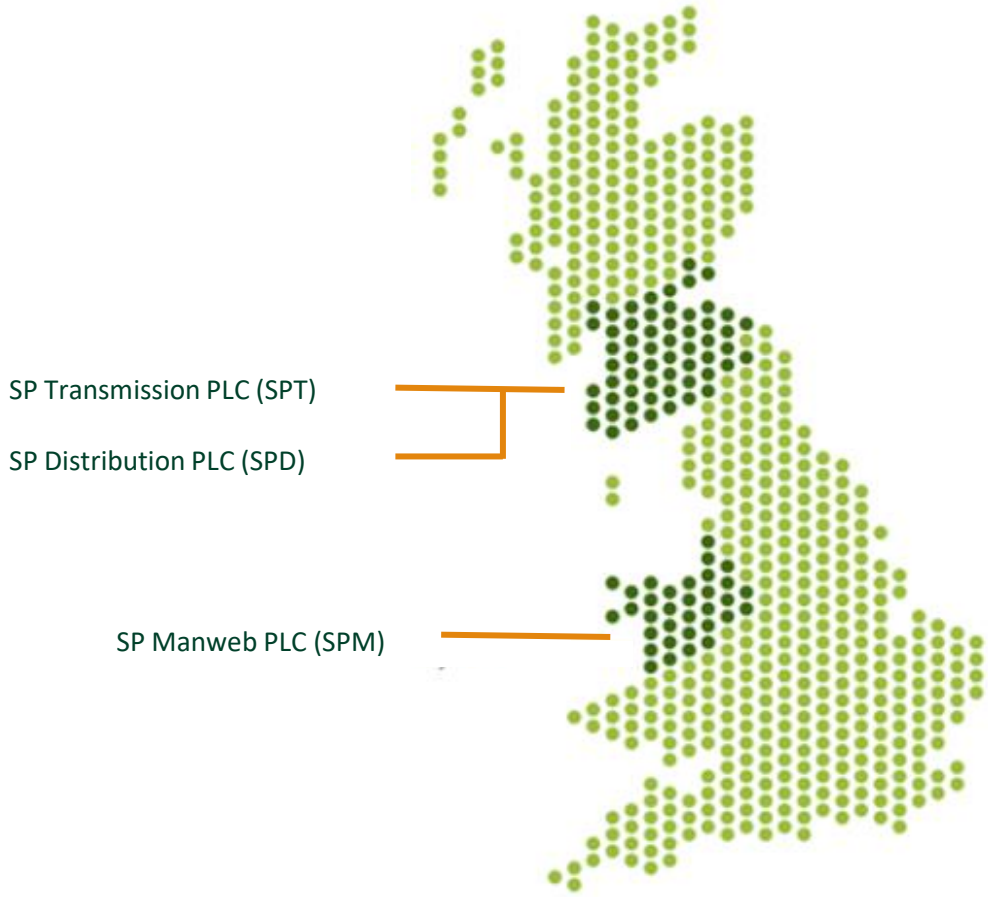
LV Engine – Smart Energy Hub Providing Hybrid LVDC/LVAC Networks

James Yu – Head of Innovation

Future Networks

SP Energy Networks

- TNO and DNO for Southern and Central Scotland
- DNO for Merseyside and North Wales
- 44,000km Overhead Lines
- 65,000km Underground Cables
- Over 3000 substations
- A Total of 3.5 Million Customers



Innovation Strategy

The Future Networks team are delivering our innovation strategy through;

- Industry leading expertise
- Concentrating on creating a positive and lasting impact on the future of distribution and transmission
- Two major fields of focus – black start and power electronics

Black Start

Black Start since 2015

Range of partners

Built expertise and capabilities

Power Electronics

Implementation across voltages on transmission and distribution networks

Power Electronics

Phoenix

Synchronous condensers + **static compensator** technologies - **manage reduced inertia** and **voltage control** on Transmission Network.

Angle-DC

Medium Voltage DC (**MVDC**) **link** to **Anglesey**, increased **renewable generation** integration.

LV Engine

Trial of innovative **Smart Transformers** for the connection of **LCTs**

£120m investment in **RIIO-2** Business plan **-** implementation of **synchronous condensers** at **Eccles**

3 further sites planned to roll out **LV Engine Technology** within **RIIO-ED2**

Transmission Network Reliability/Security

VISOR

Greater visibility of network state and assets

FITNESS

Efficient and effective digital substation

Distributed Restart

DERs supporting the network and restoring power

Synthesis

Advanced analytics and real-time control enabling rapid response to system disturbances

