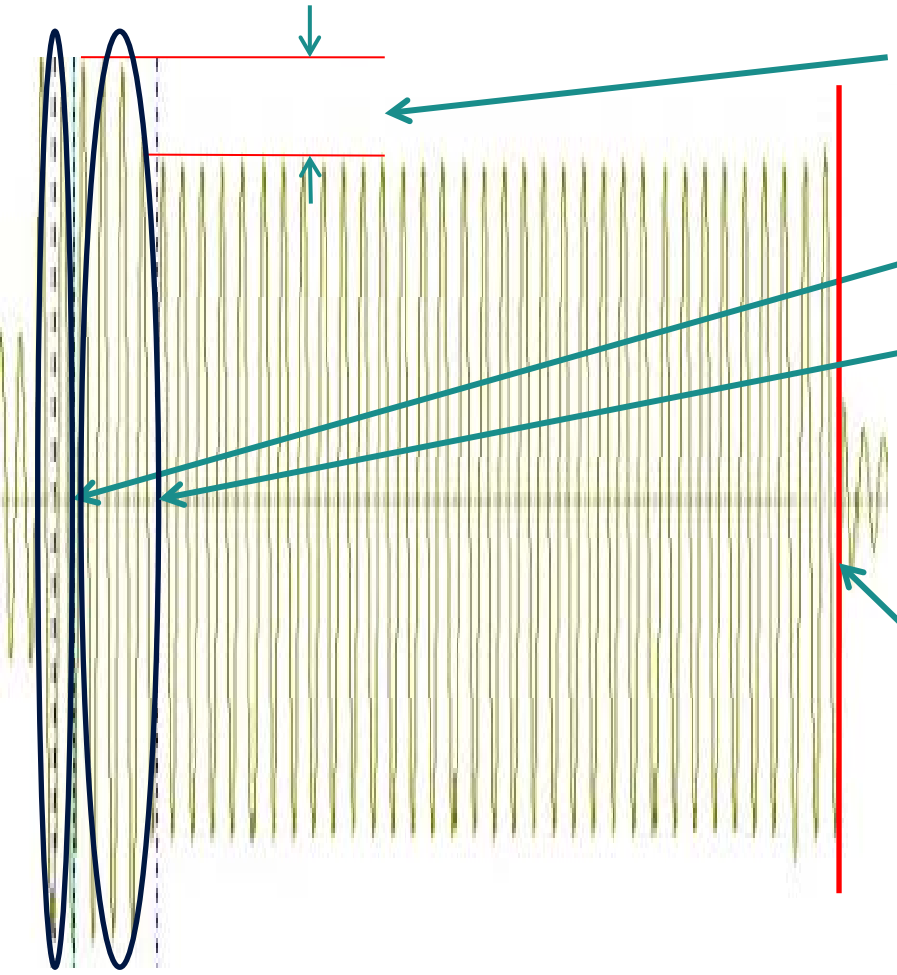


Trials and analysis phase

Respond techniques

- 105 faults occurred across 14 Respond sites
- Nine successful operations of the Respond techniques
- Seven adaptive protection operations at four different sites
- Two I_S-limiter operations at Bamber Bridge
- All techniques operated correctly as designed
- No false operations or failures to trigger occurred
- Supports the reliability of the techniques for the safety case

