# Centralised Protection & Control


## Colin Scoble
## Senior Protection Engineer


IEC 61850 Global 2019
14-18 October 2019
London, UK

INVESTORS IN PEOPLE | Gold Until 2020

THE SUNDAY TIMES 25 BEST BIG COMPANIES TO WORK FOR 2019

UK Power Networks
Delivering your electricity

# Agenda

***Why do we need a Centralised Protection and control system Architecture?***

**Our approach to Assess, specify and design a Centralised Protection and Control system?**

**How will we test and maintain our new Centralised Protection and Control systems?**

**The Centralised Protection and Control system and its benefits**

UK Power Networks
Delivering your electricity

## *Why do we need a Centralised Protection and control system Architecture?*

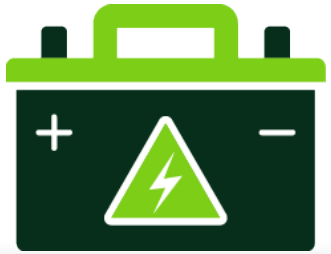
| Measure | Data |
|---|---|
| End customers | 8.3M |
| Peak demand | 16GW |
| Energy distributed | 85TWh |
| Underground electricity cables | 138,000km |
| Overhead lines | 46,000km |
| Protection relays | 45,000 |
| ED1 totex allowance | £6,029M |


**UK Power Networks metrics**

# *Why do we need a Centralised Protection and control system Architecture?*

## Growth in DG

- **9.1GW** of DG connected, doubled in the last 5 years
- First Solar / Storage schemes with no subsidy support
- Over **200,000** distributed energy resources



## Storage Market

- Over **1GW** of accepted storage offers
- **1000 (18GW**) formal enquiries since July 2015
- Two **50MW** Batteries connected,

## Growth in Electric Vehicles

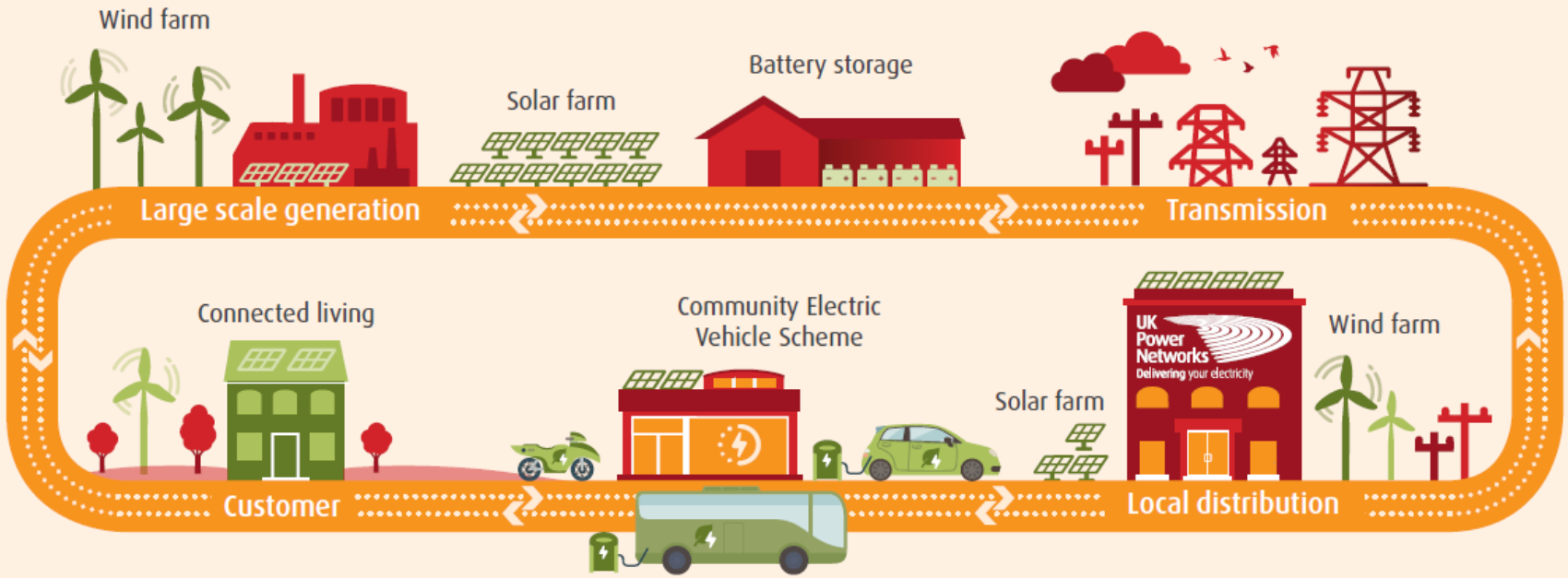
- Over 300 electric buses in London by 2020
- **195,000** Plug-in vehicles sold in the UK, **31%** on our networks
- UK EV registrations **53%** year on year growth
- Over **19,000** public Charge points

**Pace and scale of change continues to increase**

UK Power Networks
Delivering your electricity

# *Why do we need a Centralised Protection and control system Architecture?*

## New World




- Large number of generators connected on the distribution network, including behind-the-meter
- Two-way power flows
- Inclusion of renewables (such as, solar PV, wind turbines and biomass) and grid scale battery storage
- Proactive and active customer engagement

**No longer the "New World" this is our network**

UK Power Networks
Delivering your electricity

## *Why do we need a Centralised Protection and control system Architecture?*

**With the changes in our network we have a much greater need for data rich substations to support smart grid technologies and Asset management**

**We need a technology that can be deployed rapidly in strategic locations to support our DSO strategy**

**The technology required needs to achieve greater TOTEX cost efficiency than current technologies**

UK Power Networks
Delivering your electricity

# *Why do we need a Centralised Protection and control system Architecture?*

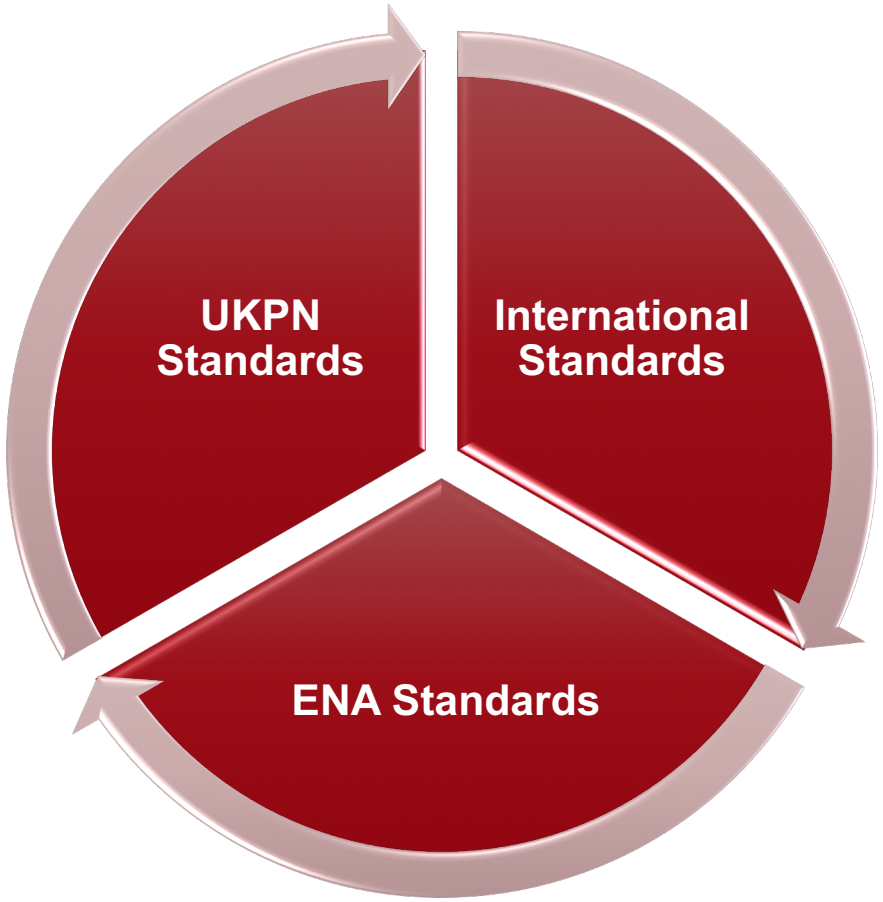


ELECTROMECH → STATIC → NUMERICAL → CENTRALISED

**Protection development timeline**

UK Power Networks
Delivering your electricity

# Our approach to Assess, specify and design a Centralised Protection and Control system?




## How we started the journey

# Our approach to Assess, specify and design a Centralised Protection and Control system?

## Hardware Assessment

Environmental Assessment of hardware completed against ENA TS 48-5 and registered hardware version and firmware type

BS EN 60068-1, 2….

BS EN 60255-21,26….

BS EN 60529

BS EN 60834 e.t.c

## Functional Assessment

Functional Assessment completed against relevant ENA TS 48-6 specification.

BS EN 60255-….

## UKPN Type approval

Complete Assessment against specific application requirements e.g. 11kV Auto-Reclosing Feeder

Produce Standard data for approval such as standard application diagrams, settings, configurations, SCL Files

