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Innovation Learning Event

Wednesday 5 July 2017

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Respond Innovative Active Fault Management

Steve Stott
Innovation Engineer

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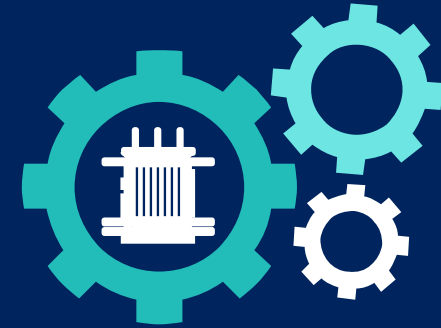
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Brief introduction to
Respond



Project aims



Fault mitigation
techniques



Results so far



Customer



Safety case for
techniques



Competitive competition

Funded by GB customers

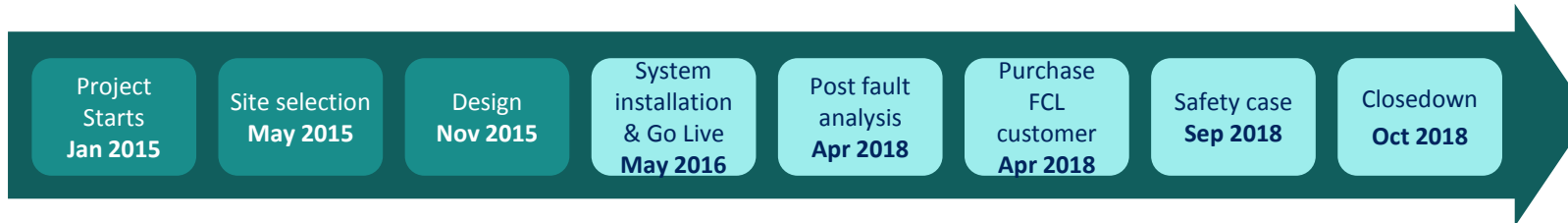
Learning, dissemination & governance

Fourth of our five successful Tier 2 / NIC projects



Investment

£5.5
million



Project partners

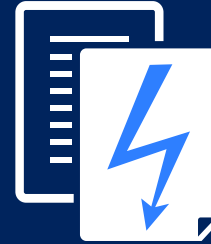


Financial
benefits

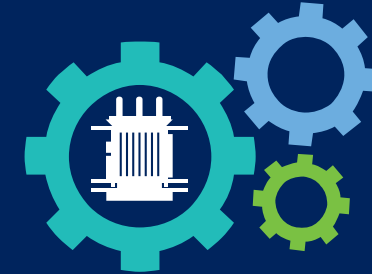
Up to £2.3bn
to GB by
2050



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



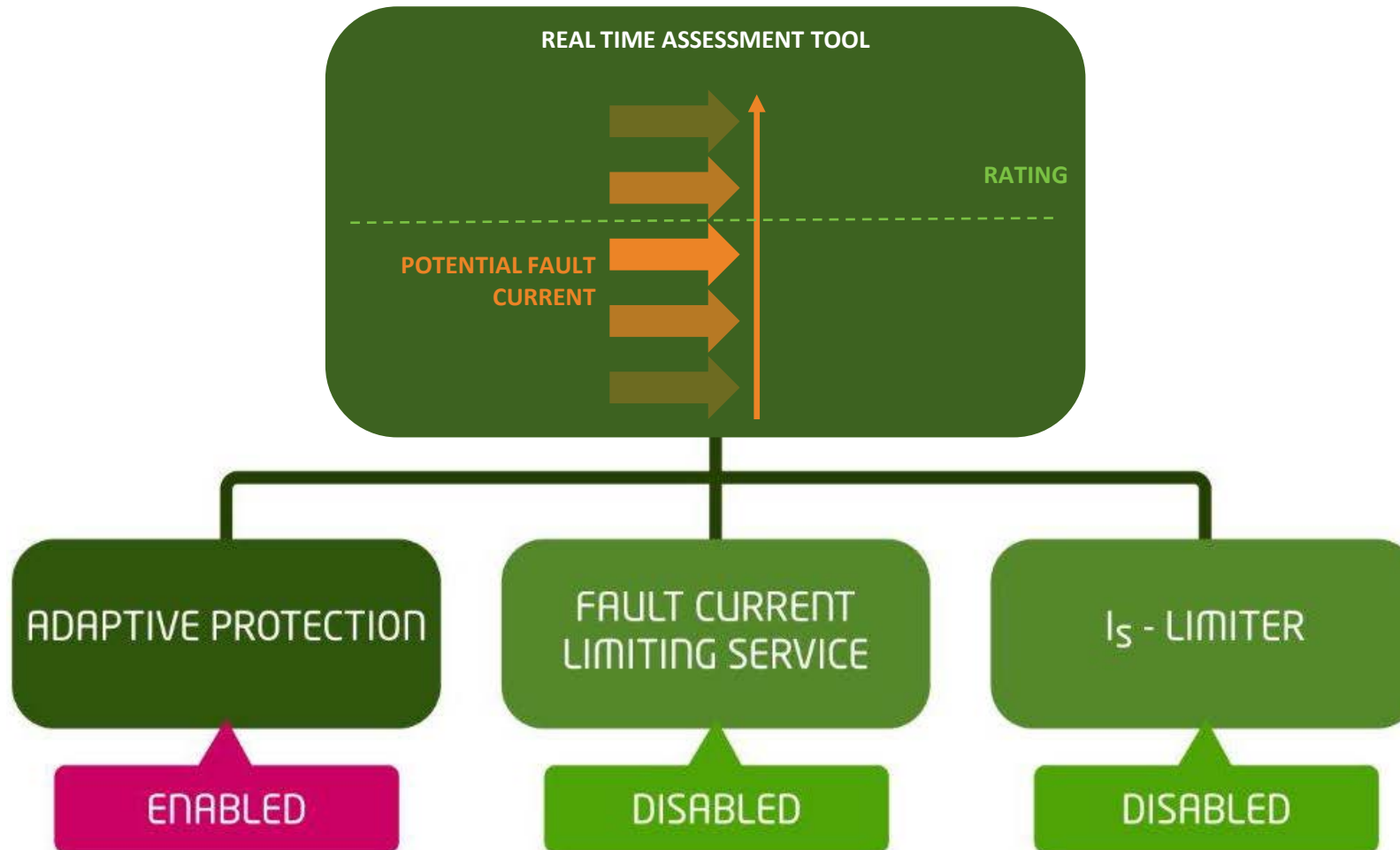
Enables a market for the provision of an FCL service



