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Electrical Network Improvements and System Operability

LCNI Conference

Wednesday 17 October 2018

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RESPOND

Innovative Active Fault Management

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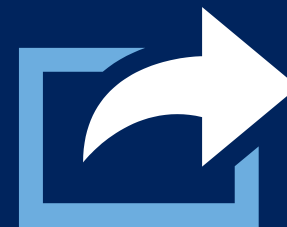
RESPOND



Introduction

Project overview

Adaptive protection



Is-limiter

Fault current
limiting service

Summary and
next steps



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

KELVATEK





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



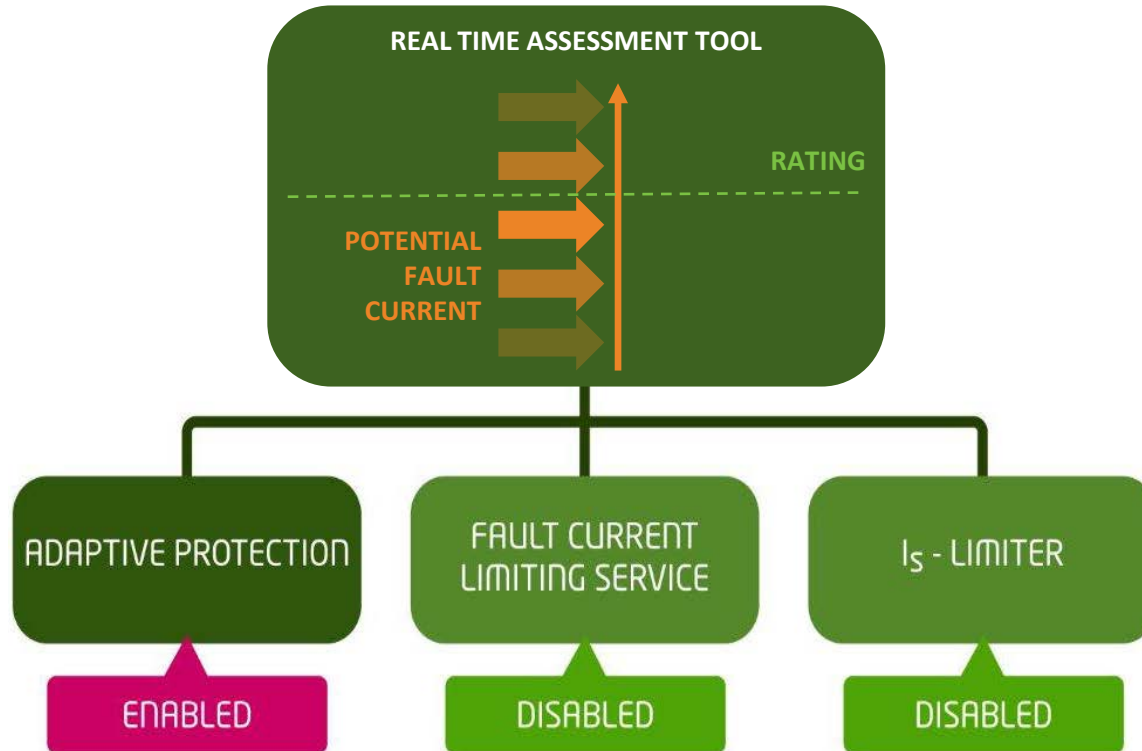
Enables a market for the provision of an FCL service