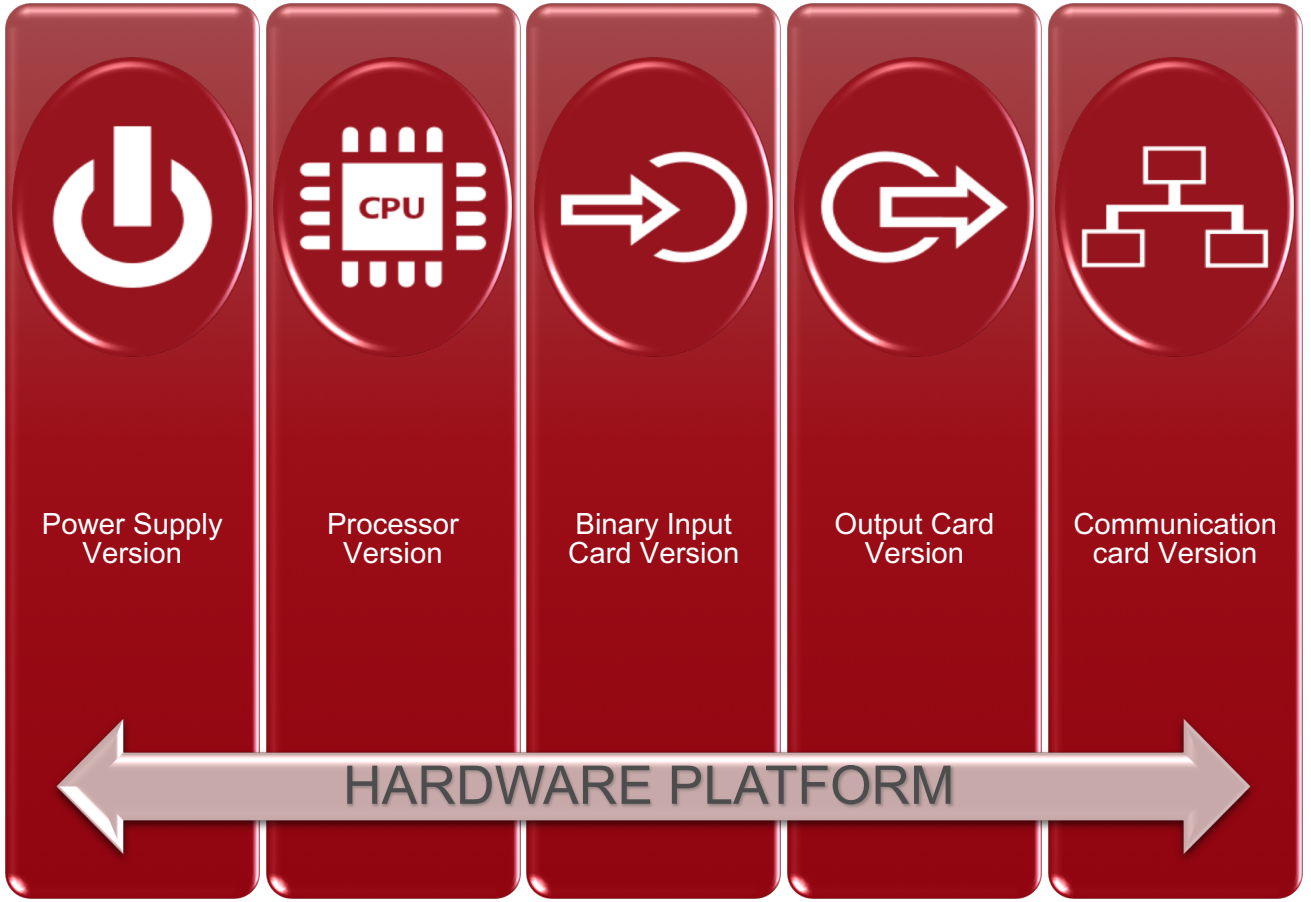
## Identify Training

Identify training modules to brief Engineering staff on the new hardware and functional elements of the architecture


**UKPN Assessment process**

UK Power Networks
Delivering your electricity

# Our approach to Assess, specify and design a Centralised Protection and Control system?

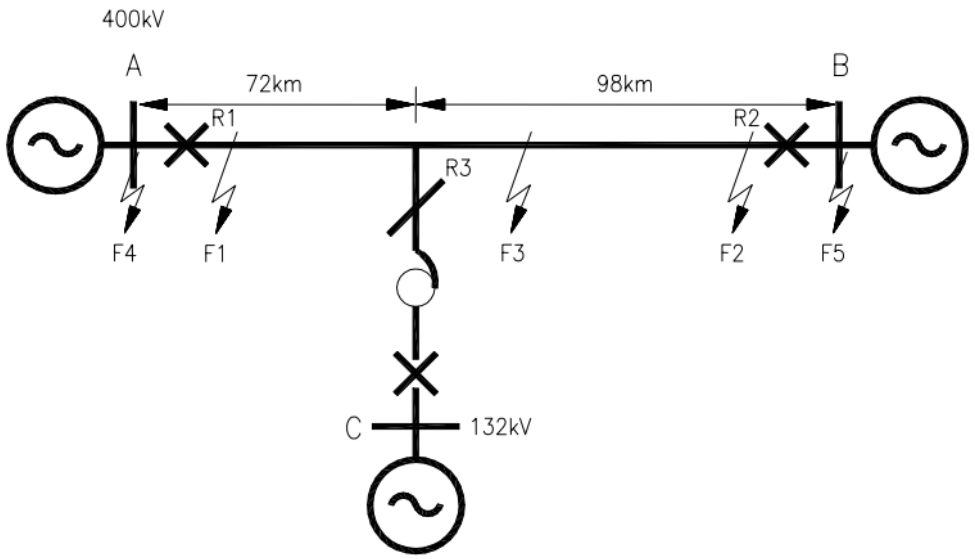



**Hardware Assessment**

UK Power Networks
Delivering your electricity

# Our approach to Assess, specify and design a Centralised Protection and Control system?

## ENA TS 48-6-2 Network Model



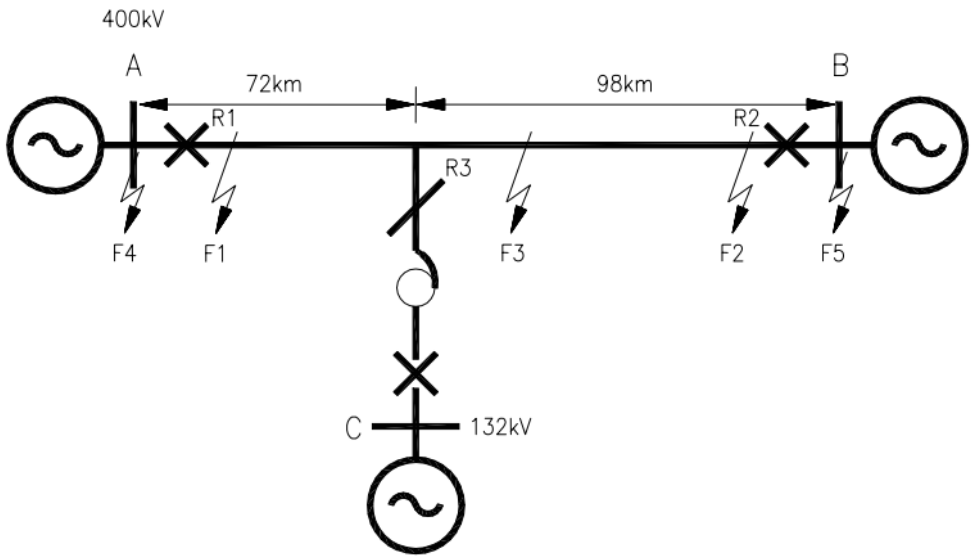

| Functional Test | Type |
|---|---|
| Operating characteristic accuracy | Threshold test |
| Operating characteristic time | Threshold test |
| Fault indications | Event capture |
| Event recording | Event capture |
| Settings transfer during fault | Data stability |

**Functional Assessment**

UK Power Networks
Delivering your electricity

# Our approach to Assess, specify and design a Centralised Protection and Control system?

## ENA TS 48-6-2 Network Model




| Test | Type |
|---|---|
| 1Ph-E | Dynamic test |
| 2Ph | Dynamic test |
| 2Ph-E | Dynamic test |
| 3Ph | Dynamic test |
| Switch onto fault | Dynamic test |
| Evolving faults | Dynamic test |

Total of 107 fault cases

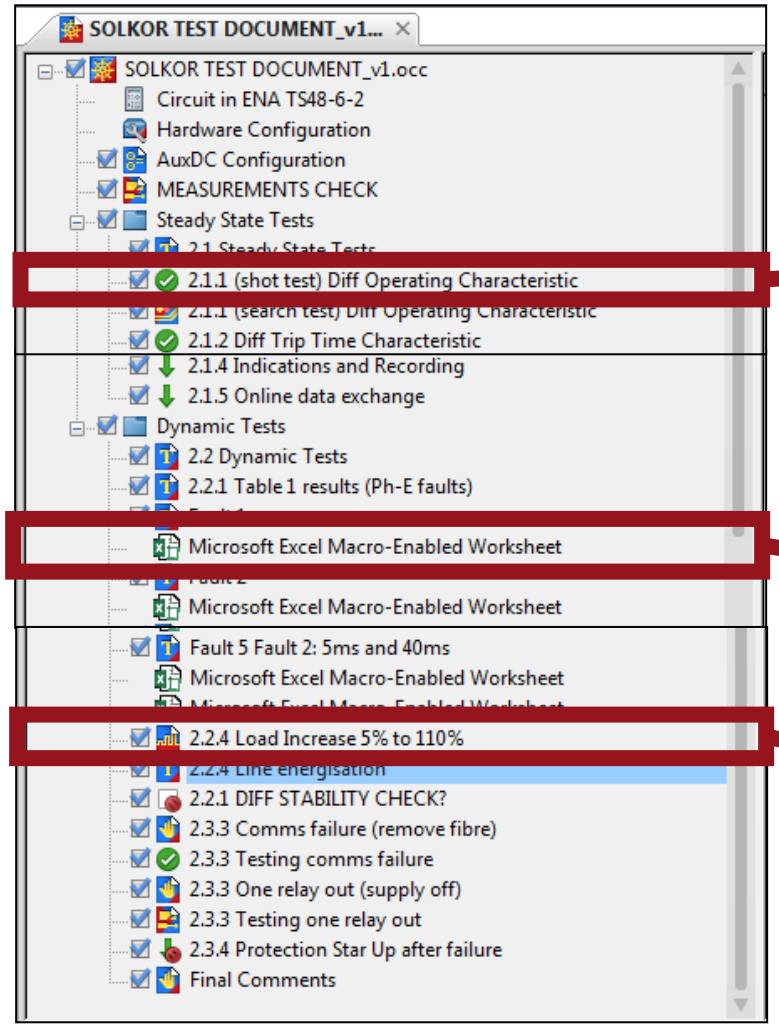
**Functional Assessment**

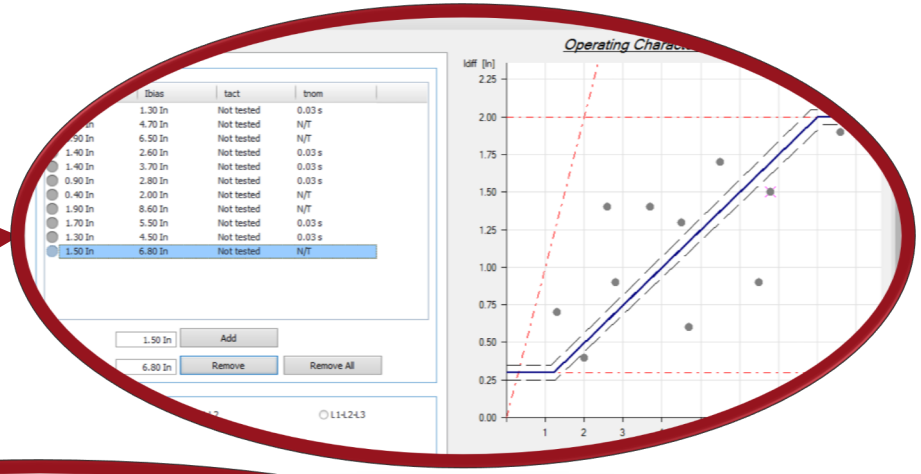
UK Power Networks
Delivering your electricity