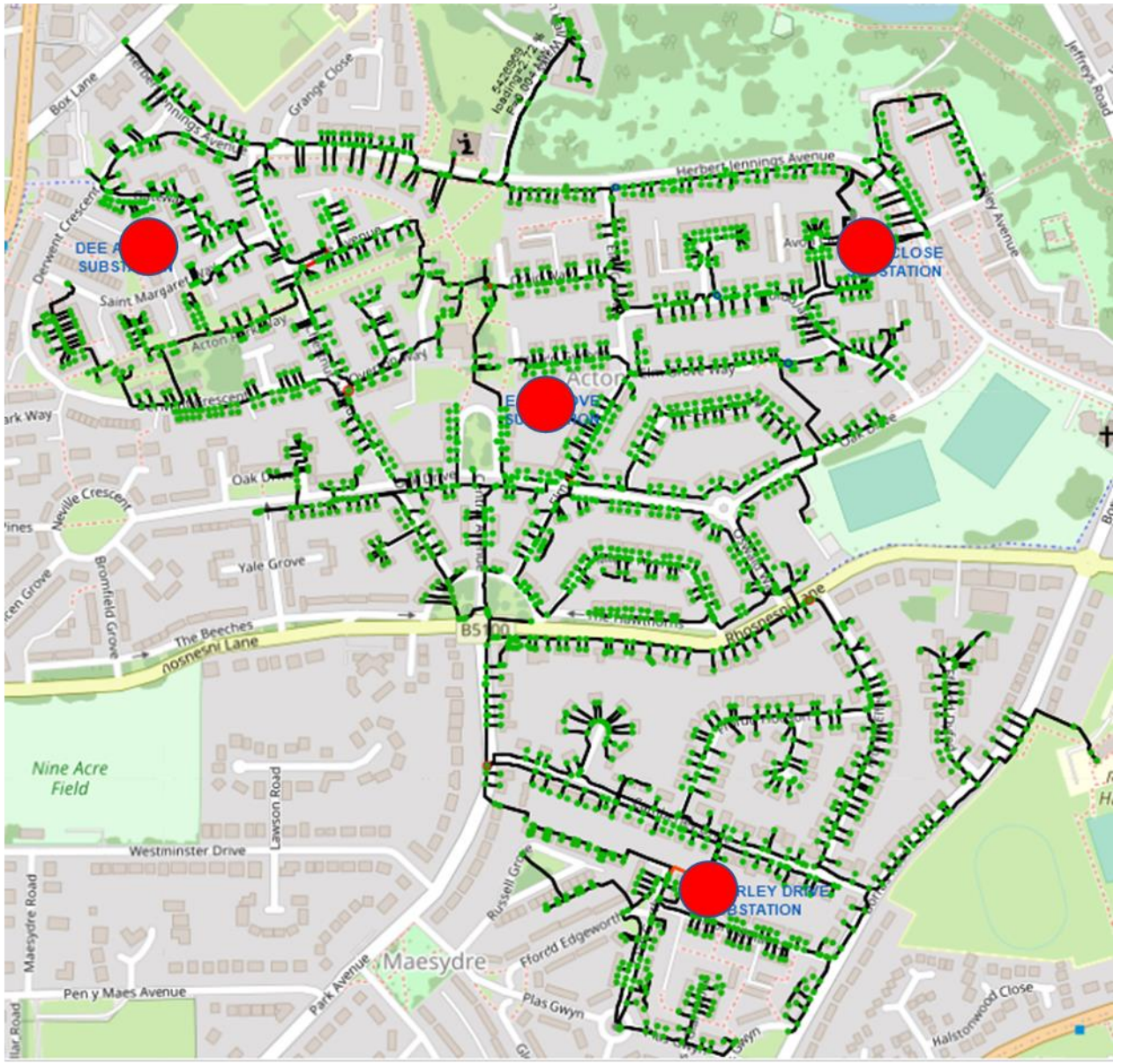
£13.59m further **investment** for **SPT**, estimated **£40m** for other GB Transmission business

£54m investment in **RIIO-2** Business plan - digital substations - Westfield and Hunterston