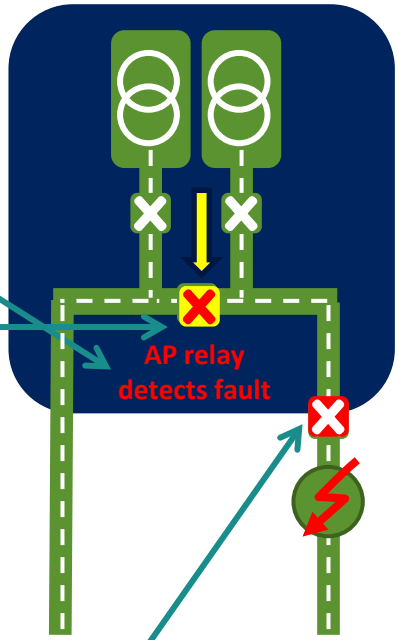
Waveform vs Sequence



Fault level magnitude is reduced

Adaptive Protection relay sees the fault and operates in 35.5ms

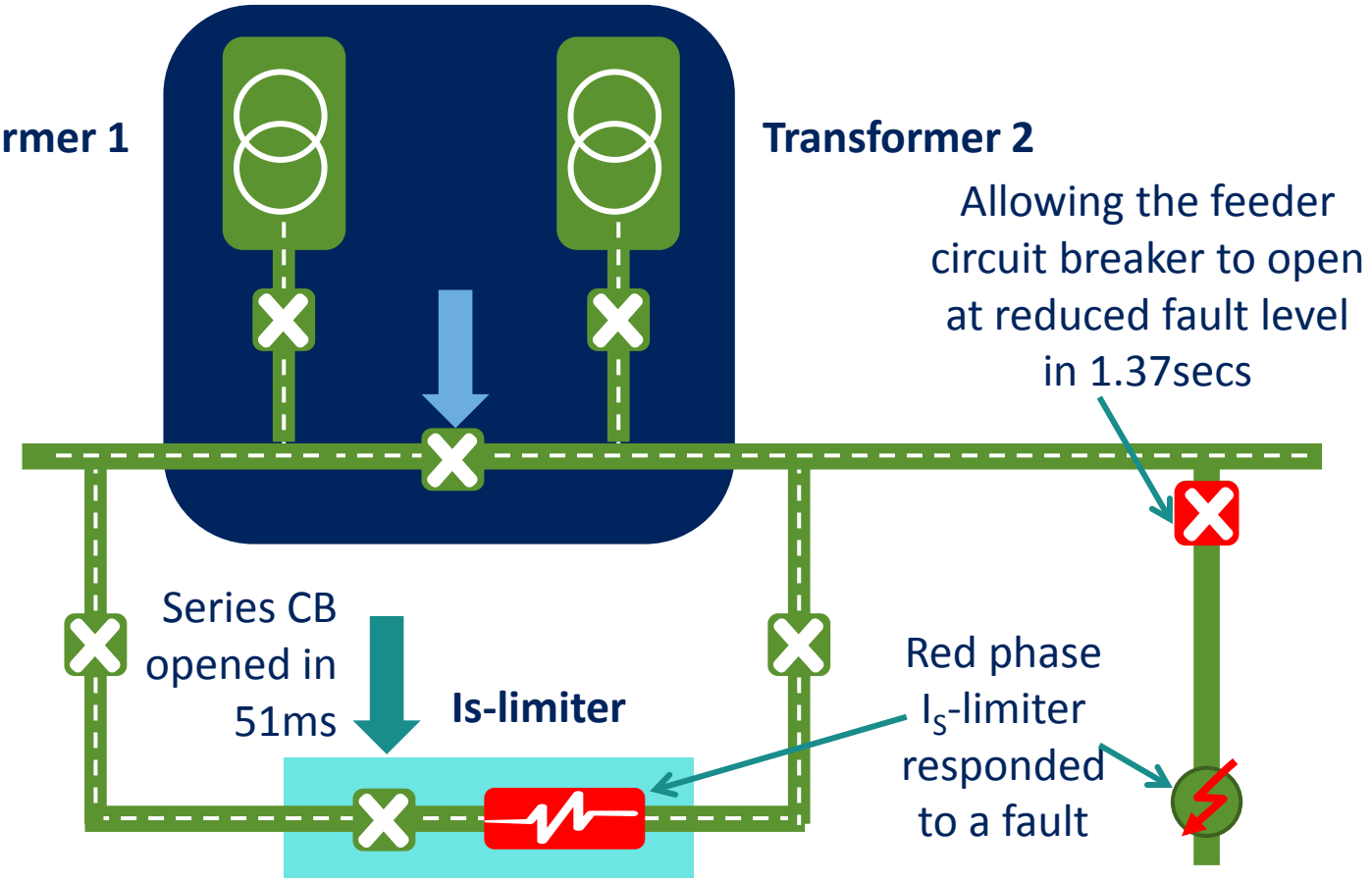
AP CB breaker operates in 100.3ms, opening the bus-section breaker