# Our approach to Assess, specify and design a Centralised Protection and Control system?

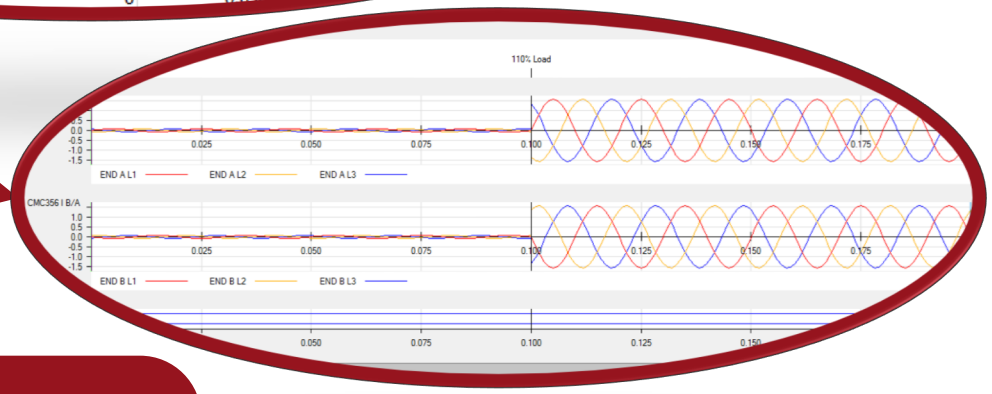

## Functional Assessment

# Our approach to Assess, specify and design a Centralised Protection and Control system?




| | | F1 - Fault type | F1 - Inception angle [°] | F1 - Fault resistance (RF) [Ω] | Trip test 1(A) [s] | Min [s] | Max [s] | Trip t |
|---|---|---|---|---|---|---|---|---|
| 1 | Passed | L1-N | 0 | 0 | 0.0292 | 0 | 0.2 | 0. |
| 2 | Passed | L1-N | 90 | 0 | 0.029 | 0 | 0.2 | 0.0277 |
| 3 | Passed | L1-N | 180 | 0 | 0.0277999 | 0 | 0.2 | 0.027 |
| | Passed | L1-N | 0 | 10 | 0.0296 | 0 | 0.2 | 0.0 |
| | | L1-N | 0 | 50 | 0.0328 | 0 | 0.2 | |
| | | | 0 | 0 | 0.0304 | | | |

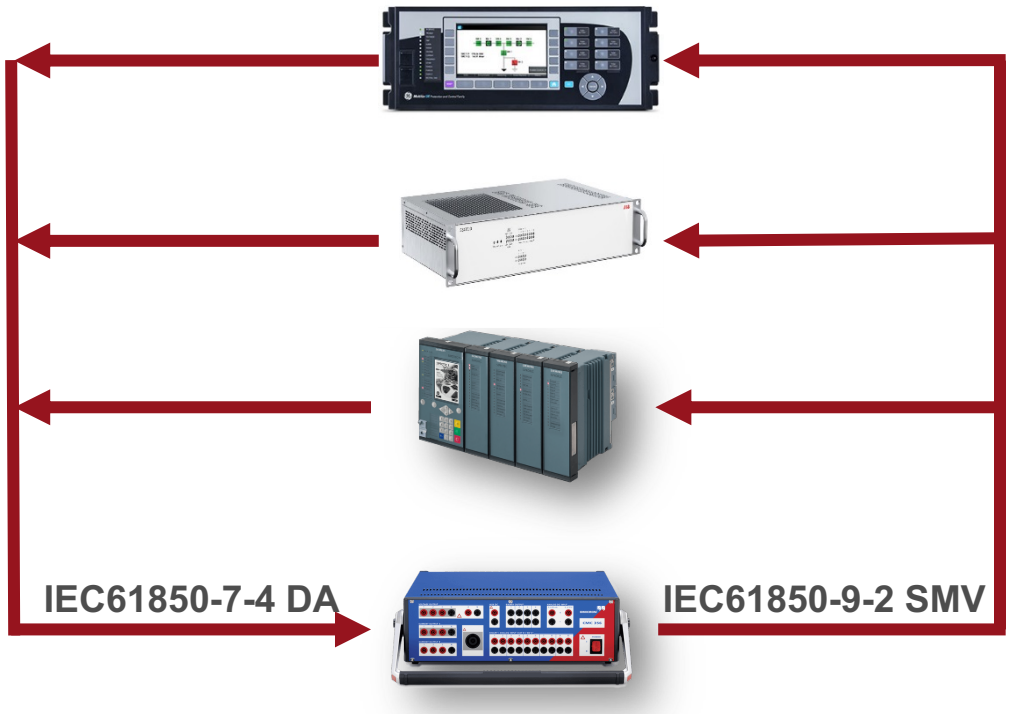



## Functional Assessment

UK Power Networks
Delivering your electricity

# Our approach to Assess, specify and design a Centralised Protection and Control system?

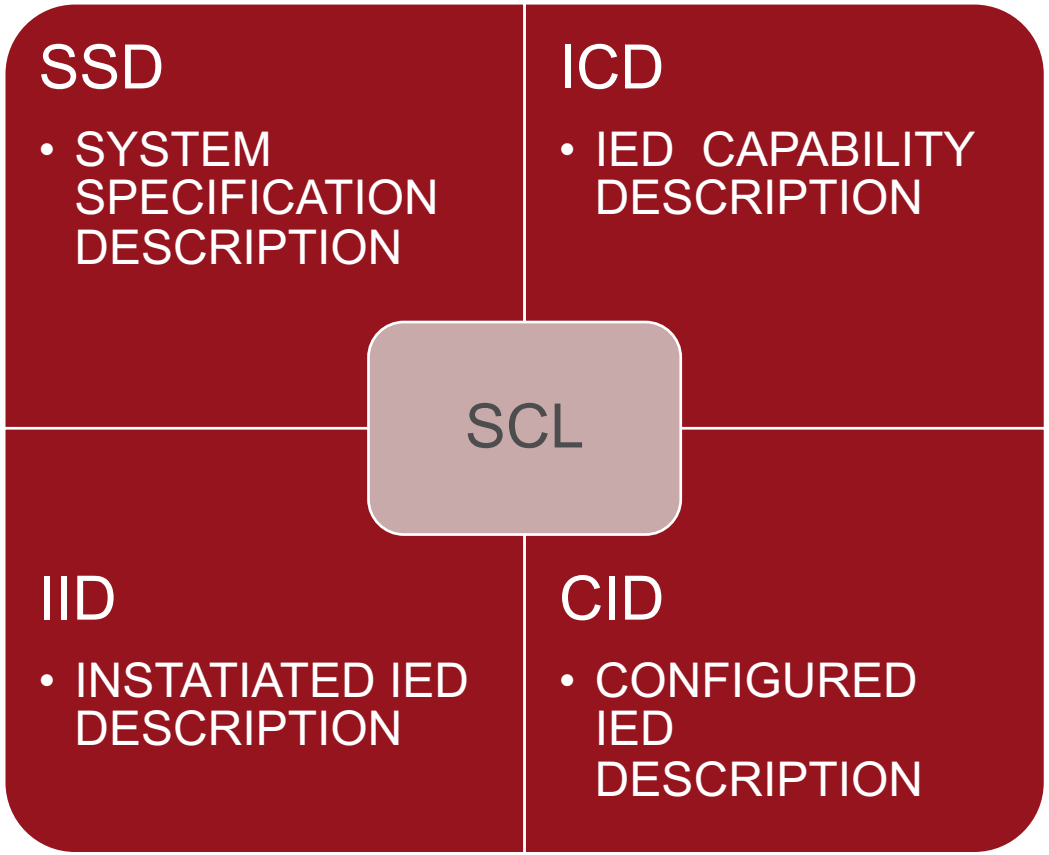
| Advantages |
| --- |
| Compliance with standards specified can be verified and compared with vendor reports submitted for Assessment |
| Consistent Assessment method across different vendor assets on the network |
| Cyber security patches can be verified through regression testing very quickly in a lab environment closing vulnerabilities quickly and efficiently |
| IEC 61850 data attributes from logical nodes can be confirmed during Assessment phase |
| Network model can be easily modified for project specific queries or investigations |
| New functions or upgrades can be assessed before being deployed on the live network |