£5m Green Recovery Fund: Synergy

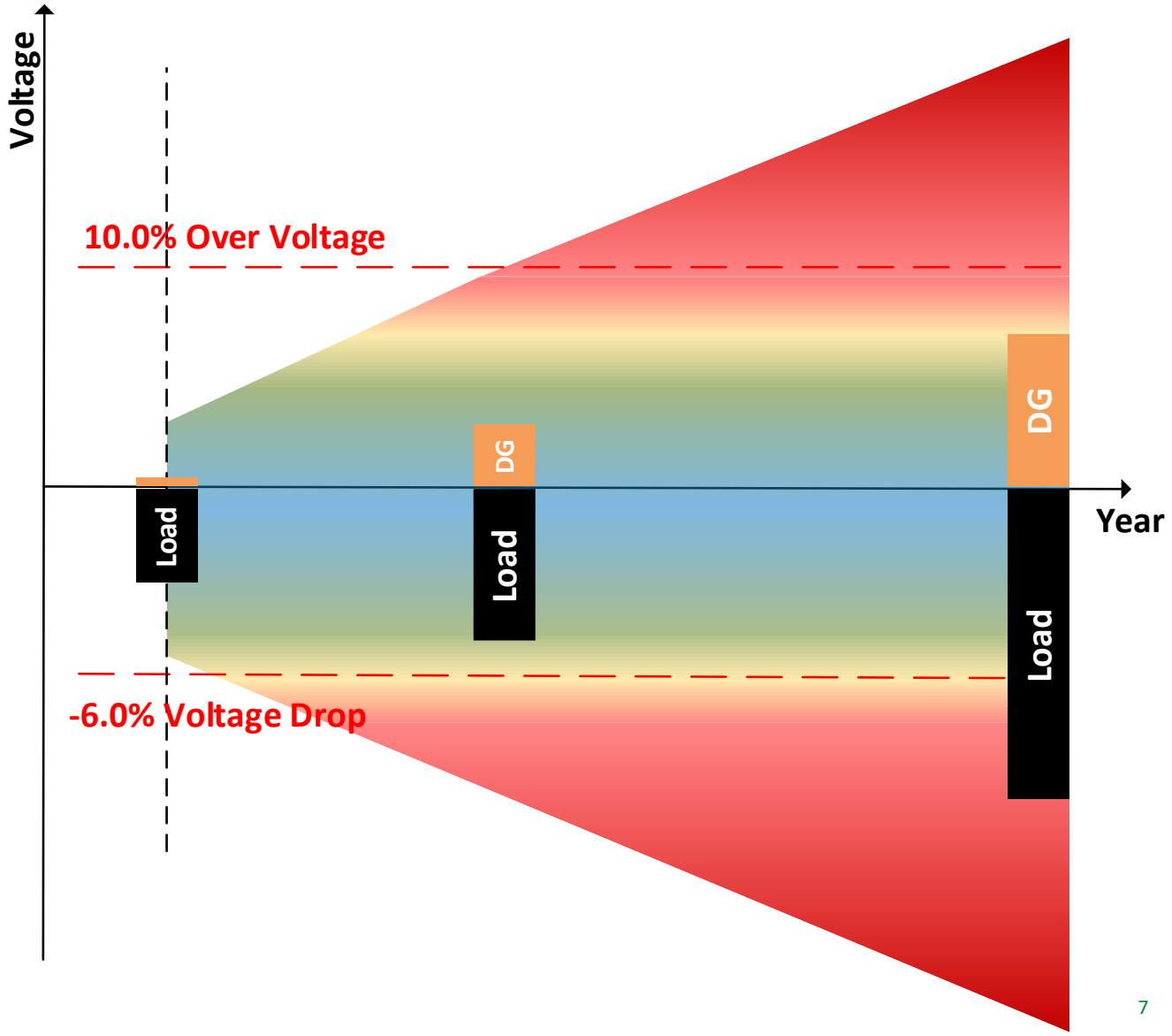
2023-SIF: Black-start from the offshore

LV Network operation - background



Growing Voltage and Thermal Issues
- Distribution Networks

- Increase in demand and LV DG connections
- The additional demand caused by EVs and heat pumps
- Uncertainties in LCTs growth (when, where, how much..)
- Increasing demand for the supply of DC power



LV Engine

Better Use of Assets

- Capacity Sharing between substations and on AC and DC
- Increases available transformers capacity

Intelligent LV Voltage Regulation

- Voltage regulation based on voltage profile
- Alleviates LV voltage depression

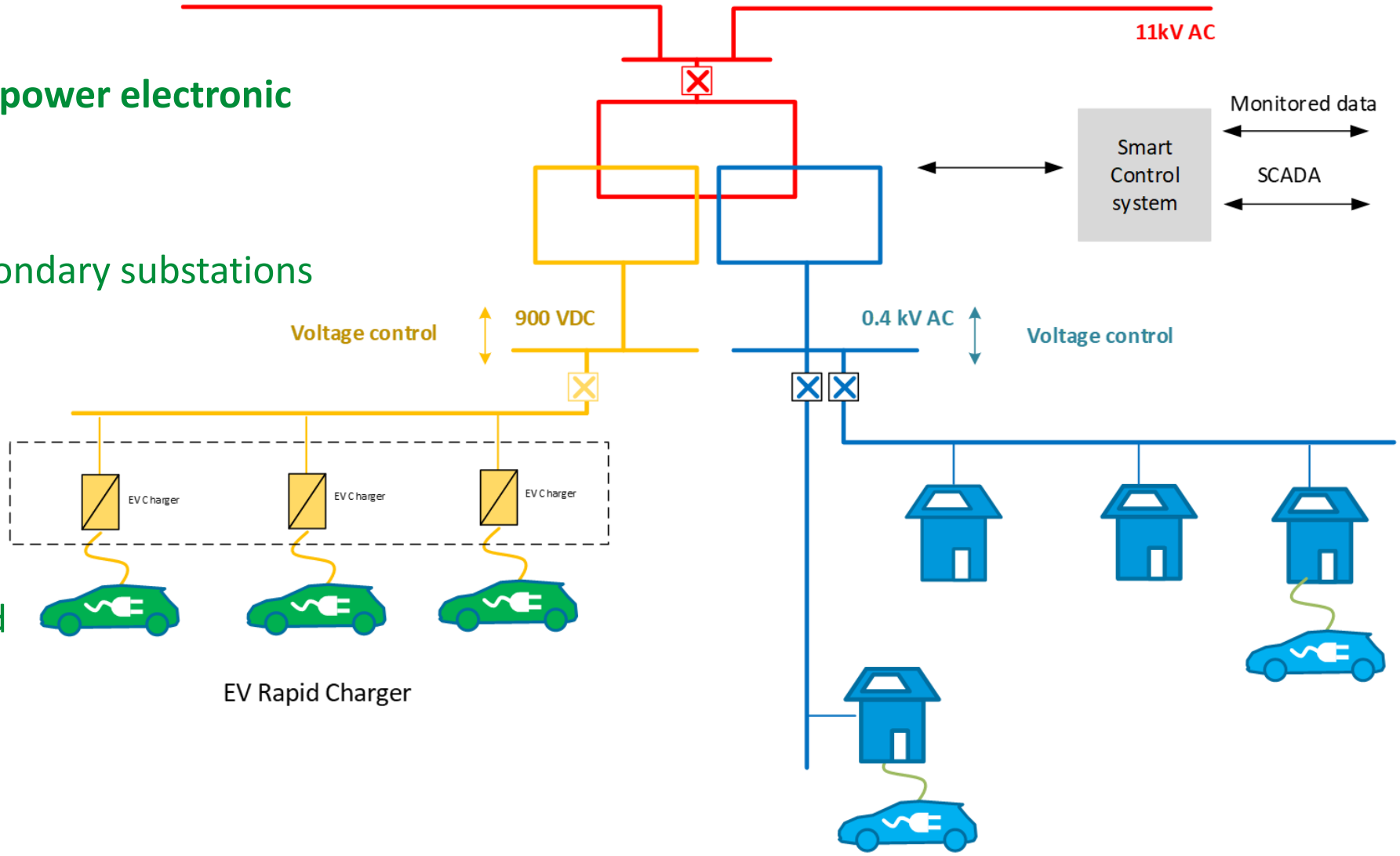
Public LVDC Network

- Low voltage DC network for, better efficiency,
- Allows Rapid Chargers to connect directly to DC network

