MSIP Re-opener Application Stage 1 – Kincardine North 400kV Substation		
Ofgem Scheme Reference/ Name of Scheme	SPT200205 / Kincardine North 400kV Substation	
Investment Category	Wider Works	
Primary Investment Driver	Thermal Uprating	
Secondary Investment Driver	Asset Health	
Licence Mechanism/ Activity	Special Condition 3.14 Medium Sized Investment Projects Re-opener and Price Control Deliverable/ Clause 3.14.6 (c)	
Materiality Threshold exceeded (£3.5m)	Yes, as a single project due to the threshold for activity 3.14.6 (c)	
PCD primary Output	Installation of Kincardine North 400kV Substation and decommissioning of Longannet 275kV Substation.	
Total Project Cost (£m)	97.73	
Funding Allowance (£m)	To be confirmed	Requested
Delivery Year	2027/28	
Reporting Table	Annual RRP – PCD Table	
PCD Modification Process	Special Condition 3.14, Appendix 1	

Issue Date	Issue No	Amendment Details
31st January 2023	1	First issue of document.

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1. Abbreviations / Terminology

Table 1: Table of Abbreviations

Abbreviation	Term
ACSR	Aluminium Conductor Steel Reinforced
AAAC	All Aluminium Alloy Conductor
AIS	Air Insulated Switchgear
AOD	Above Ordnance Datum
BEIS	Department for Business, Energy & Industrial Strategy
CEC	Connection Entry Capacity
CfD	Contract for Difference
CION	Connection and Infrastructure Options Note
EISD	Earliest In Service Date
EoL	End of Life
ESO	Electricity System Operator
FES	Future Energy Scenario
FNC	Final Needs Case
GIS	Gas Insulated Switchgear
GSP	Grid Supply Point
HND	Holistic Network Design
HTLS	High Temperature Low Sag
HVDC	High Voltage, Direct Current
INC	Initial Needs Case
ITT	Invitation to Tender
Km	Kilometre
kV	Kilovolt
LC	Licence Condition
LOTI	Large Onshore Transmission Investment
LSpC	Licence Special Condition
MITS	Main Interconnected Transmission System
MSCDN	Mechanically Switched Capacitor with Damping Network
MSIP	Medium Sized Investment Project
MW	Megawatt
NETS SQSS	National Electricity Transmission System Security and Quality of Supply Standard
NGET	National Grid Electricity Transmission
NGESO	National Grid Electricity System Operator
NOA	Network Options Assessment
OEM	Original Equipment Manufacturer
OHL	Overhead Line
OTNR	Offshore Transmission Network Review
OFTO	Offshore Transmission Owner
PCD	Price Control Deliverable
RIIO	Revenue = Incentives + Innovation + Outputs
SGT	Supergrid Transformer
SHET	Scottish Hydro Electric Transmission
SPA	Special Protection Area
SPT	SP Transmission
SPEN	SP Energy Networks

SSSI	Site of Special Scientific Interest
STC	System Operator – Transmission Owner Code
TEC	Transmission Entry Capacity
UK	United Kingdom
VDUM	Volume Driver Uncertainty Mechanism

2. Reference Documents

Table 2: Table of Reference Documents

Document Reference	Title
SPEN-RIIO-T2_Business_Plan	SP Energy Networks RIIO T2 Business Plan 2021 - 2026
SPNLT 2063	Longannet 275kV Series Reactor Refurbishment
SPNLT 2099	Longannet 275kV Switchgear Replacement

3. Introduction

This MSIP Re-opener application sets out SP Transmission's (SPT) plans to establish Kincardine North 400kV Substation. The purpose of the project is to facilitate increased power transfer into and through the SPT network from renewable developments across the north of Scotland and enable the decommissioning of Longannet 275kV Substation, which is now approaching end of life. These works are programmed to commence in the RIIO-T2 period (April 2021 – March 2026) and complete in 2027/28, during the RIIO-T3 period.

The need to replace Longannet 275kV Substation was presented to Ofgem as part of the RIIO-T2 business plan as scheme SPNLT2099[1]. The need to intervene was accepted at that time, but due to interaction with load-related drivers, the scheme was subject to a re-opener under Licence Special Condition (LSpC) 3.29.