Uses existing assets with no detriment to asset health

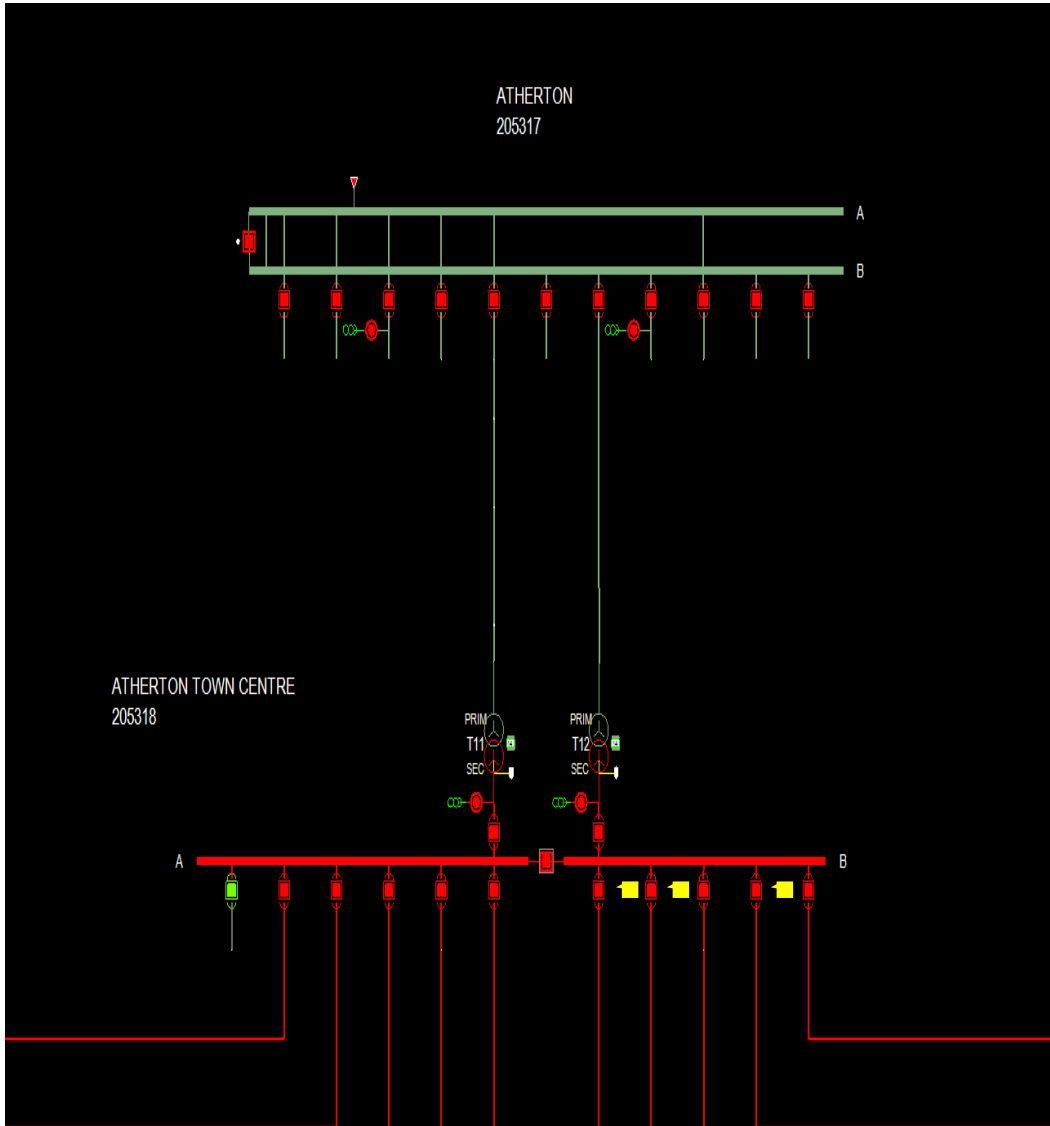


Reduces bills to customers through reduced network reinforcement costs



- Real time fault current assessment
- Safe network operation
-

Fault Level Assessment Tool



Fault level calculation
Trigger topology
Change/time



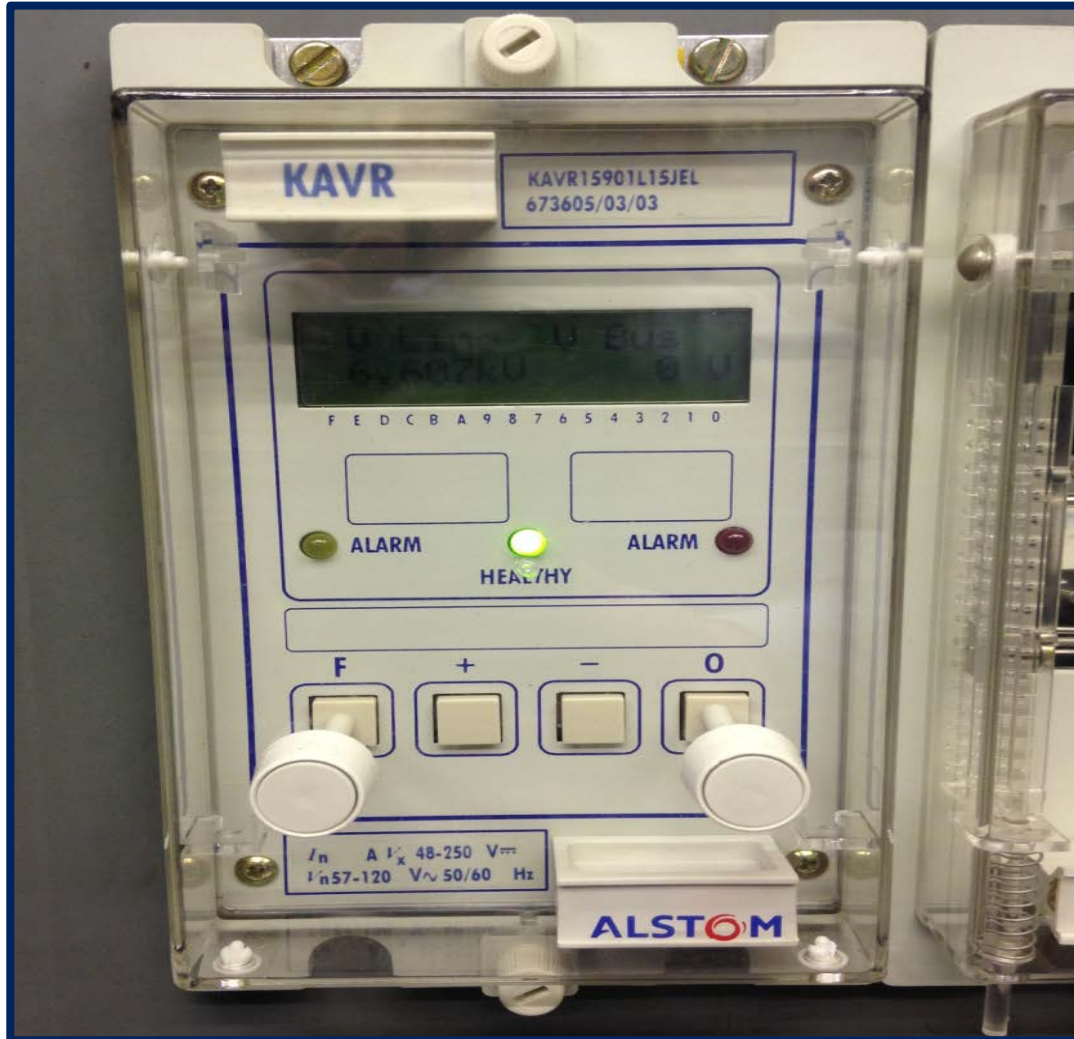
Compares calculated FL with
CB rating capacity
Symmetrical RMS break
IEC606909

DISABLE

ENABLE

Enable or disable fault level
mitigation technique signal
issued to respective site