£8.3m Project funded through **NIC** mechanism**. Completion** by **end** of **2024**

LV Engine

- **Globally innovative trial** of **power electronic** technologies
- Distribution network at secondary substations
- **Enhance** network **flexibility** and **Controllability**
- For **additional capacity** and facilitate the **implementation of Low Carbon Technologies**



Project partners

SP Energy Networks

GRIDBRIDGE
AN ERMCO COMPANY

UNIVERSITY of STRATHCLYDE
PNDC
A DECADE OF INNOVATION

UK Power Networks
Delivering your electricity

Falkirk Council

Schneider Electric

enspec

University of Strathclyde Glasgow

C&W
Cherry & White

TRITIUM

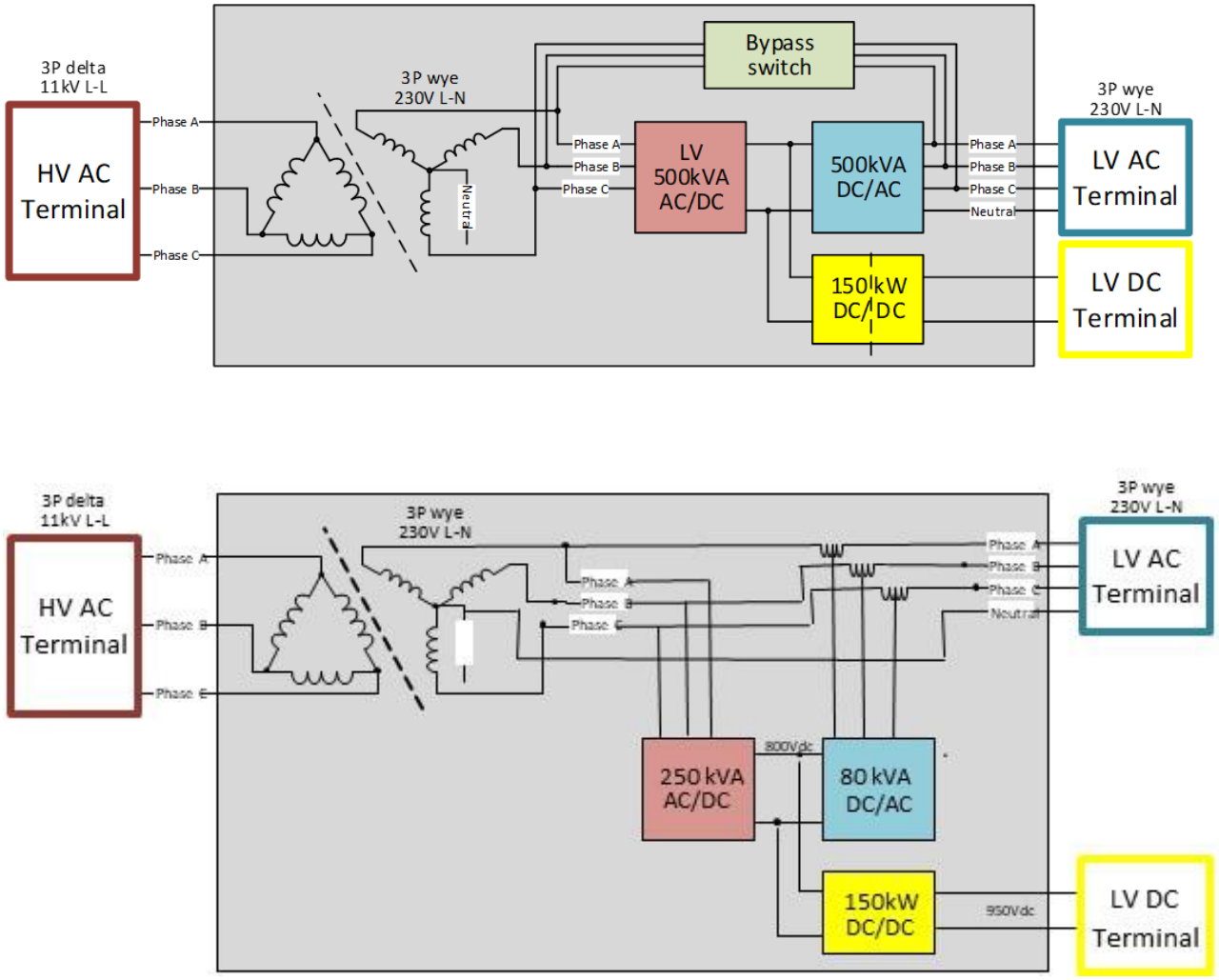
CAU
Kiel University
Christian-Albrechts-Universität zu Kiel