Allowing the feeder circuit breaker to open at reduced fault level in 800ms

I_S –limiter Bamber Bridge 22nd May 2017

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



Bamber Bridge red phase fuse

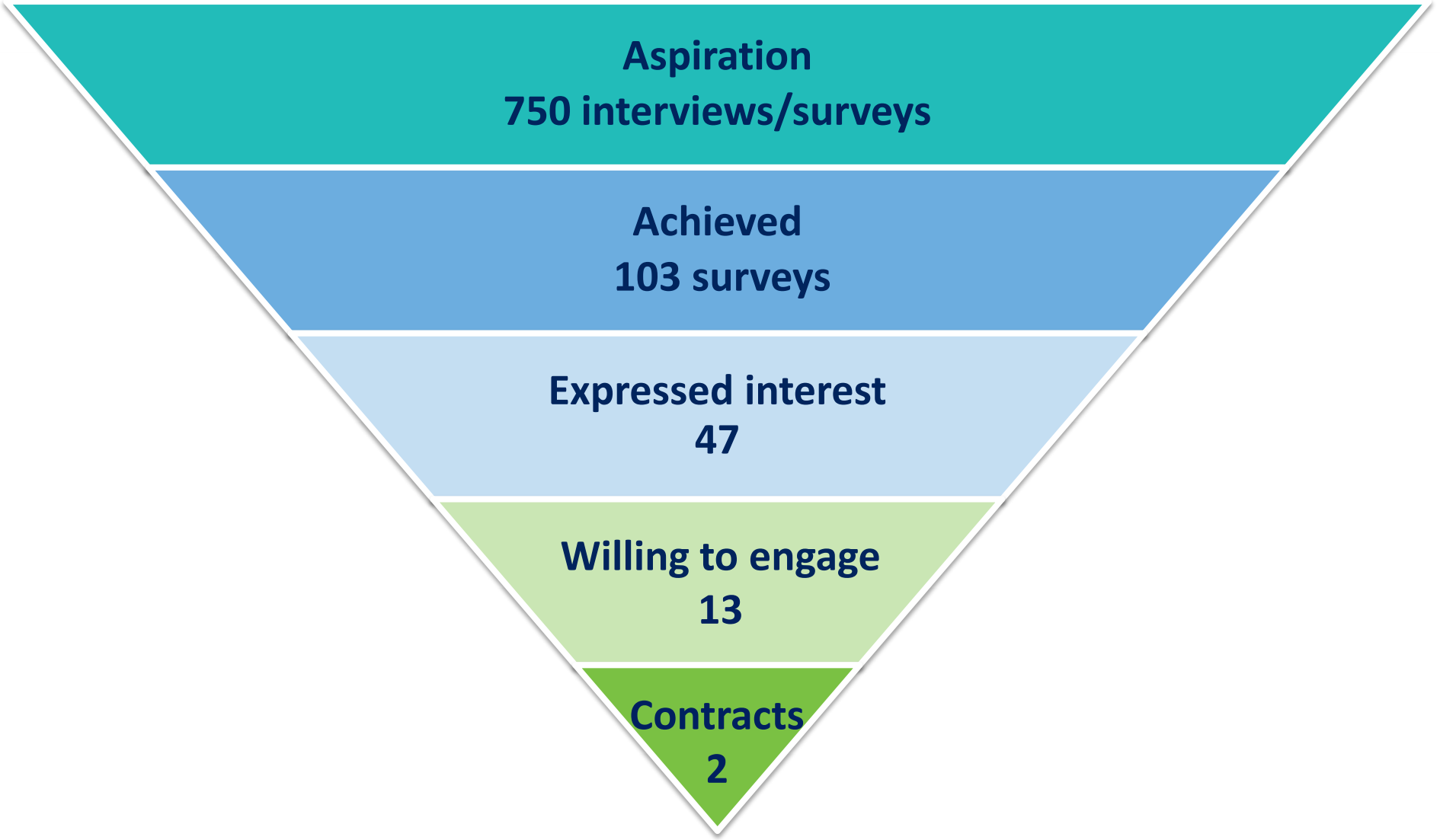
Fault Current Limiting service

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

The reality – challenges of engaging with customers



Lessons learned from customer engagement

DNO community must develop greater commercial understanding of its target market

Transition from expression of interest to active participation in FCL service identifies need for greater awareness	Loss of critical plant, even for a short duration, can have a significant impact	Assessment of risk verses the incentives and saving available is fundamental in an organisation's decision-making process	Conflicts with other services are a significant barrier DNOs need to better understand services already available in expanding and competitive marketplace	While there are potential conflicts, equally there could be possible synergies which warrant further investigation

Next steps

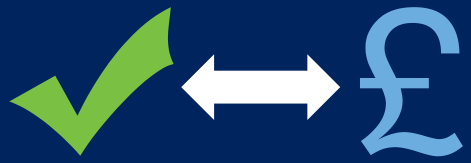
Continue to deploy the FLAT and the three techniques

Trial ongoing until May 2018

Examine the key questions and hypotheses

Customer recruitment phase for FCL service

Build safety cases for each of the techniques



Examine the relative benefits versus financials for the three techniques

For more information

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