Adaptive protection at five sites



Network already designed to break fault current

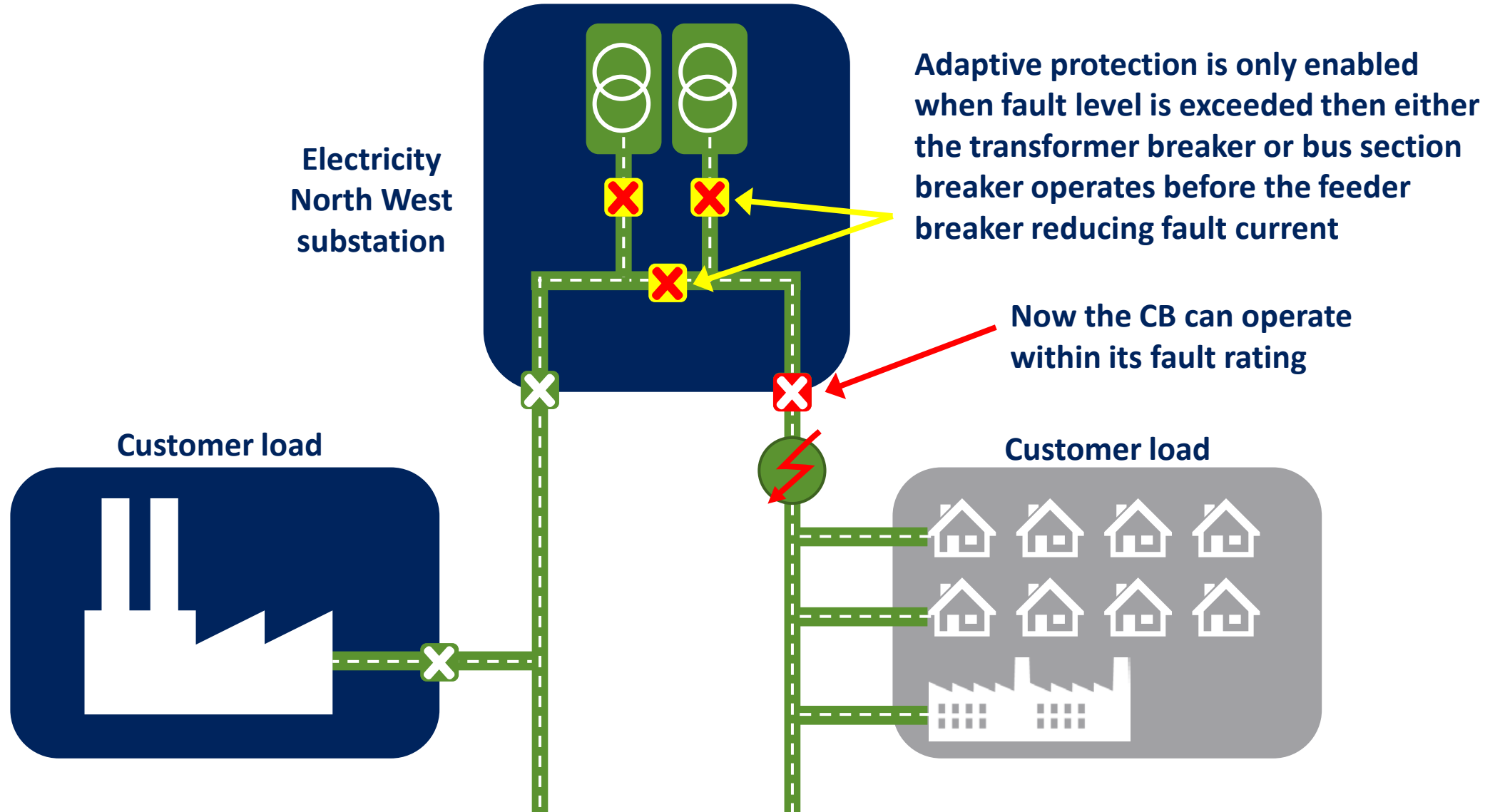


Adaptive protection changes the order in which circuit breakers operate to safely disconnect the fault