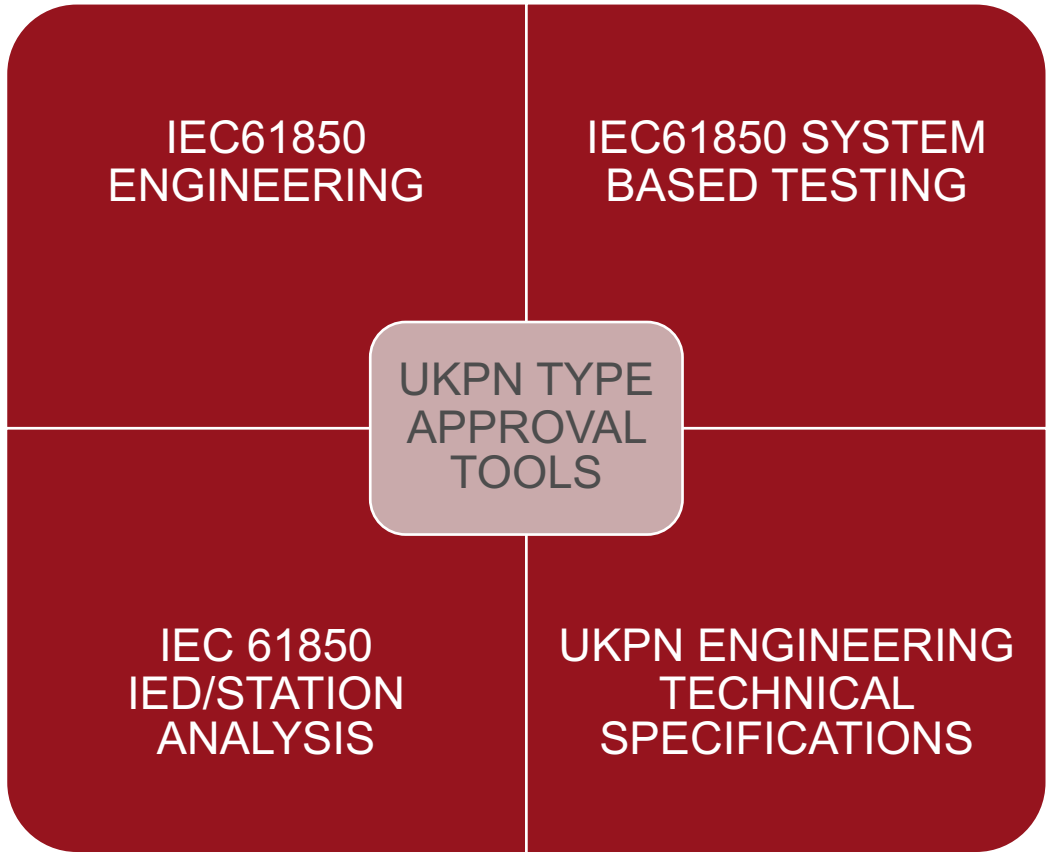



**Functional Assessment**

UK Power Networks
Delivering your electricity

# Our approach to Assess, specify and design a Centralised Protection and Control system?

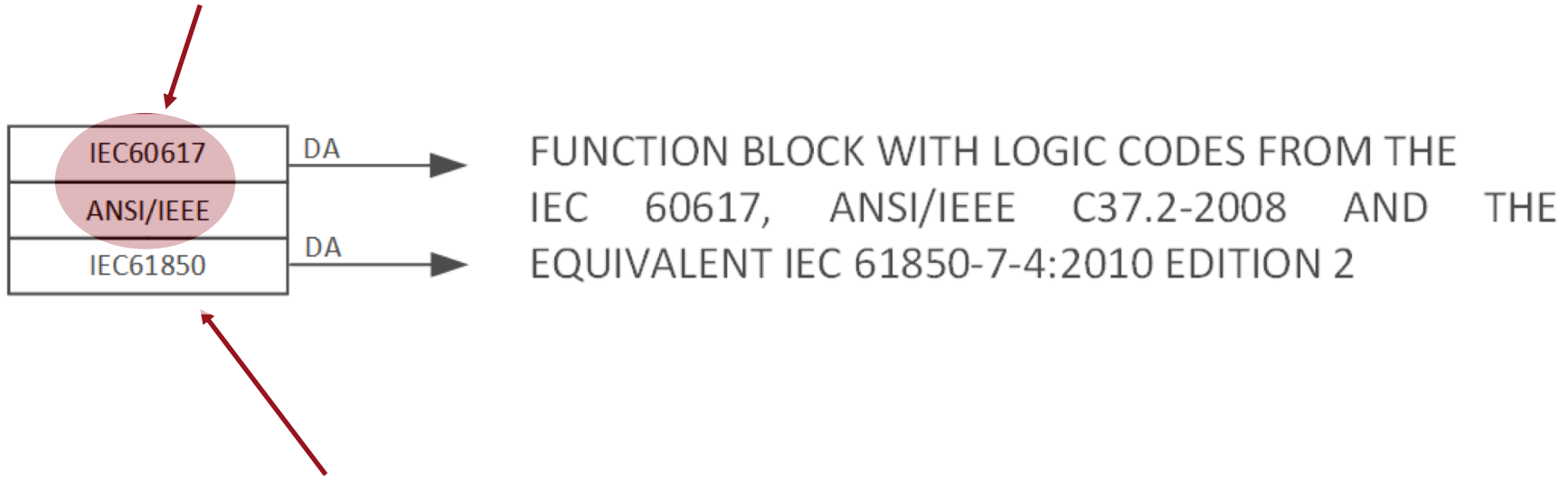



**UKPN Type approval**

**Our approach to Assess, specify and design a Centralised Protection and Control system?**

## ANSI AND IEC STANDARDS FOR FLEXIBILITY




## SPECIFIED INLINE WITH IEC61850-7-4:2010 EDITION 2

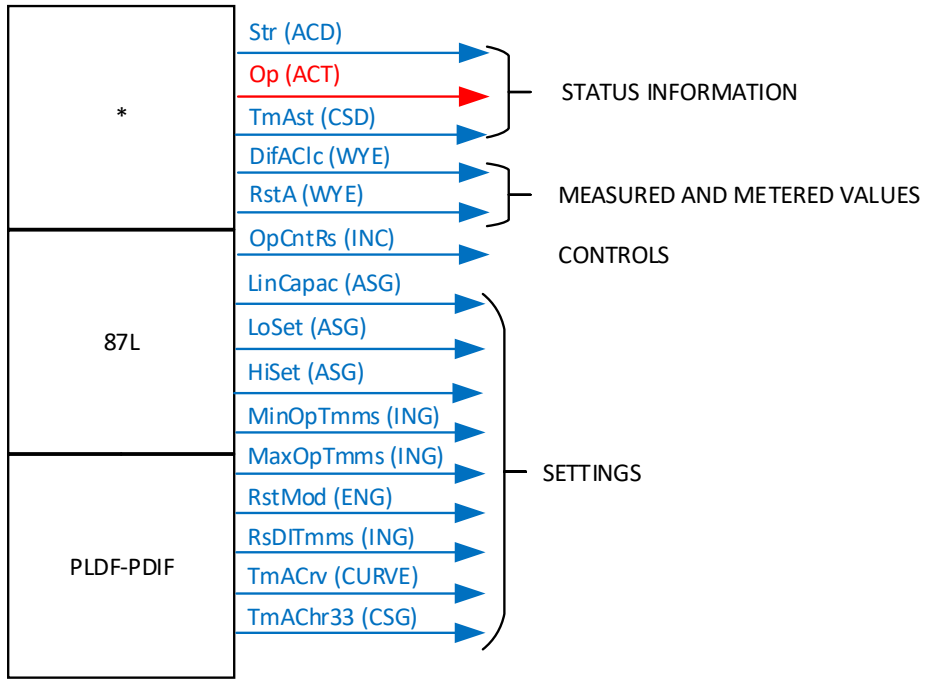
**UKPN Type approval (SSD)**

UK Power Networks
Delivering your electricity

# Our approach to Assess, specify and design a Centralised Protection and Control system?

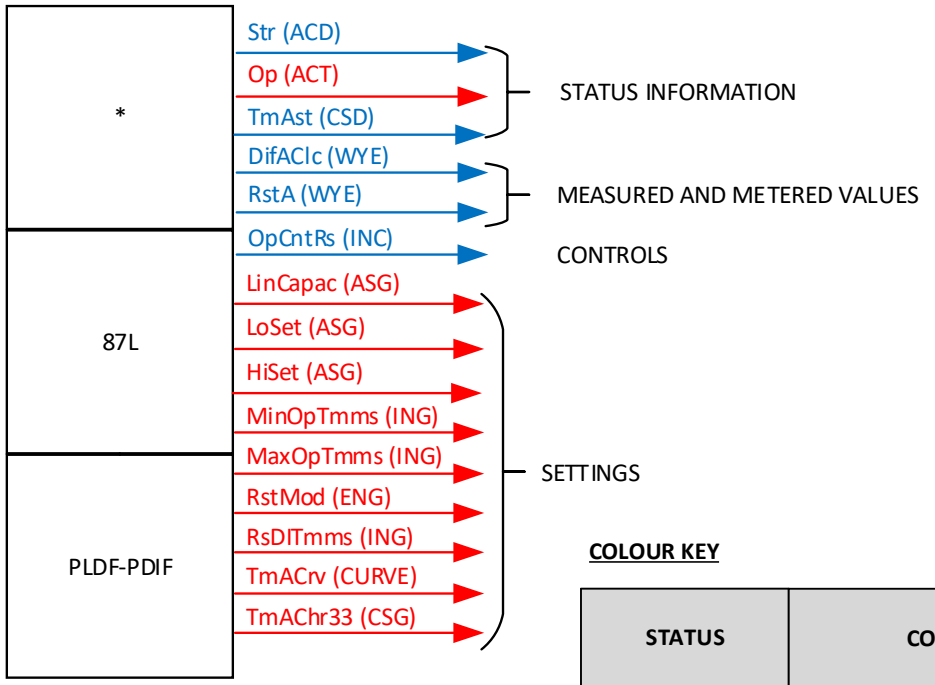
## IEC61850-7-4 SPEC

DIFFERENTIAL LINE PROTECTION