wsp

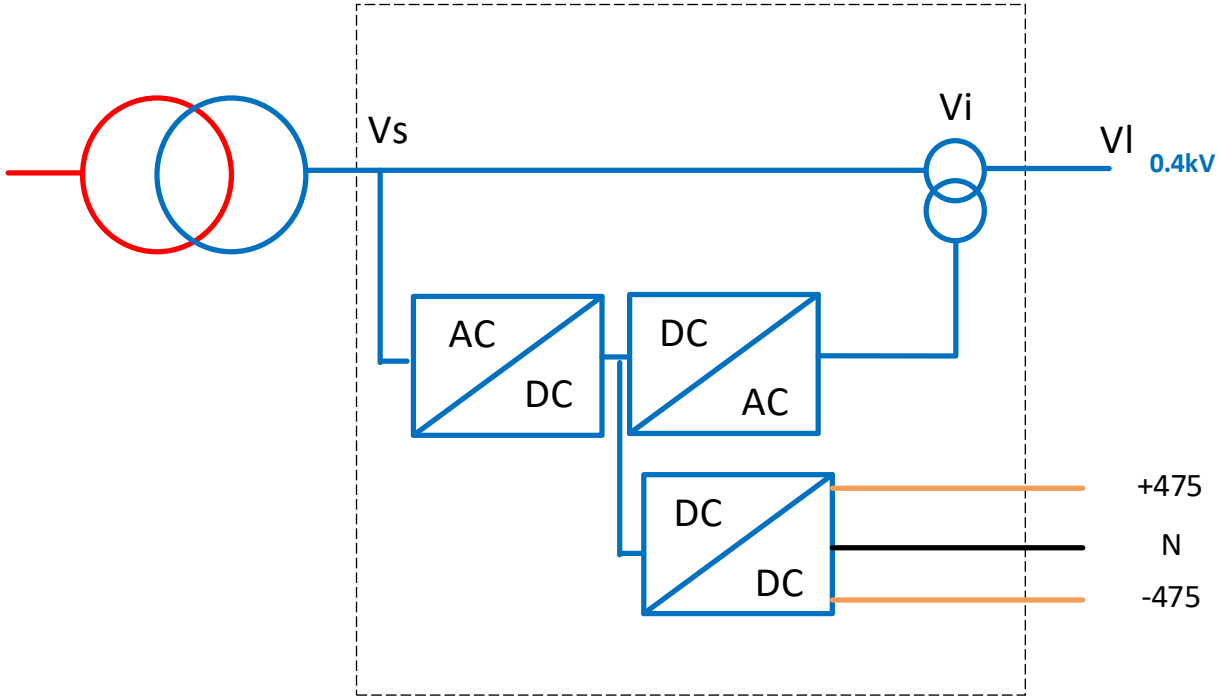
nortech

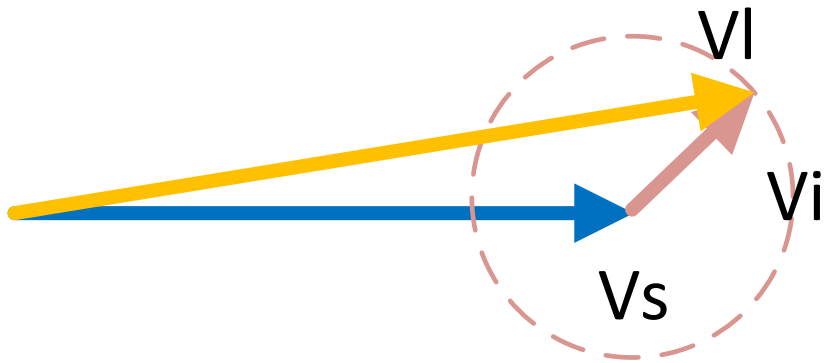
Design optioneering

- Improved performance during the fault
- Improved efficiency
- Smaller power electronics power rating
- Bypass possibility
- Smaller dimensions
- Improved overall reliability



Products – PED (UPFC)