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

Adaptive protection



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

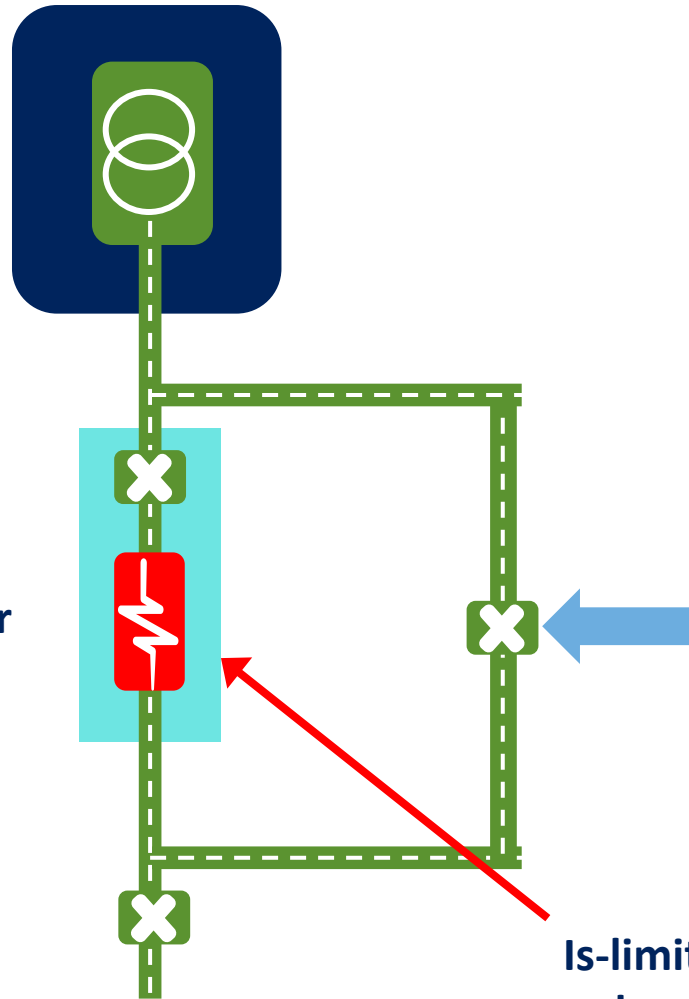


Respond will prove the technology, review safety case and deploy at two sites



Broadheath

Transformer 3

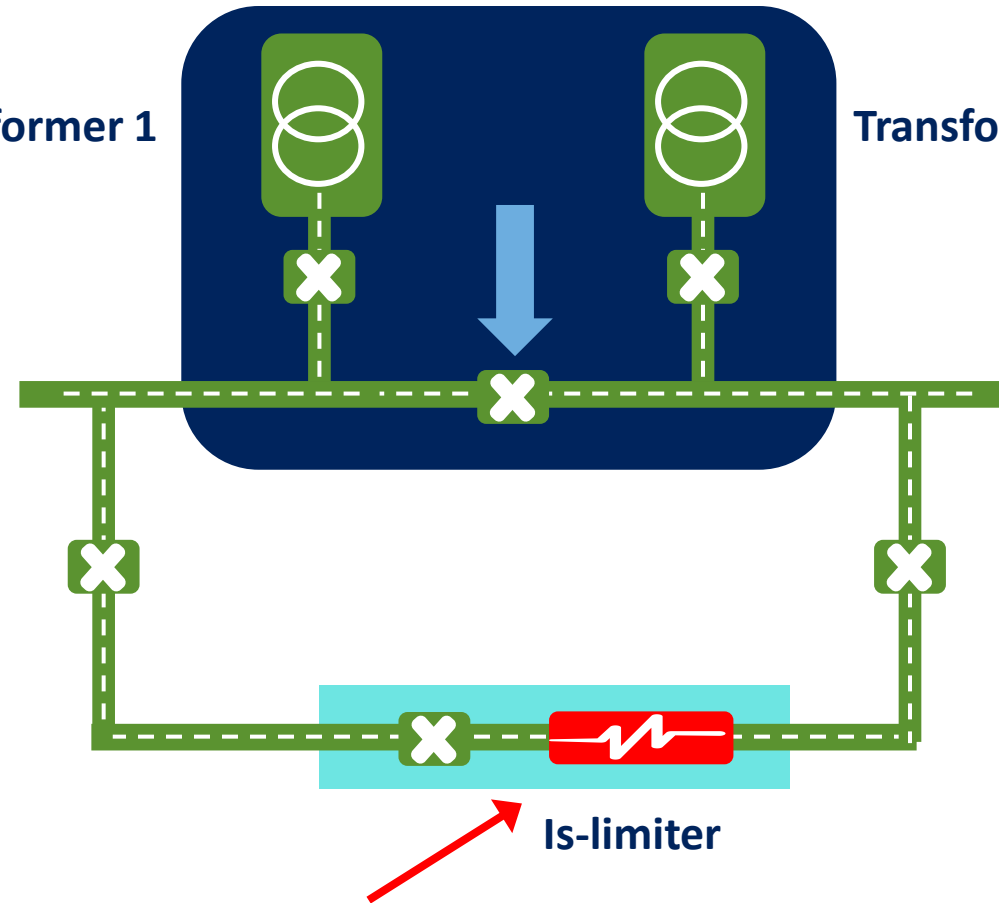


Is-limiter

Bamber Bridge

Transformer 1

Transformer 2



Is-limiter

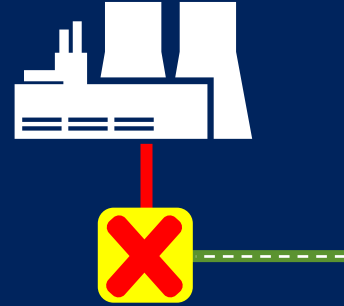
I_S -limiter acts like the bus section breaker or transformer breaker and is only enabled when fault level has been