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
-



Real time calculation
successfully
demonstrated



Control of on-site
devices shown



Data issues led to
inaccuracies in results



Network already designed to break fault current

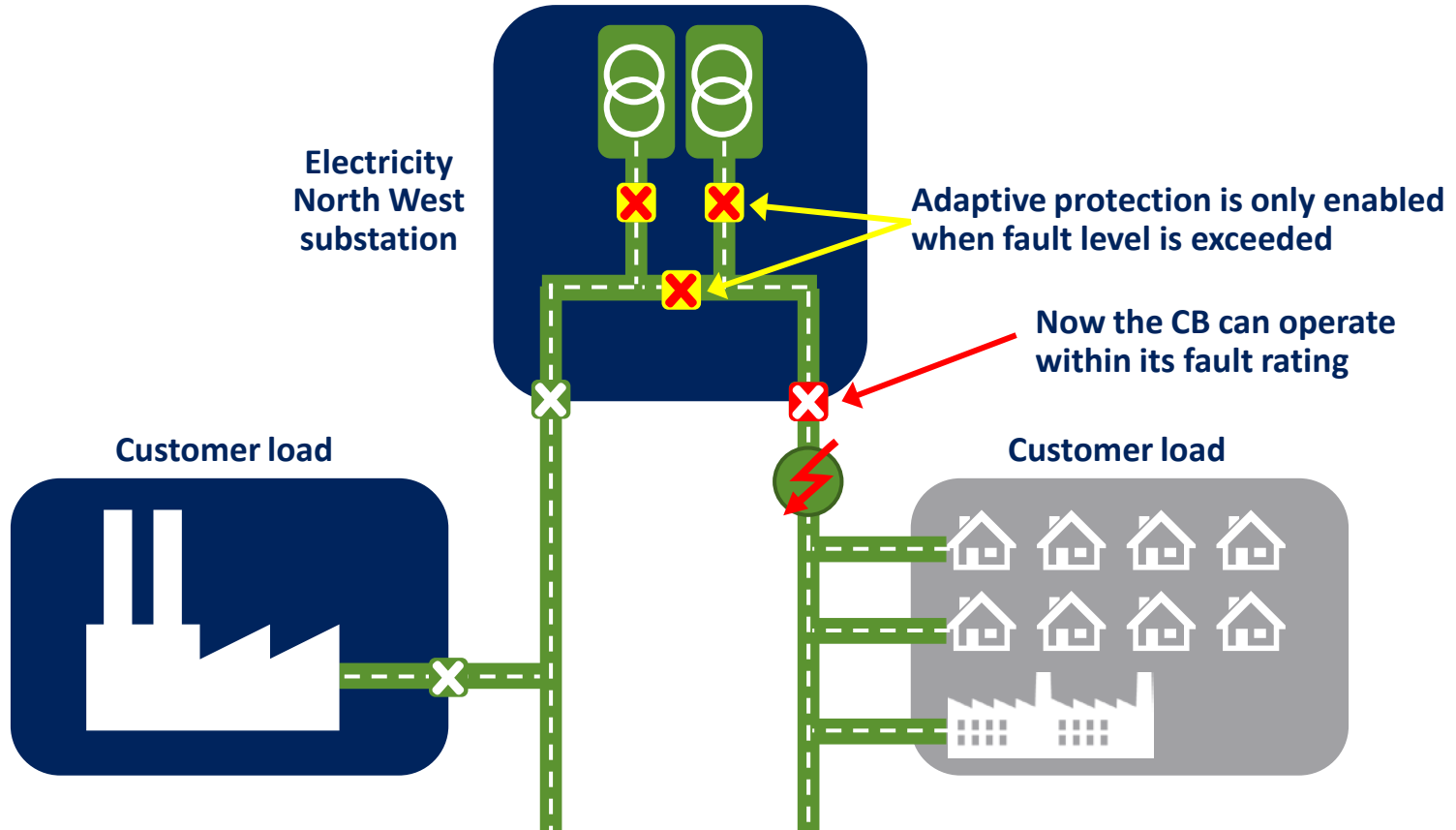


Adaptive protection changes the order in which circuit breakers operate to safely disconnect the fault