## UKPN SPEC

DIFFERENTIAL LINE PROTECTION



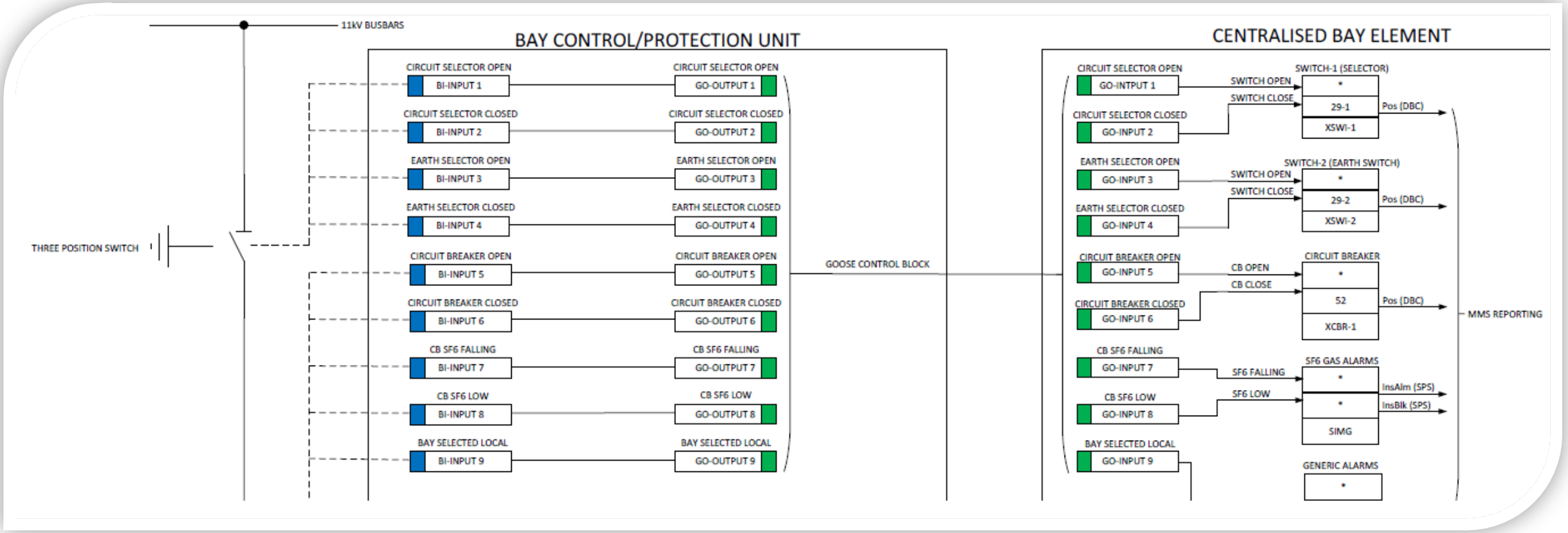

**COLOUR KEY**

| STATUS | COLOUR |
|---|---|
| MANDATORY | |
| OPTIONAL | |
| CONDITIONAL | |

## UKPN Type approval (SSD)

UK Power Networks
Delivering your electricity

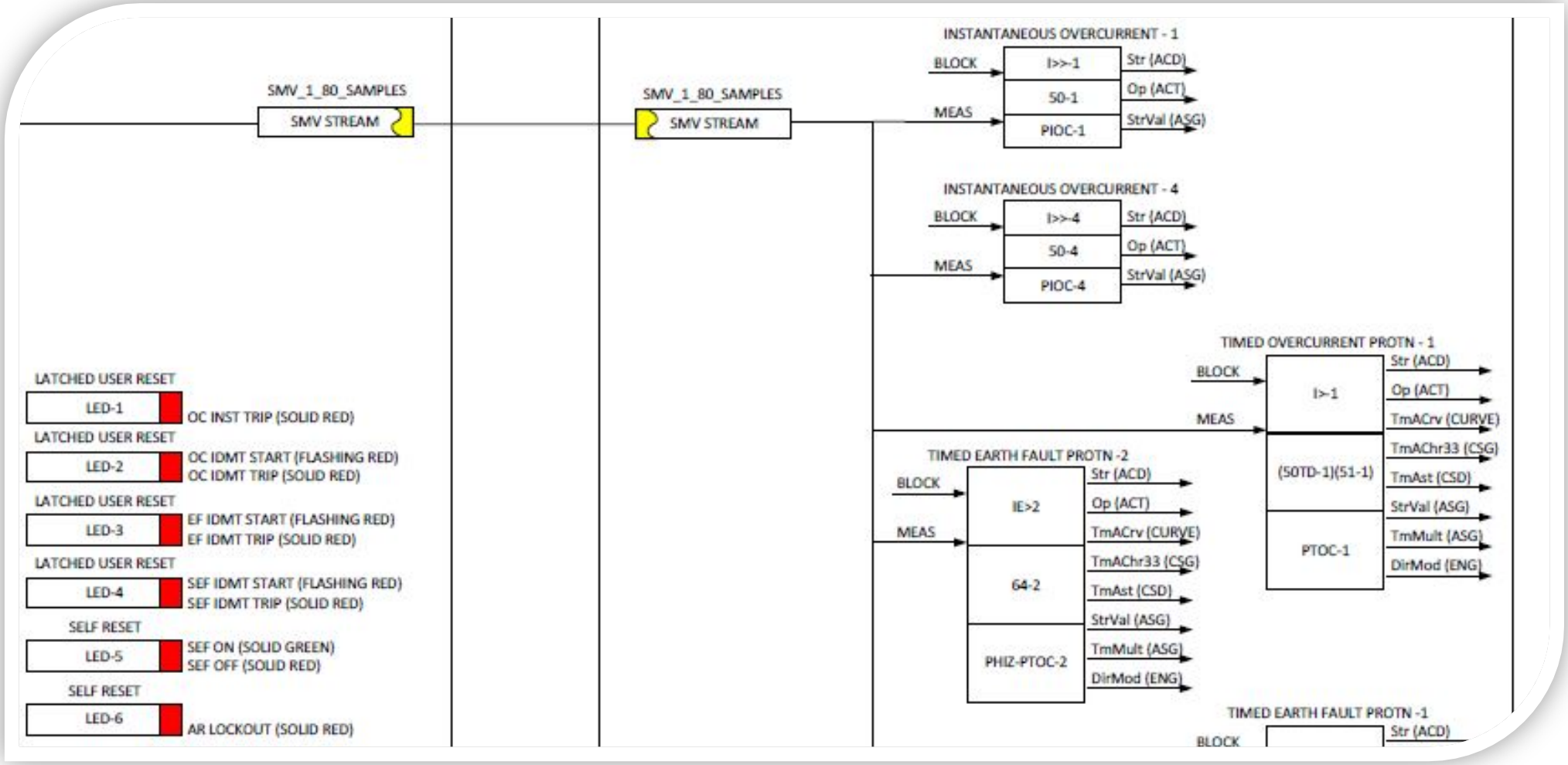
# Our approach to Assess, specify and design a Centralised Protection and Control system?




**UKPN Type approval (SSD)**

UK Power Networks
Delivering your electricity

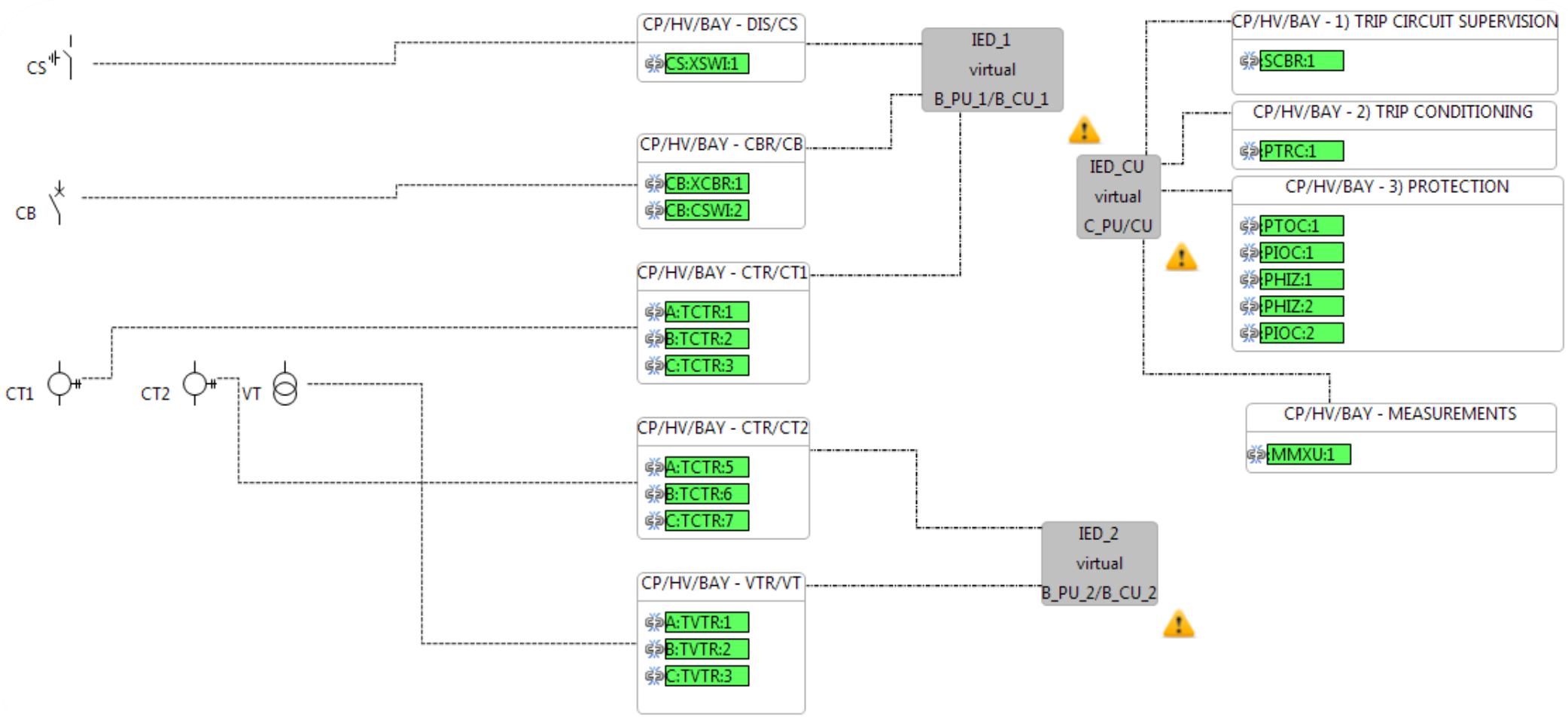
# Our approach to Assess, specify and design a Centralised Protection and Control system?




**UKPN Type approval (SSD)**

UK Power Networks
Delivering your electricity

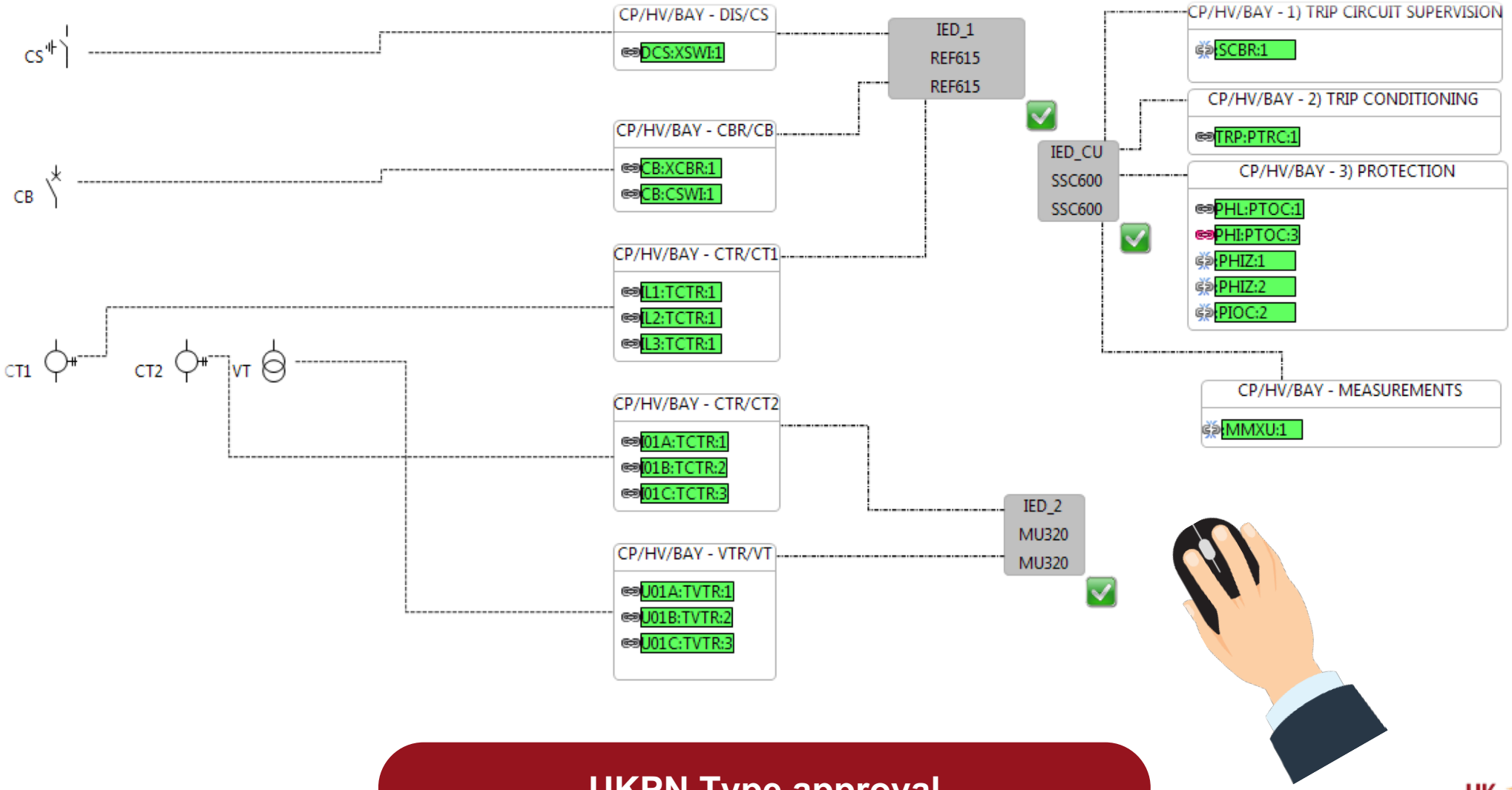
# Our approach to Assess, specify and design a Centralised Protection and Control system?