exceeded and then in the event of a fault operates in 2-3 milliseconds reducing fault current



I_s -limiter



Fault Current Limiting (FCL) service



Fault current generated by customers can be disconnected using new technology



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

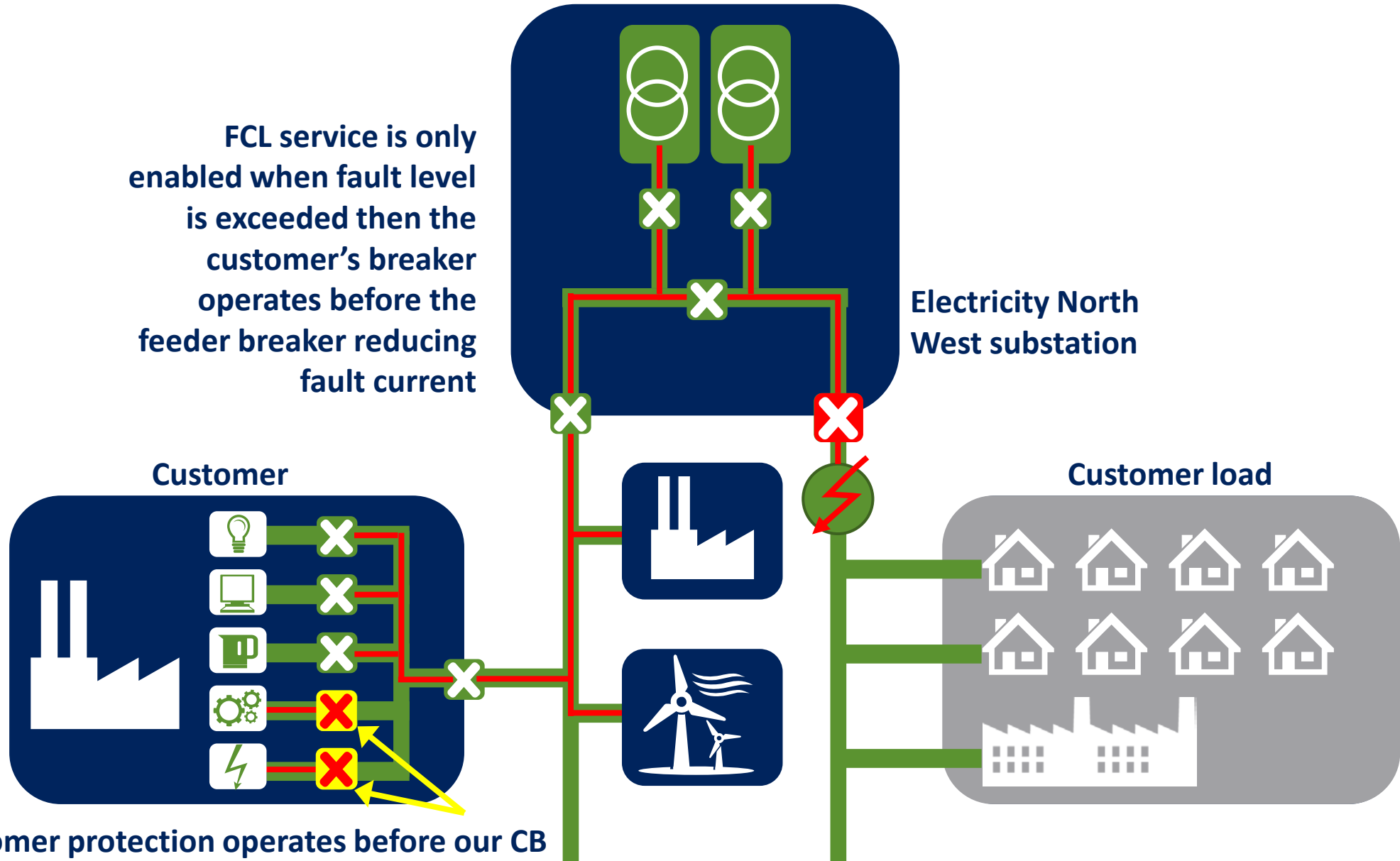


Challenge is to identify customers to take part in a trial of the FCL service

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



Customer protection operates before our CB

Trial for 12 months – what have we found out?