In the period since the RIIO-T2 business plan was submitted, expected increases in onshore and offshore wind generation, supported by the 2021 and 2022 Future Energy Scenarios (FES), confirm the need to deliver significant additional transmission capacity through central and southern Scotland in the period to the end of the current decade and beyond.

To ensure the electricity transmission system enables a timely transition to Net Zero, in line with United Kingdom (UK) and Scottish Government targets of 2050 and 2045 respectively, asset intervention must be considered in the context of both current and future system requirements. It is vital that the risk of repeated intervention on strategic routes and assets (and therefore repeated system access for construction purposes) is minimised, in particular where the need for such intervention within the operational lifetime of the replacement asset may reasonably be foreseen.

Integrating load and non-load related drivers in an economic, efficient and co-ordinated manner, it is therefore proposed to proceed with a scope of works which involves the construction of a new 400kV substation, to the north of Kincardine, and the decommissioning of the existing Longannet 275kV Substation. Project timing is dictated by: (i) existing asset condition at Longannet 275kV Substation; and (ii) the need for additional boundary capability through central and southern Scotland. Both RIIO-T2 schemes SPNLT2099 and SPNLT2063 shall be superseded by this proposal and related re-opener applications under LSpC 3.29 will not be submitted.

This project was recommended to proceed by National Grid Electricity System Operator (NGESO) as part of the Network Options Assessment (NOA) published January 2022[2] (ref. NOA7 code LWUP). It was identified by NGESO as 'Required for 2027' in the Offshore Transmission Network Review (OTNR) Holistic Network Design (HND)[3] and recommended to proceed in the associated NOA7 Refresh[4] published July 2022.

Kincardine North is a significant new 400kV substation development, utilising Gas Insulated Switchgear (GIS), in the north-east of the SPT network, near Kincardine. The project will be closely co-ordinated with the East Coast Incremental 400kV Reinforcement (ref. NOA code ECUP), which is a Price Control Deliverable (PCD) in accordance with LSpC 3.9 Appendix 1. The scope of the East Coast Incremental 400kV Reinforcement project will be modified to ensure an economic, efficient and co-ordinated overall programme of works.

[1] RIIO-T2 Engineering Justification Papers (spenergynetworks.co.uk)
[2] Network Options Assessment 2021/22, January 2022
[3] The Pathway to 2030 Holistic Network Design (ref. Appendix 1).
[4] Network Options Assessment 2021/22 Refresh, July 2022

The Kincardine North 400kV Substation project will:

- Prepare the network for further planned increases in north to south transfer capability across Boundaries B4 and B5. Kincardine North 400kV Substation, which has been recommended to proceed by the Network Options Assessment (NOA) process (ref. NOA7 code LWUP), is a key enabler for several dependent projects (ref. NOA7 codes DWUP, DLUP, TKUP, BDUP and LCU2).
- Support the maximisation of transfer capability via existing transmission overhead line routes, prior to the construction of new overhead line routes e.g. Denny – Wishaw, helping to relieve thermal bottlenecks in the SPT network which can impact Scottish import and export capability.

It is proposed that Kincardine North 400kV Substation is constructed initially to provide:

- Six circuits to Denny North, Kincardine and SHE Transmission's Alyth 400kV Substation; and
- Future capability for the connection of up to a further eight circuits.

Subject to separate regulatory approval(s), it is proposed that four of these further eight bays form part of the initial contract award and site development (two bays for NOA7 project TKUP, one bay for NOA7 project DWUP and one bay for NOA7 project LCU2), with space retained within the GIS building for the future population of up to four bays (two at each end of the building), as required.

The proposed configuration of Kincardine North 400kV Substation will help to ensure the network is ready for the changes required by Net Zero targets. While capable of expansion, this configuration and tendering approach will help to reduce the risk of future busbar system extension requiring lengthy network outages and disruptive reconfiguration.

This MSIP Re-opener application is submitted in accordance with Licence Special Condition (LSpC) 3.14.6 and relates specifically to LSpC 3.14.6 activity (c):

"3.14.6 The licensee may apply to the Authority for a direction amending the outputs, delivery dates or associated allowances in Appendix1 in relation to one or more of the following activities:

(c) a Boundary Reinforcement Project that has received a NOA Proceed Signal in the most recent NOA"

The needs case for Kincardine North 400kV Substation and the factors that have an impact on the timing and scope of works are discussed in the following sections. Full justification for the preferred investment option is presented, together with a detailed description of the proposed solution.