**UKPN Type approval (SSD)**

UK Power Networks
Delivering your electricity

# Our approach to Assess, specify and design a Centralised Protection and Control system?

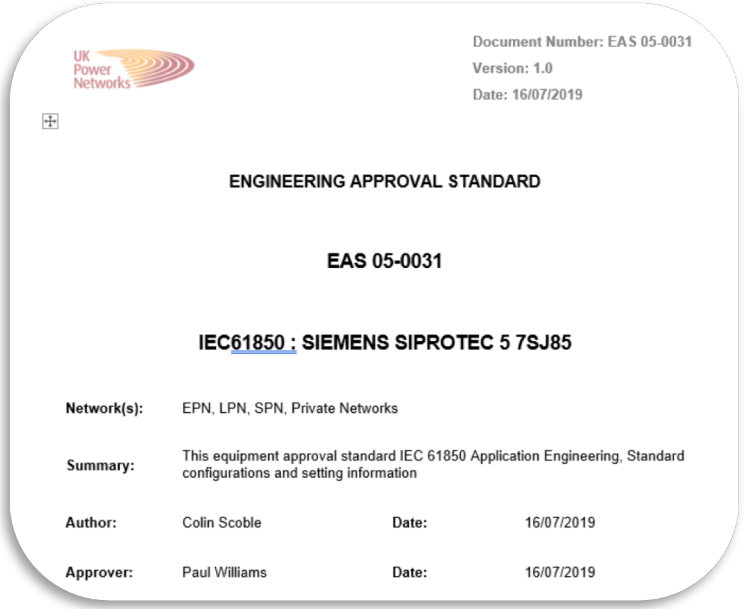



**UKPN Type approval**

# Our approach to Assess, specify and design a Centralised Protection and Control system?

## UPDATE UKPN STANDARD LIBRARY


## PUBLISH ENGINEERING APPROVAL



UK Power Networks

Document Number: EAS 05-0031
Version: 1.0
Date: 16/07/2019

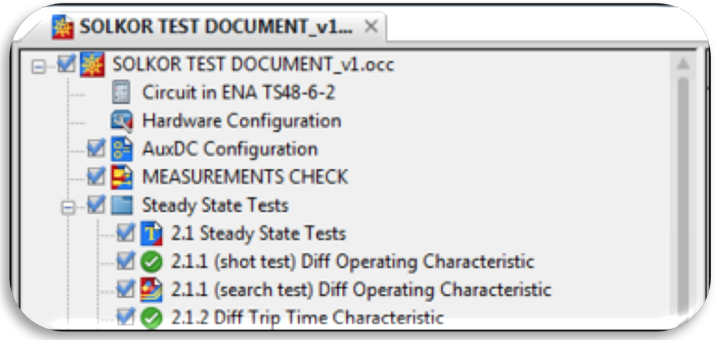
**ENGINEERING APPROVAL STANDARD**

**EAS 05-0031**

**IEC61850 : SIEMENS SIPROTEC 5 7SJ85**

| | | | |
|---|---|---|---|
| **Network(s):** | EPN, LPN, SPN, Private Networks | | |
| **Summary:** | This equipment approval standard IEC 61850 Application Engineering, Standard configurations and setting information | | |
| **Author:** | Colin Scoble | **Date:** | 16/07/2019 |
| **Approver:** | Paul Williams | **Date:** | 16/07/2019 |