Substation	FLM technique	No of Network faults out of Substation	No of primary substation trips	No of successful operations of FLMT	No of failures of FLMT
Bamber Bridge	HV Is Limiter bus section	6	3	1	0
Broadheath	HV Is Limiter Incomer	8	2	0	0
Atherton Town Centre	HV Adaptive Protection	13	5	3	0
Denton West	HV Adaptive Protection	0	0	0	0
Blackbull	HV Adaptive Protection	8	1	1	0
Irlam	HV Adaptive Protection	0	0	0	0
Littleborough	HV Adaptive Protection	3	1	1	0
Monton	EHV 33kV AP	0	0	0	0
Offerton	EHV 33kV AP	0	0	0	0
Athletic St	EHV Is sensing	0	0	0	0
Wigan	EHV Is sensing	0	0	0	0
Longridge	HV Is sensing	22	2	0	0
Nelson	HV Is sensing	8	3	0	0
Hareholme	HV Is sensing	11	2	0	0
	Totals	79	19	6	0

Atherton Town Centre – Collier brook 11kV cct

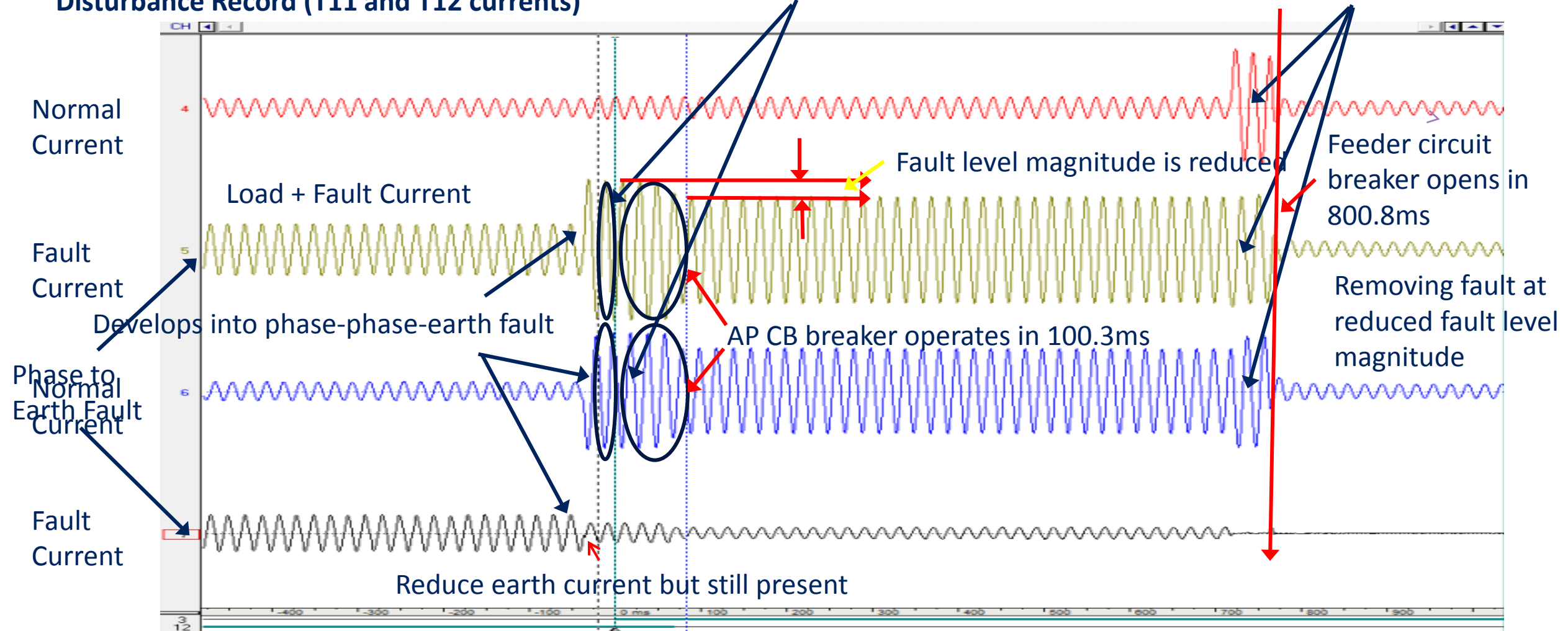
29 July 2016 @ 22:39



Disturbance Record (T11 and T12 currents)

Adaptive Protection sees the Fault and operates in 35.5ms

Develops into a 3 phase fault



Atherton Town Centre – Thomas St/Holland St 11kV cct. 28 August 2016 @ 19:35



Disturbance Record (T11 and T12 currents)

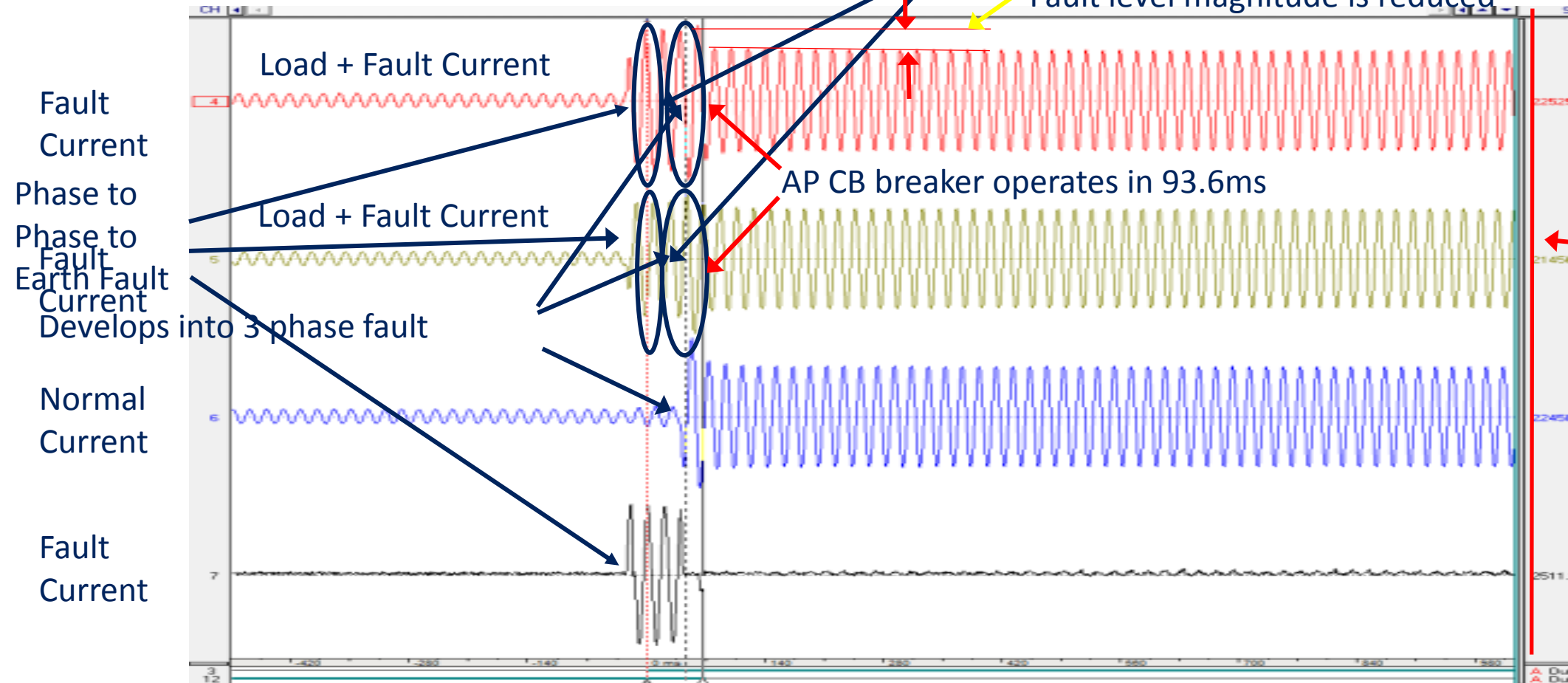
Adaptive Protection sees the Fault and operates in 23.7ms