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

Adaptive protection





Eight successful operations of adaptive protection

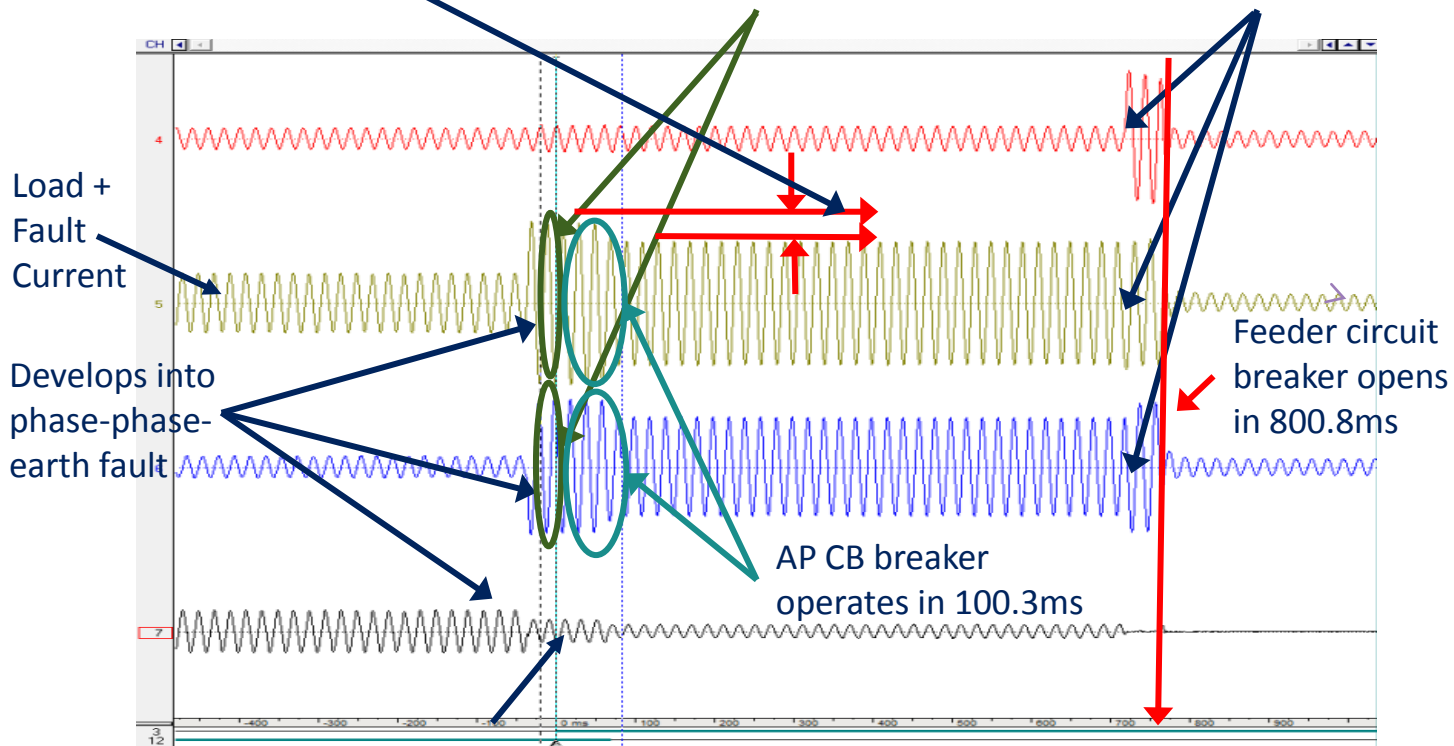
No mal-operations

Faults seen to develop

Fault level magnitude is reduced

Adaptive Protection sees the Fault and operates in 35.5ms

Develops into a 3 phase fault