## ARCHIVE Assessment REPORTS




## UKPN Type approval

UK Power Networks
Delivering your electricity

# How will we test and maintain our new Centralised Protection and Control systems?

**ONLY MAINTAIN WHEN SYSTEM TELLS YOU**

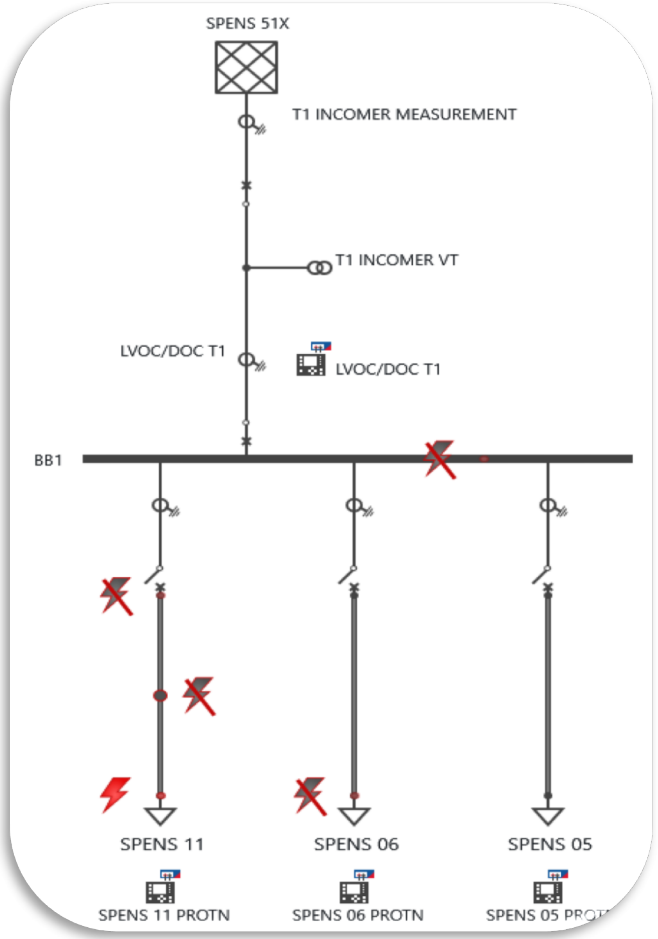

**CYBER SECURITY PATCH**

**UPGRADES**

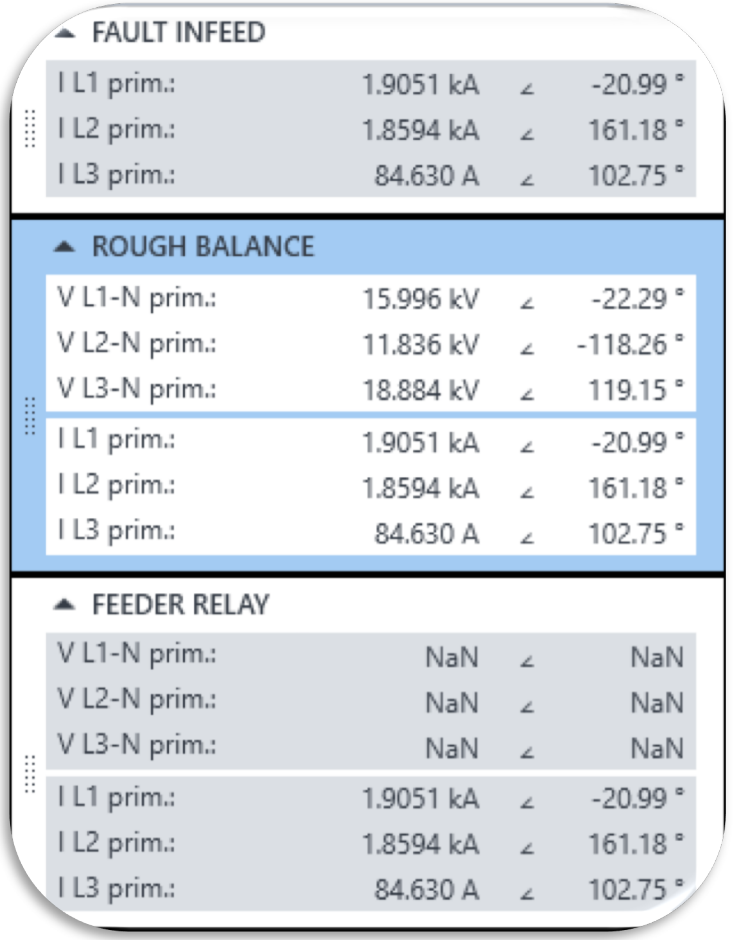

UK Power Networks
Delivering your electricity

# How will we test and maintain our new Centralised Protection and Control systems?

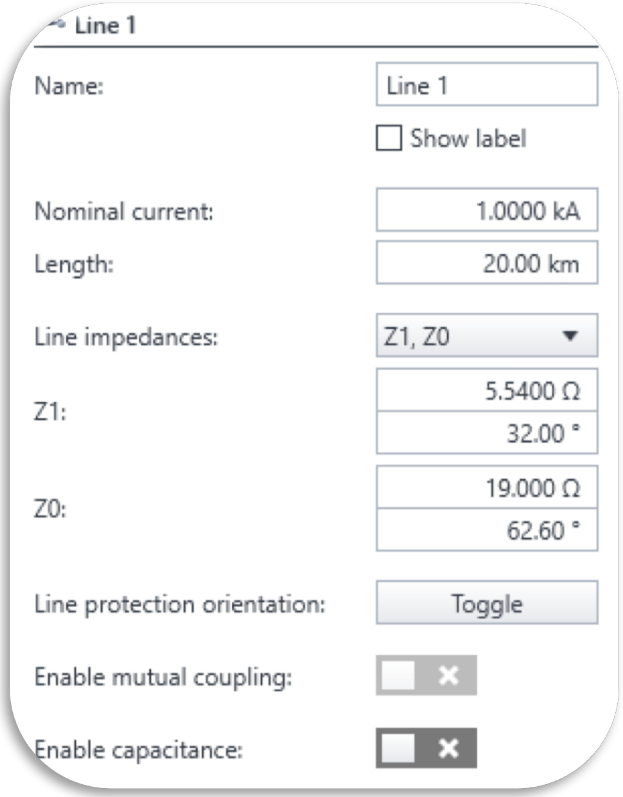
## SYSTEM TEST MODEL




## INJECTED QUANTITIES



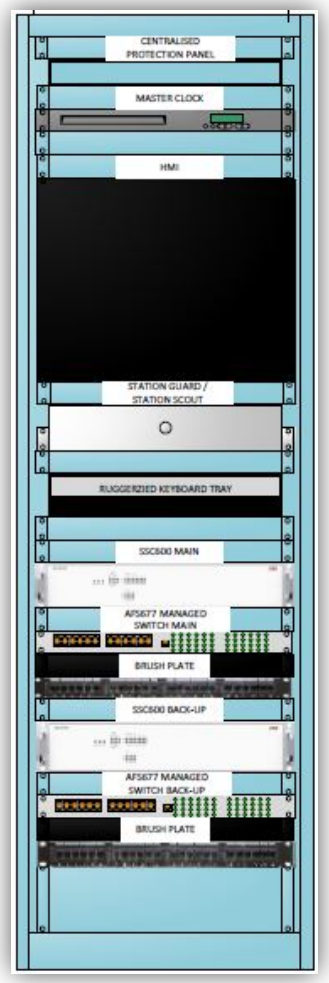

## NETWORK PARAMETERS




UK Power Networks
Delivering your electricity

# The Centralised Protection and Control system and its benefits

## GENERAL ARRANGEMENT DESIGN

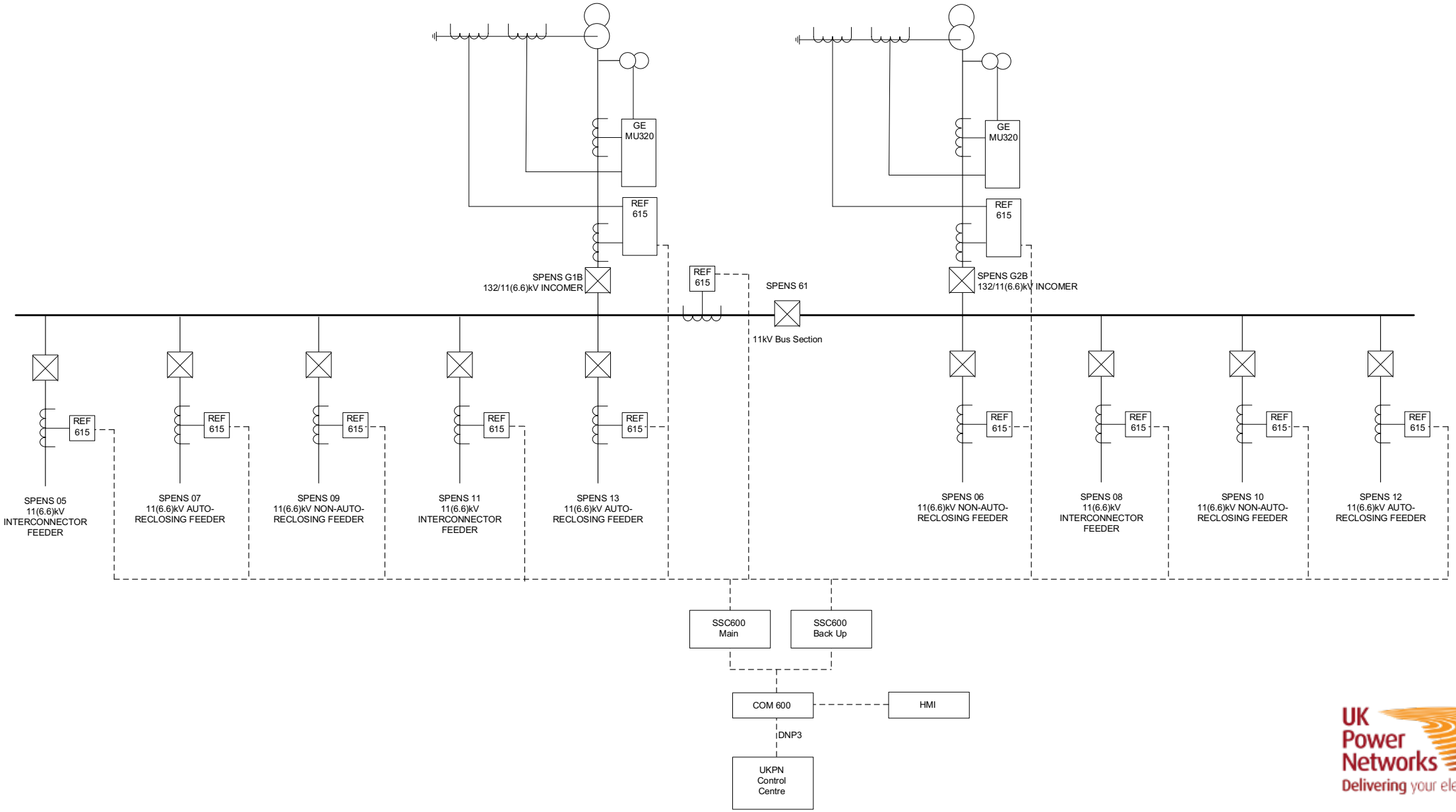



## CENTRALISED PROTECTION CUBICLE

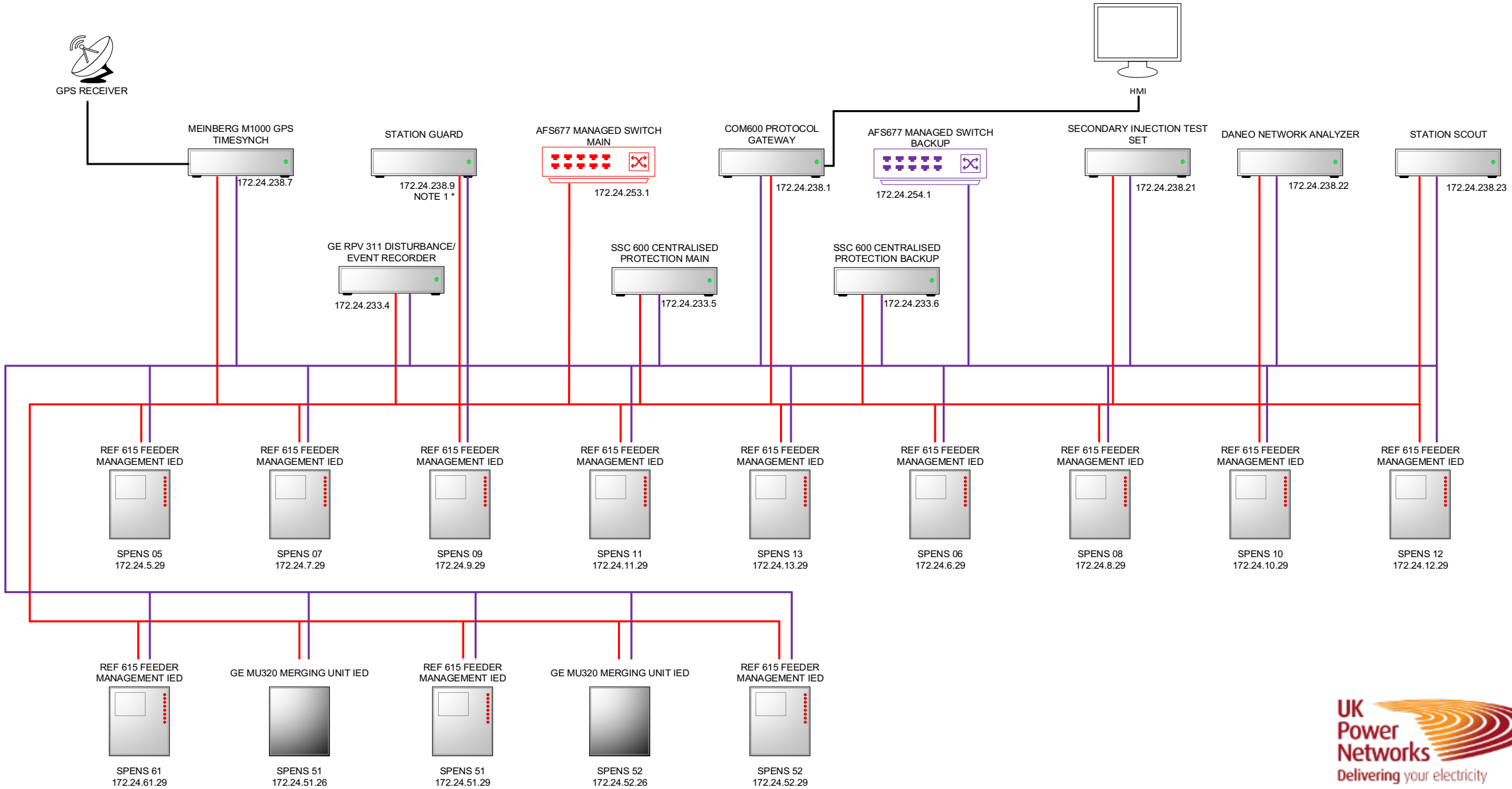
## RETROFIT SWITCHGEAR


UK Power Networks
Delivering your electricity

# The Centralised Protection and Control system and its benefits

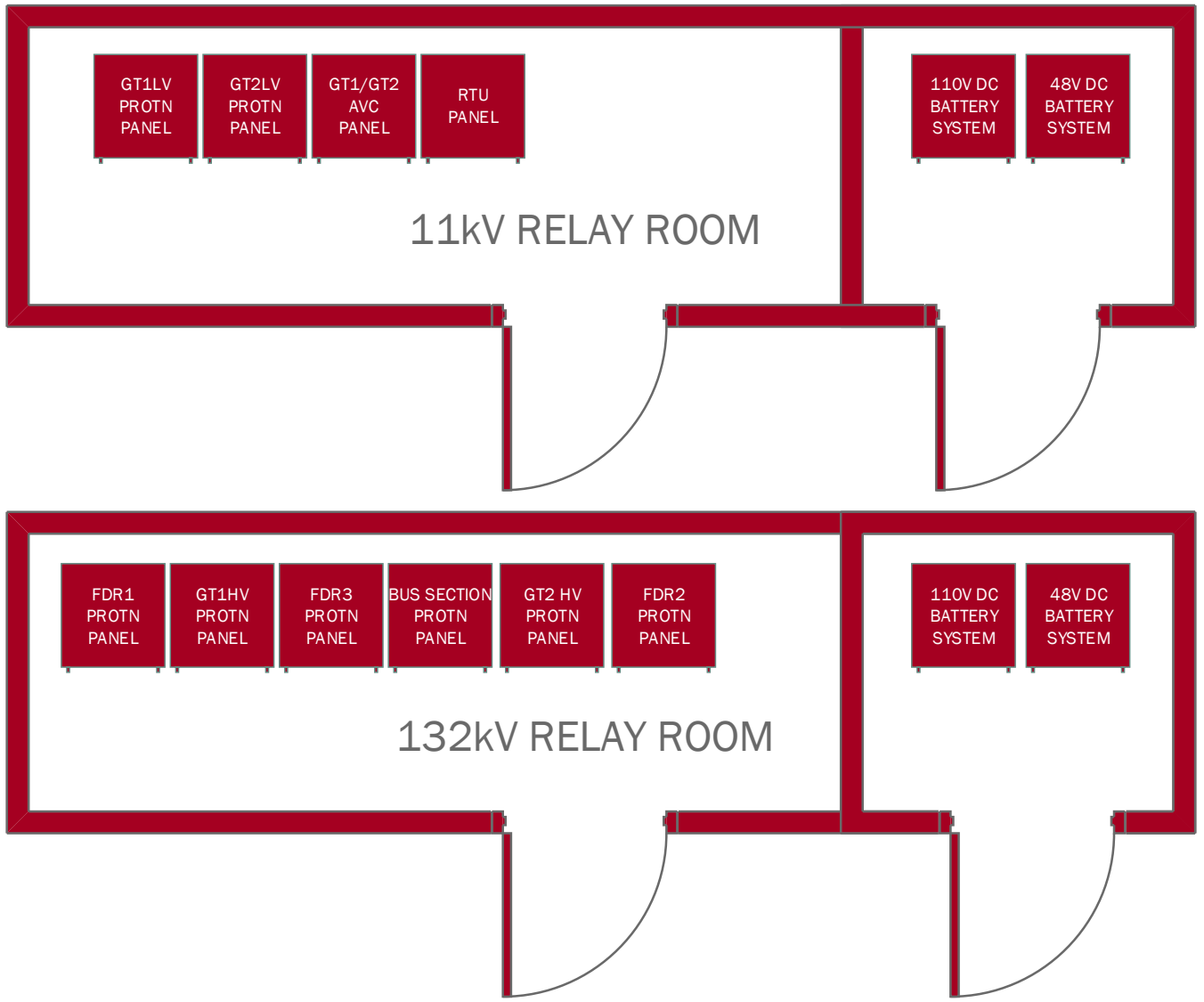


# The Centralised Protection and Control system and its benefits

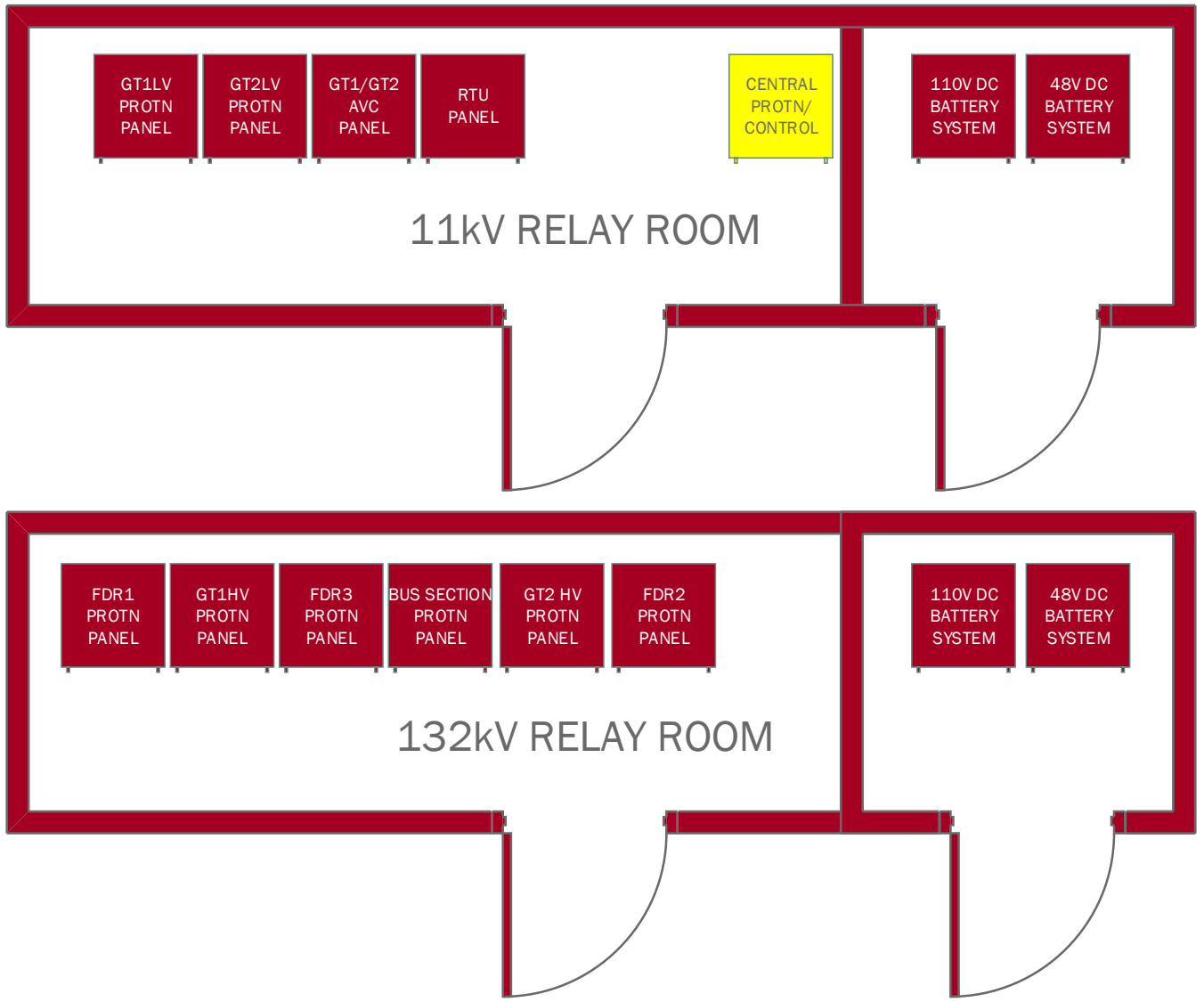



UK Power Networks
Delivering your electricity

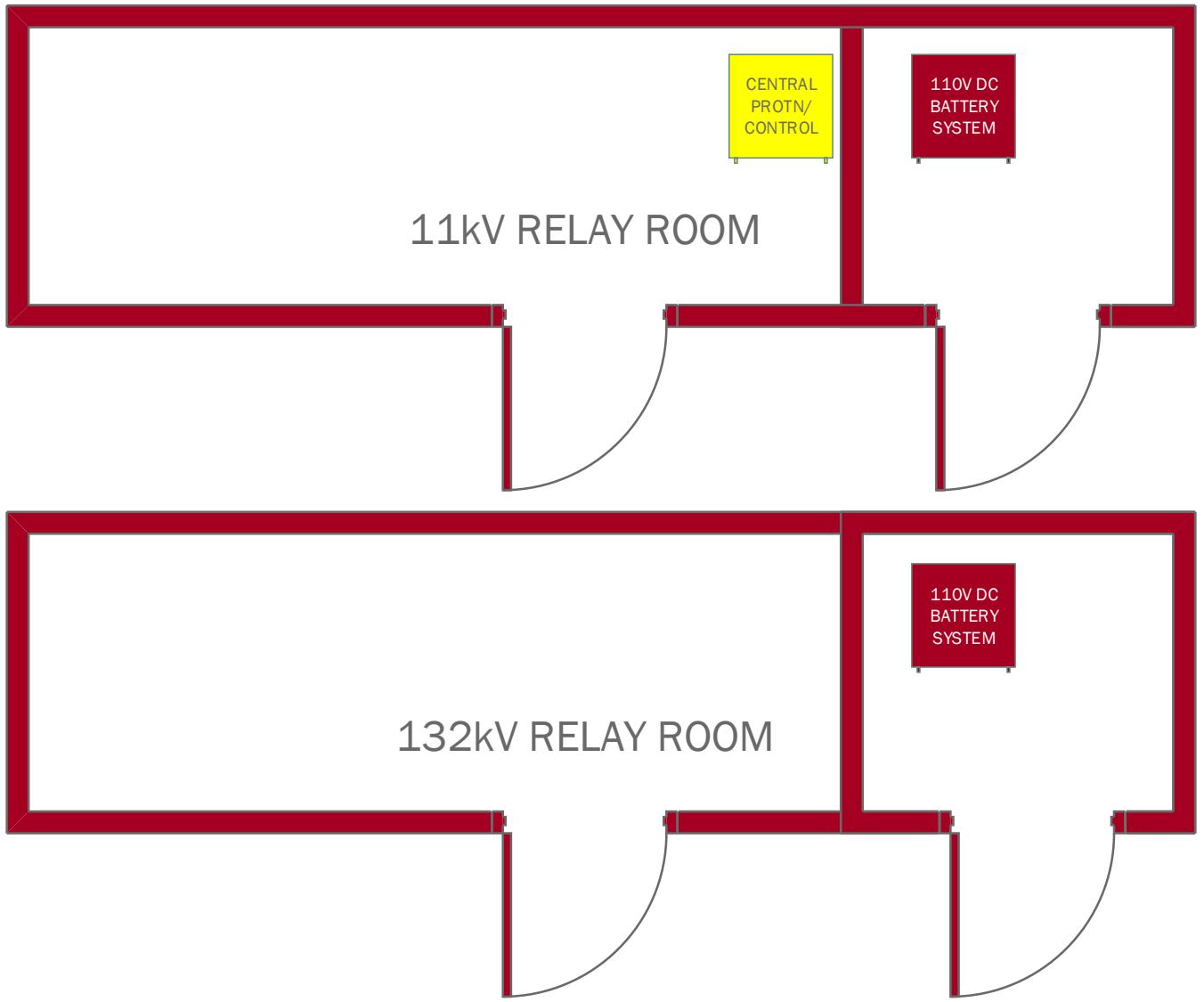