Fault level magnitude is reduced

AP CB breaker operates in 93.6ms

Feeder circuit breaker opens in >1000ms, outside of recoding window.

Removing fault at reduced fault level magnitude



Atherton Town Centre – York St 11kV cct

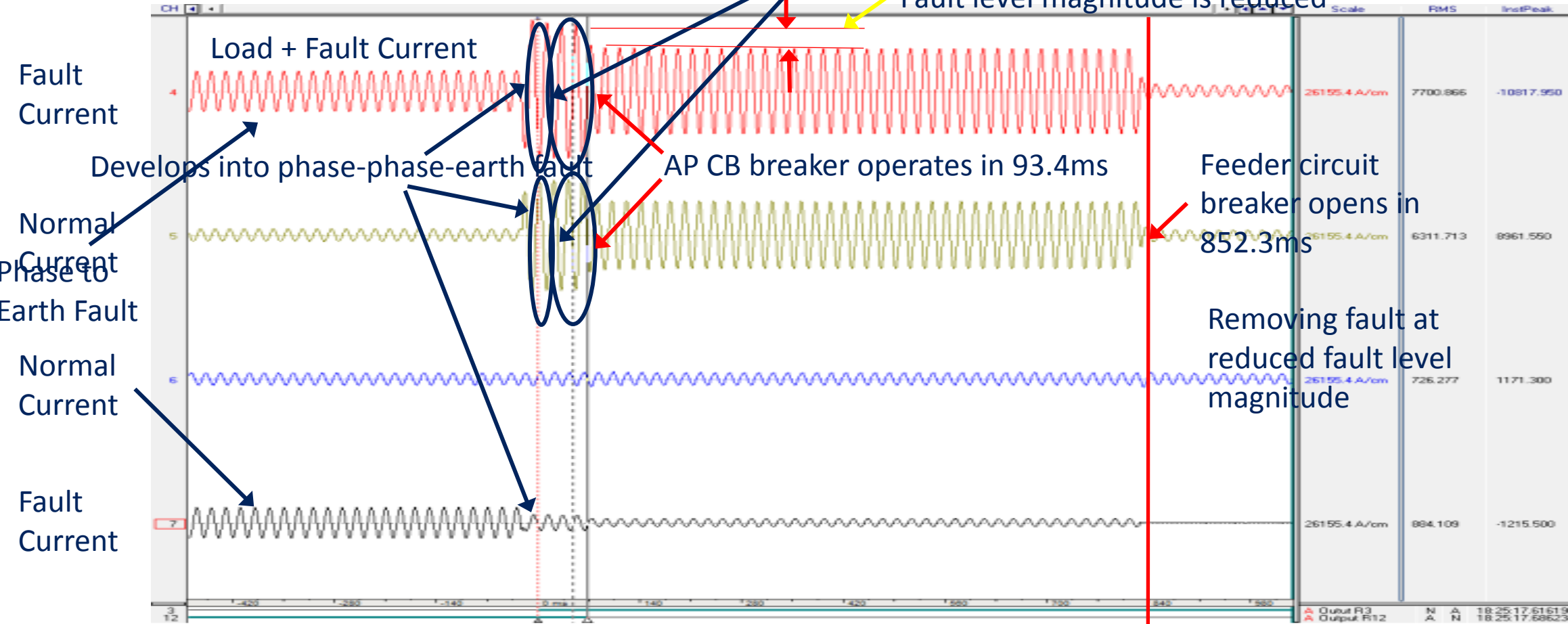
29 September 2016 @ 18:25

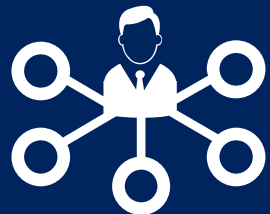


Adaptive Protection sees the Fault and operates in 22.5ms

Disturbance Record (T11 and T12 currents)

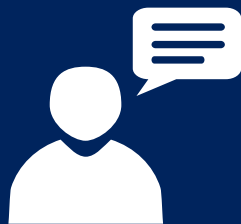
Fault level magnitude is reduced





ECP

Formulate
engagement
materials



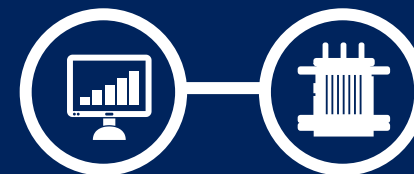
UK-wide Customer survey

Test appetite
Establish price point
Commercial
arrangements that
need to be in place
(Oct 15 – Feb 16)



Dialogue & terms

FCL service
agreements with at
least
1 demand &
1 generation
customer
May 16 – Apr 18



Trial phase

What technical
arrangements need
to be in place?