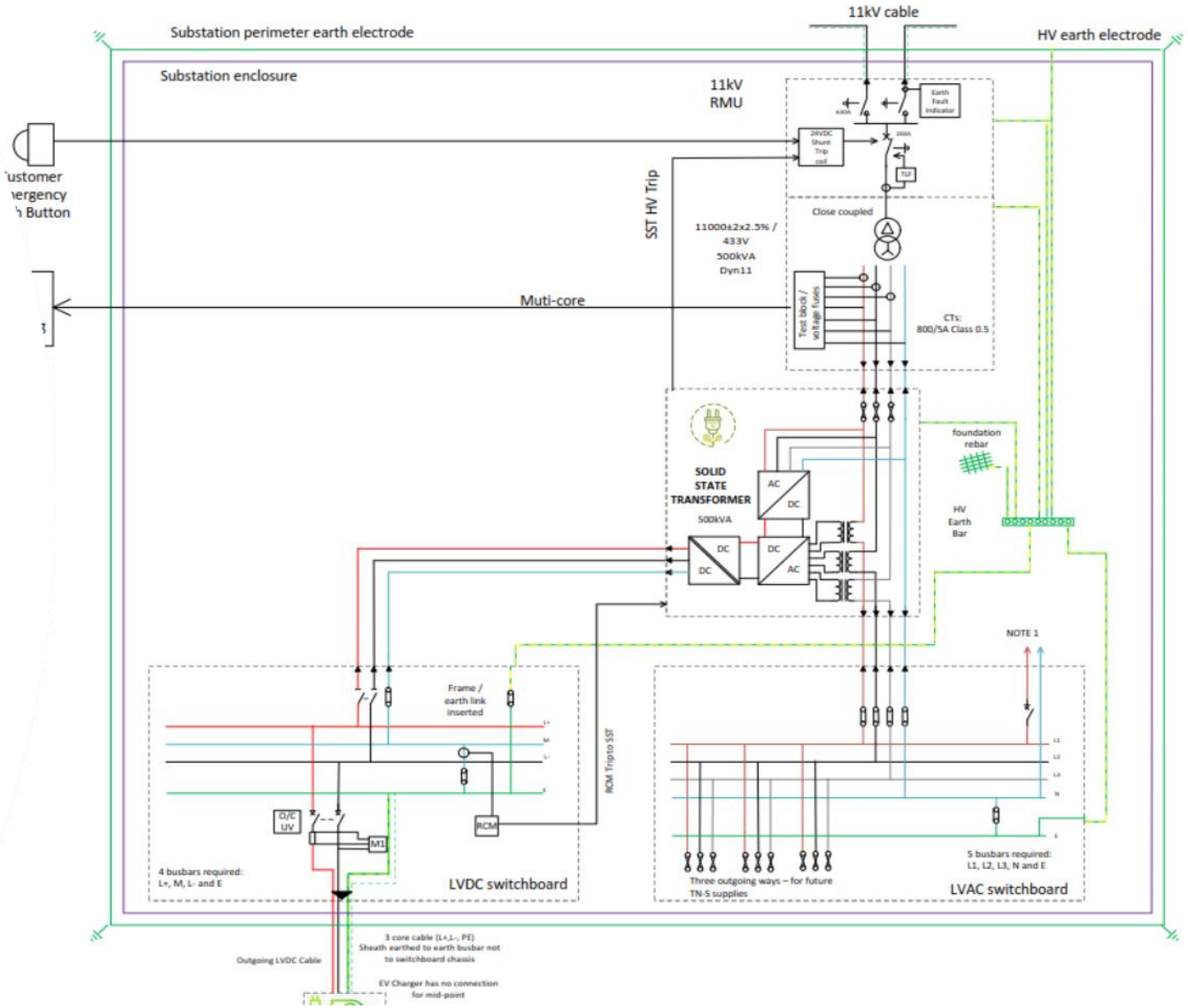


UPFC - services

- Voltage control : **36.8 V boost/ buck**
- Power factor correction : **0.9 (lead/lag) to unity**
- Load imbalance cancelation: **30%**
- LV DC supply : **150 kW**
- Control power flow: **P and Q control**

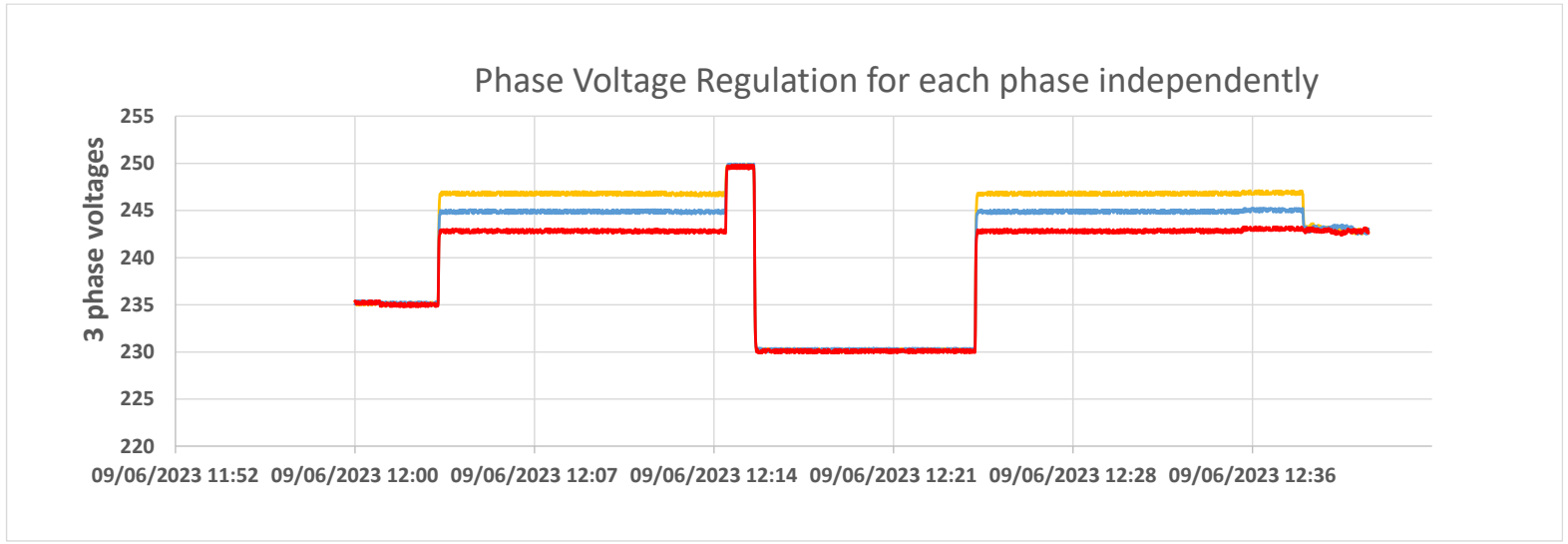
Priority	Total load	Total Imbalance cancelation	PF target	Voltage control (boost/buck)	DC
1	500kVA	30%	Unity	36.8V	150kW
2	500kVA	20%	Unity	36.8V	150kW
3	500kVA	10%	Unity	36.8V	150kW
4	500kVA	0.0%	Unity	36.8V	150kW
5	500kVA	0.0%	Load PF	36.8V	150kW