Reduced earth current but still present



Two additional
designs
completed

Single digital
Tx relay variant

Single relay
integrated
with existing
analogue
protection

I_s-limiters – two sites and five sensing sites



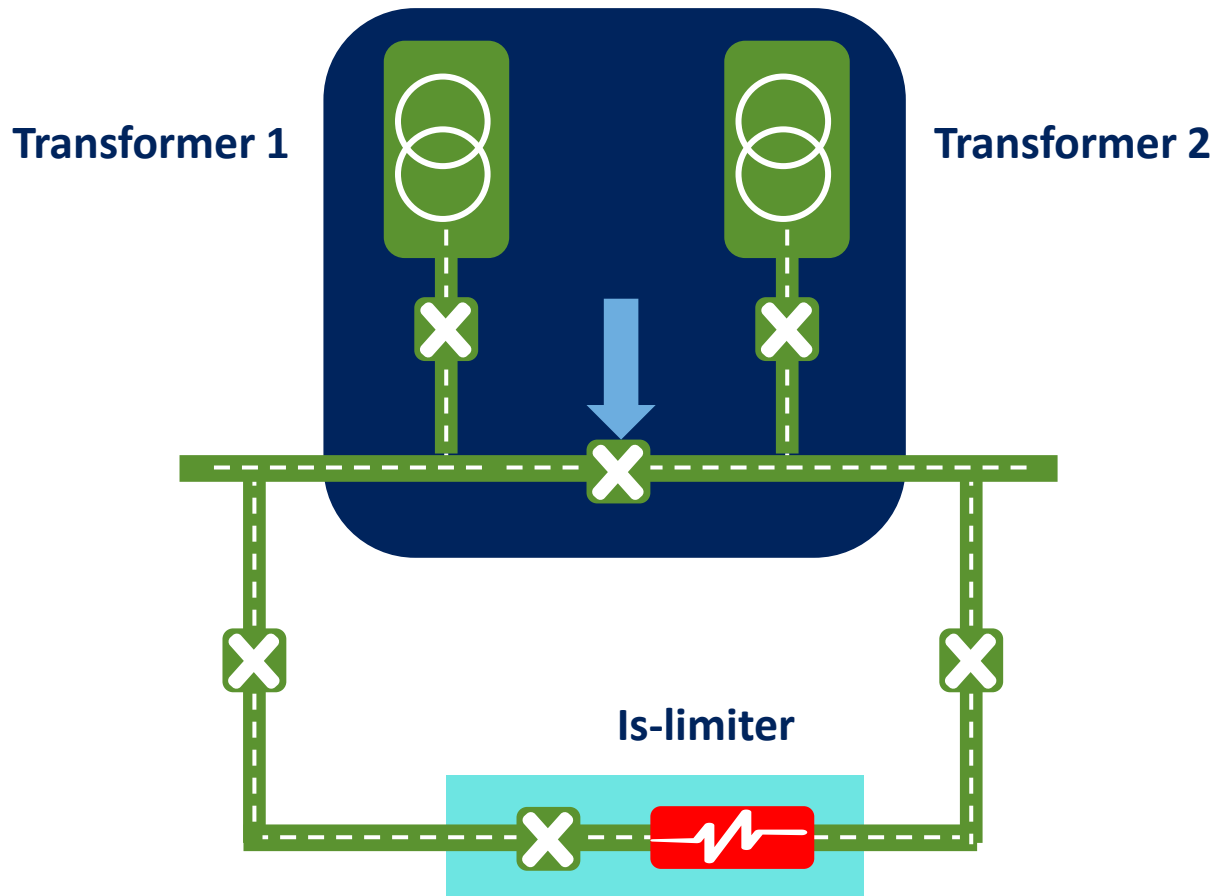
Operates within
5 milliseconds or
1/200th of a second