Consultation

Qualify customer
experience
Assess long term &
scale of benefit to
GB customers

September 15 *"The method enables a market for the provision of an FCL service"* May 18 2018

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



Agreeing sites
to be trialled
with United
Utilities

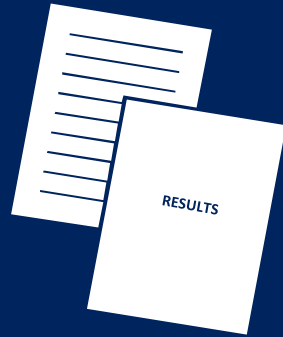
Ongoing
customer
consultation

Trial technology
outside
'triad period'

CBA of
traditional
connection
vs
new
constrained
connection
agreement

Customer
survey report
published May
2017

Contract
templates &
commercial
arrangements
developed,
published May
2018



Survey analysis
'appeared to prove'
the hypothesis that the

**There is a market for an FCL
service, where a constraint will
have little or no impact**



Future potential to provide
alternative 'constrained'
connection offers

(lower cost and quicker
connection on fault level
constrained networks)



Objective

Produce a written safety case for each fault level mitigation technique:

Adaptive Protection

Is Limiter

Fault Current Limiting service

Publish the peer reviewed safety case by September 2018

The UK HSE regards *a safety case as*

“ *a document that gives confidence to operators, owners, workers and the competent authority that the duty holder has the ability and means to manage and control major accident hazards effectively*”.





ALARP =
As Low As
Reasonably
Possible

Identify hazards and quantify their potential impact

Show how mitigated risk can be managed to ALARP

Identify remaining high risk hazards and redesign to ALARP

Challenge and make clear the assumptions and judgements used

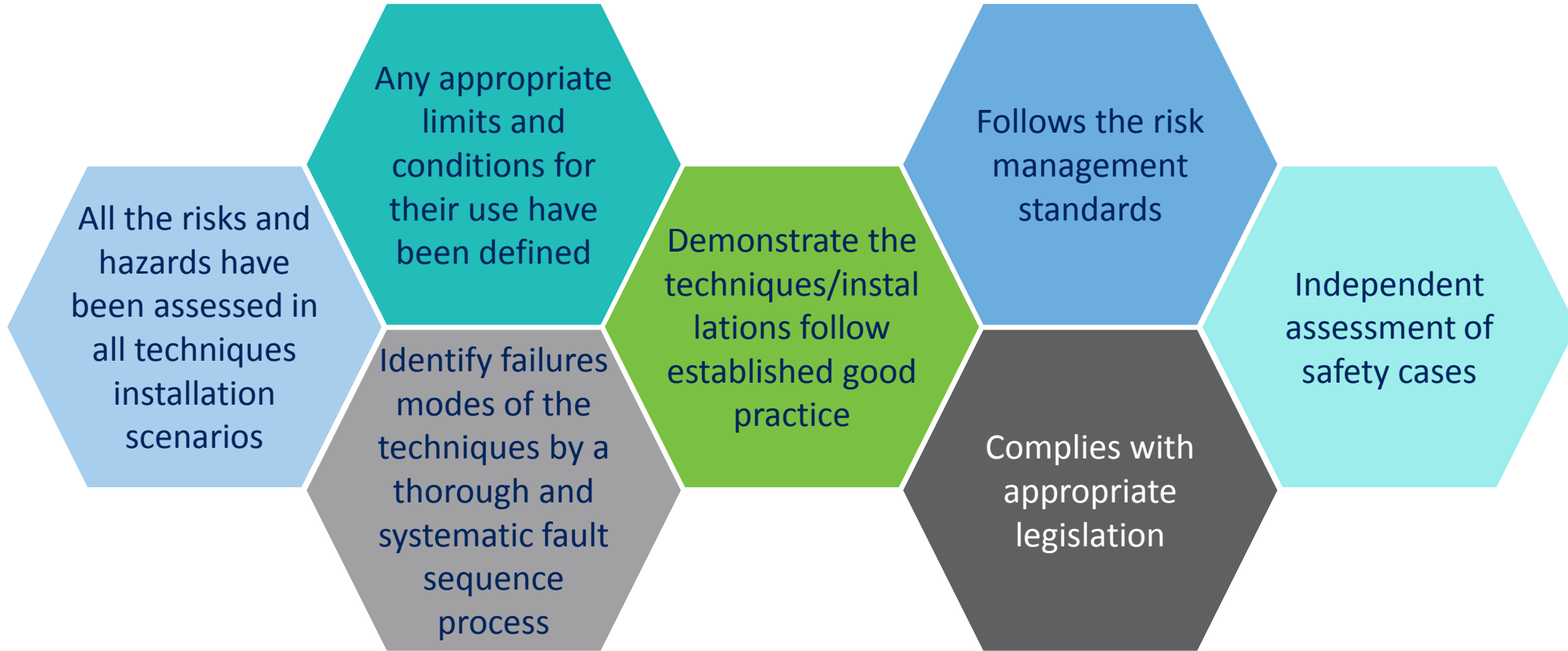
Provide supporting evidence

Justify the mitigations for the worst credible scenarios

Provide documentation to record and support the safety case



It is essential that the safety case demonstrates



The safety case will be a clear and logical document so that the three techniques can be operated safely and reliably

Next steps for Respond



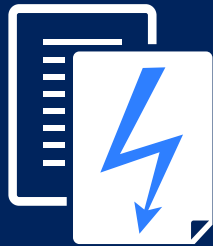
Complete the FCLS installations and learning



Complete and peer review the safety cases



Monitor the trial and analysis of the techniques for another 12 months



Produce a buy order of the fault level mitigation techniques



Assess the health impact of the trial on our assets



Carbon footprint study of the techniques