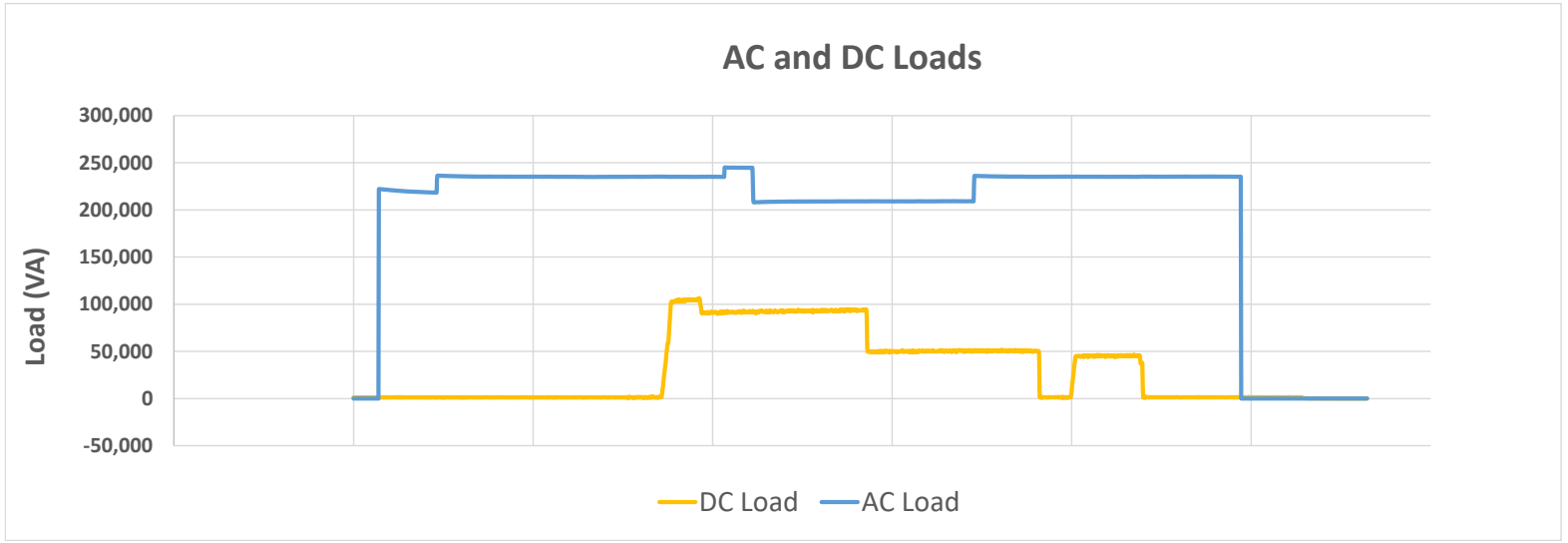
Electrical Design



LV Engine test bay in PNDC 2023

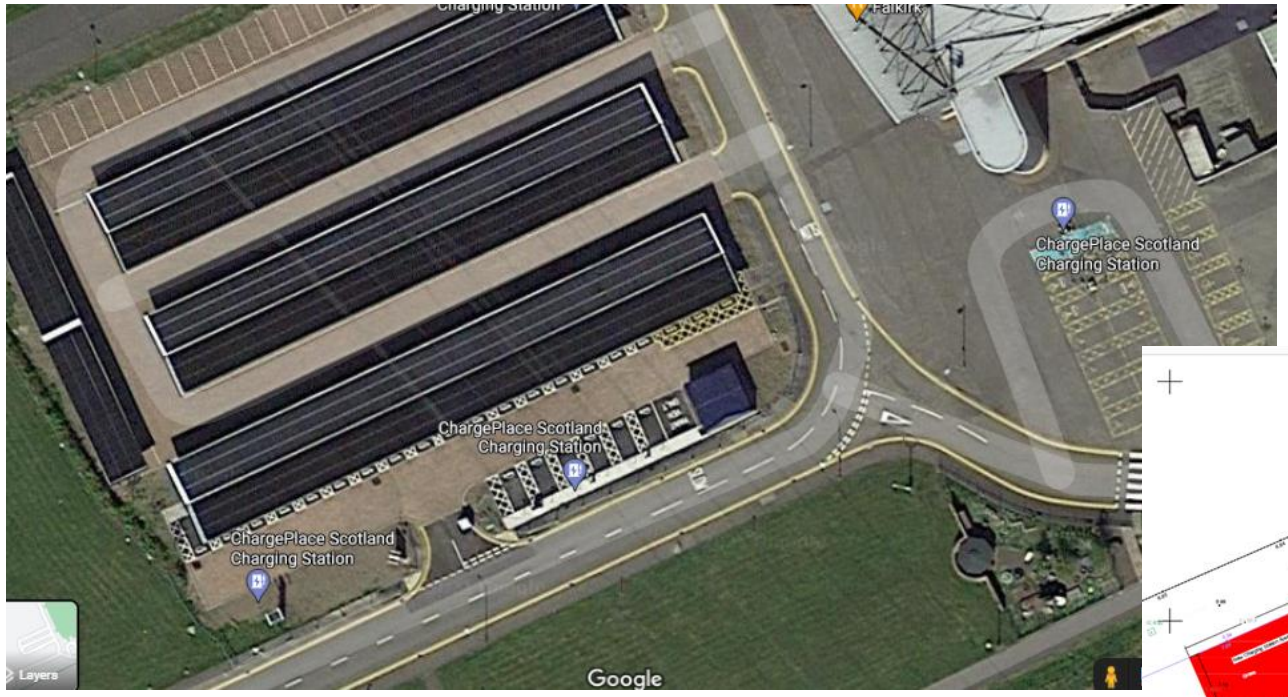
Supplying AC and DC load

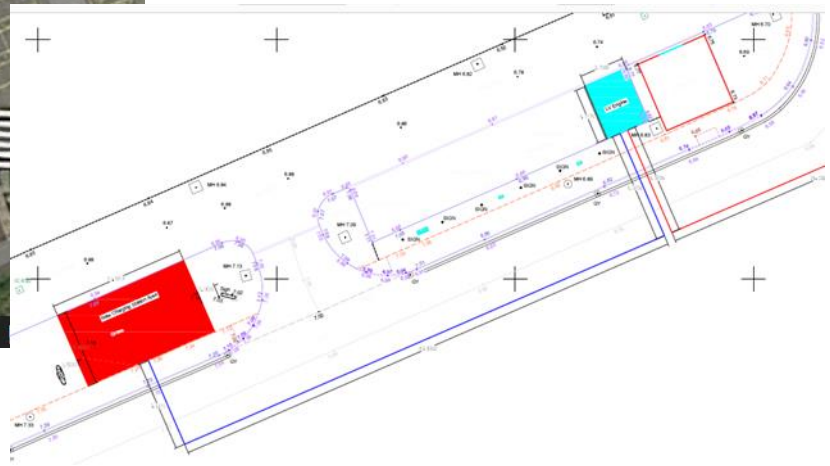


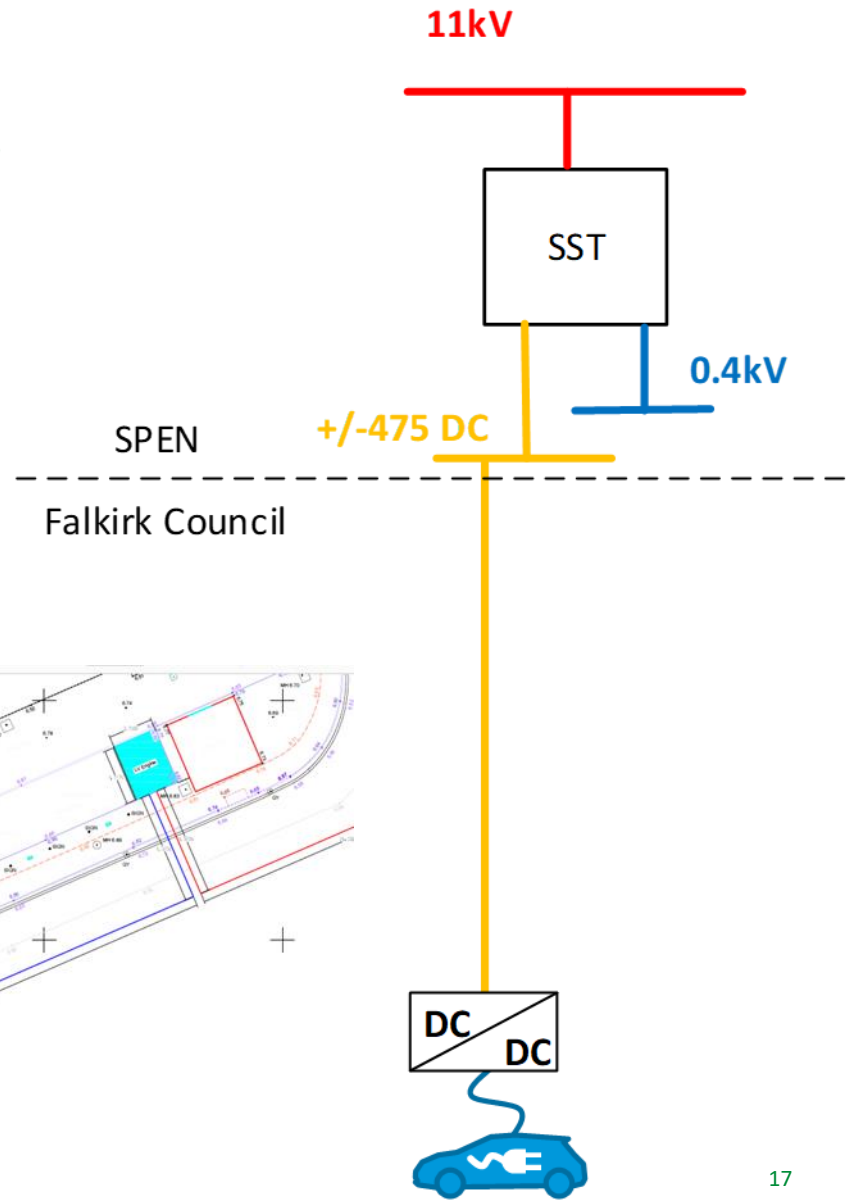


Trial Sites

Supplying an LVDC customer (150kW ultra-rapid EV) charger)







What’s next for LV Engine?

INSTALLATION AND COMMISSIONING BEING PLANNED - THREE SITES UNTIL END OF 2024.

PERFORMANCE MONITORING, OPERATIONAL EXPERIENCE, MORE DOCUMENTATIONS FOR BAU ADOPTION

MANUFACTURING ANOTHER UNIT (NEXT GEN) BASED ON LEARNINGS IN LIVE TRIAL

MORE DISSEMINATIONS AND SITE VISITS FOR STAKEHOLDERS

PROJECT REPLICATIONS AND BAU INTEGRATION


SP Energy
Networks