# The Centralised Protection and Control system and its benefits



# The Centralised Protection and Control system and its benefits

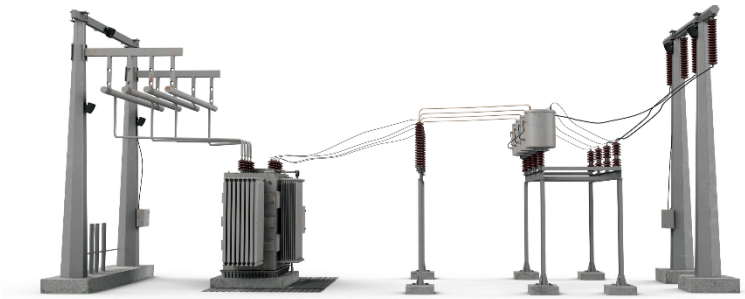


# The Centralised Protection and Control system and its benefits




UK Power Networks
Delivering your electricity

# The Centralised Protection and Control system and its benefits



# NIA PROJECT - UNIFIED PROTECTION PROJECT

colin.scoble@ukpowernetworks.co.uk

# Conclusions

A new strategy on how we Assess a centralised protection and control system was required. This included an opportunity to align our specifications to the latest standards and communicate clearly to vendors

We identified opportunities to drastically reduce our substation footprint and reduce Engineering, Commissioning and maintenance time providing TOTEX cost efficiency benefits

Greater opportunities to complete full system testing prior to circuit transfers which reduces network risk and outage durations

Look to obtain additional funding in RIIO-ED2 (2023-2031) period to accelerate deployment of these systems

UK Power Networks
Delivering your electricity

# Thank you
# Questions?

INVESTORS IN PEOPLE | Gold Until 2020

THE SUNDAY TIMES 25 BEST BIG COMPANIES TO WORK FOR 2019

UK Power Networks
Delivering your electricity