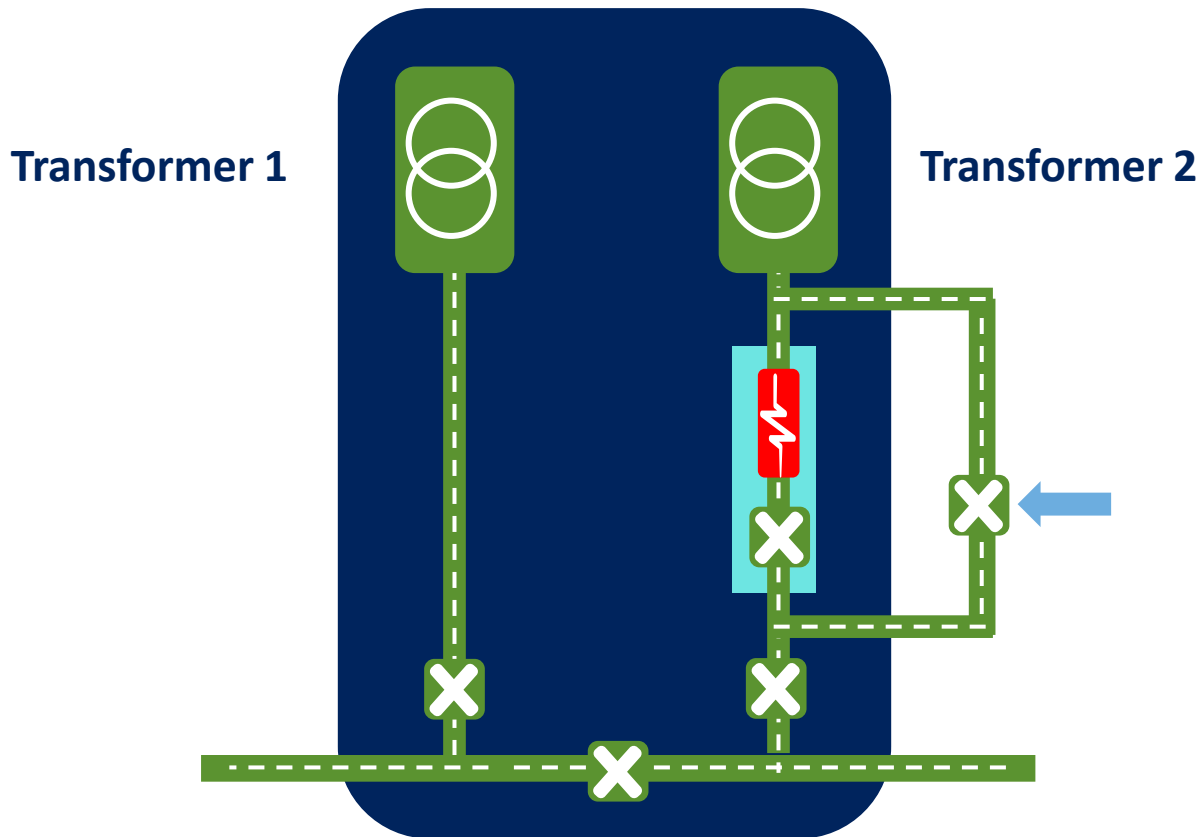


Detects rapid rise in current
when a fault occurs and
responds to break the
current



Respond has proven the
technology, reviewed the
safety case and deployed at
two sites







1

The red phase I_S -limiter responded to a fault and operated to interrupt the fault

2

The time interval between the Bamber Bridge local feeder earth fault alarm and the tripping of the I_S -limiter was 10 ms

3

The series circuit breaker opened 51 ms after the tripping of the I_S -limiter

4

The event log indicates that the Bamber Bridge local 11kV protection relay operated 1.371 seconds after the I_S -limiter series CB opened

5

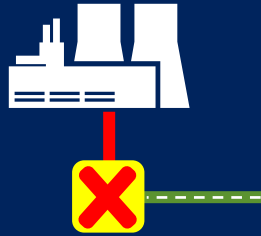
No waveforms are available

Bamber Bridge red phase fuse



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



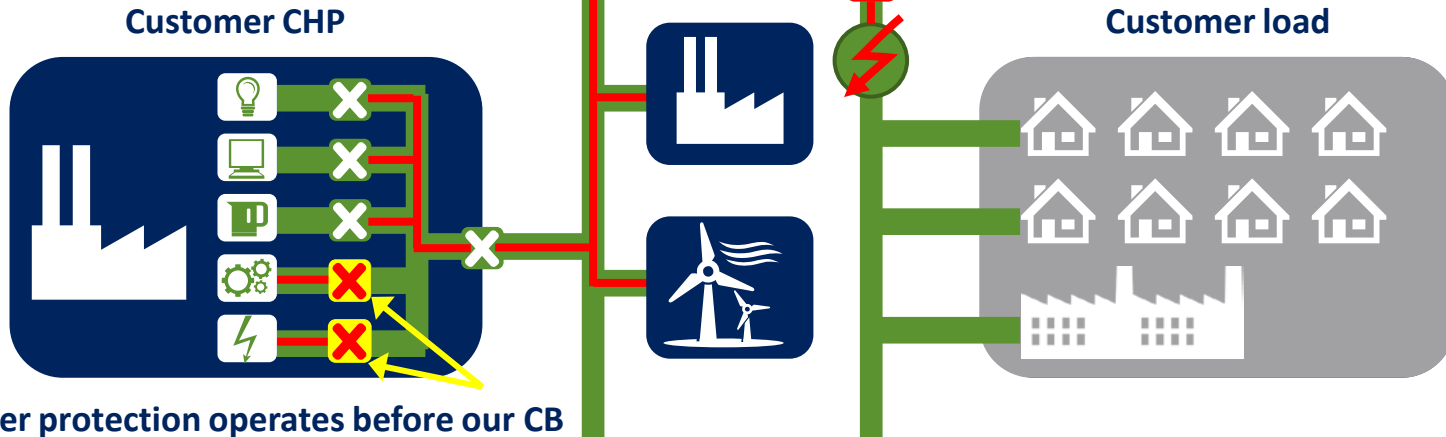
Challenge was to identify customers to take part in a trial of the FCL service

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



Customer protection operates before our CB

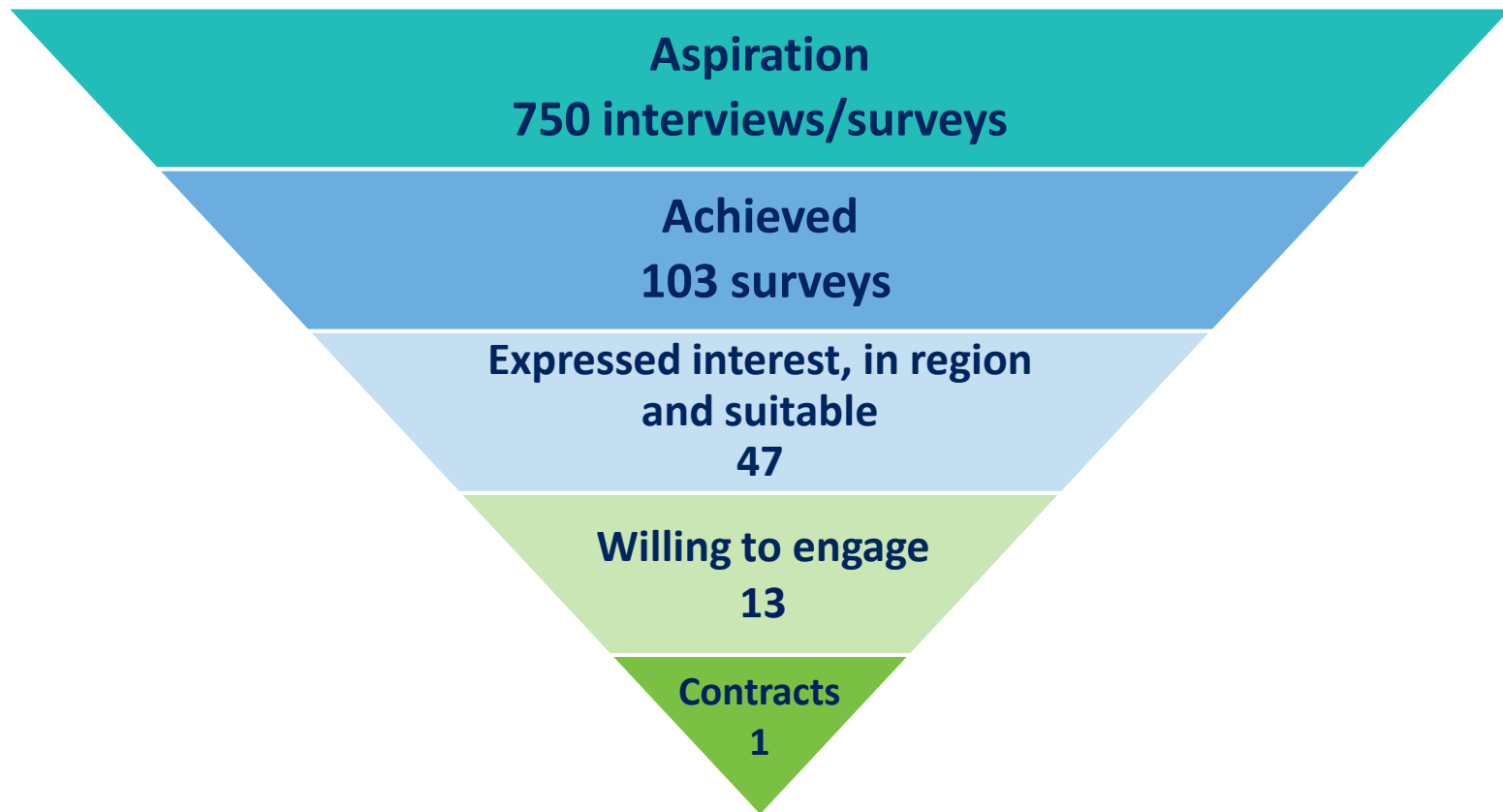


Survey analysis
'appeared to prove'
the hypothesis that the

**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 and capacity market) and 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



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



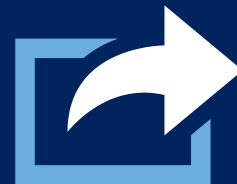
Loss of critical plant, even for a short duration, can have a significant impact



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



~ 10% of primary
switchboard
replacement costs
for adaptive
protection



I_s -limiters more
cost effective
when deferring
cable overlays



Up to
502,594kgCO_{2e}
for adaptive
protection



Up to
40,331kgCO_{2e}
for I_s-limiters



Extrapolates to
~7,432,431kgCO_{2e}
for a GB-wide
rollout



Demonstrated FLAT can be used to calculate near real-time fault levels and enable techniques



AP and Is-limiter were successfully implemented and can reduce fault level



FCL service is technically proven but there is currently no commercial appetite



Safety cases produced and peer reviewed for each technique



Closedown report – end October 2018



Update our policy and procedures to use the Respond techniques



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