The estimated total project cost may be subject to change. As agreed with Ofgem, a second stage MSIP submission will be made at the right time relating to the associated amendments outputs, delivery dates and allowances to be detailed as Price Control Deliverables (PCDs) in LSpC 3.14 Appendix 1.

3.1 Structure of Document

This MSIP Re-opener application is structured as follows:

Section 4 – Background and Needs Case

This section outlines the background to the proposed works and details the key project drivers.

Section 5 – Assessment of Options

This section sets out the approach taken to considering the distinct options available to address the needs identified in Section 4. The results of an evaluation of the alternative options are presented and the reasoning behind the selection of the preferred option is summarised.

Section 6 – Proposed Works

This section provides a description of the proposed solution. It sets out the scope and other key supporting information.

Section 7 – Project Cost Estimate

This section summarises the estimated cost of the selected option.

Section 8 – Project Delivery

This section outlines the approach which will be taken to deliver the project.

3.2 Requirements Mapping Table

Table 3 maps the requirements set out within Chapter 3 of the RIIO-T2 Re-opener Guidance and Application Requirements Document[5] against specific sections within this document.

Table 3: Requirements Mapping Table

Section	Description	Relevant Section(s) in RIIO-T2 Re-opener Guidance and Application Requirements Document
3	Introduction	3.3, 3.4
4	Background and Needs Case	3.8, 3.9, 3.10, 3.11
5	Assessment of Options	3.13, 3.14, 3.21, 3.22
6	Proposed Works	3.14, 3.16
7	Project Cost Estimate	3.12, 3.19, 3.20
8	Project Delivery	3.15, 3.17

[5] RIIO-2 Re-opener Guidance and Application Requirements Document: Version 2

4. Background and Needs Case

4.1 Statutory and Licence Obligations on SP Transmission plc

SP Transmission plc (SPT) is licenced under section 6(1)(b) of the Electricity Act 1989 ("the 1989 Act") to transmit electricity. The licence is granted subject to certain standard and special conditions. Under section 9(2) of the 1989 Act, SPT is required to fulfil the following duty:-

- *To develop and maintain an efficient, co-ordinated and economical system of electricity transmission; and*
- *To facilitate competition in the supply and generation of electricity.*

This statutory duty is reflected in SPT's transmission licence. In addition, SPT has the following obligations pursuant to its licence conditions (LCs):-

- To at all times have in force a System Operator-Transmission Owner Code (STC) which, amongst other things, provides for the co-ordination of the planning of the transmission system (LC B12);
- To at all times plan and develop its transmission system in accordance with the National Electricity Transmission System Security and Quality of Supply Standard (NETS SQSS) and in so doing take account of National Grid Electricity System Operator's (NGESO's) obligations to co-ordinate and direct the flow of electricity on, to and over the GB transmission system (LC D3);
- To make available those parts of its transmission system which are intended for the purposes of conveying, or affecting the flow of, electricity so that such parts are capable of doing so and are fit for those purposes (LC D2); and
- To offer to enter into an agreement with the system operator on notification of receipt of an application for connection, or for modification to an existing connection (LC D4A).

Section 38 and Schedule 9 of the 1989 Act also impose duties on SPT when formulating any relevant proposals. In response to statutory and licence obligations upon it, SPT therefore requires to ensure that the transmission system is developed and maintained in an economic, co-ordinated and efficient manner, in the interests of existing and future electricity consumers, balancing technical, economic and environmental factors.

4.2 Key Project Drivers - Non-Load Related

Longannet 275kV Substation is an indoor Air Insulated Switchgear (AIS) substation configured in a "1 ½ switch" arrangement located adjacent to the former Longannet Generating Station site. While the adjacent power station has been demolished, Longannet 275kV Substation continues to serve as a key node on the SP Transmission network in central and southern Scotland, supporting continued security of supply to 2 million customers in the SPT area as well as across the wider system in Great Britain.

With connections to Clyde's Mill 275kV Substation, Denny North 275kV Substation, Easterhouse 275kV Substation, Kincardine 275kV Substation, Mossmorran 275kV Substation and Westfield 275kV Substation, Longannet 275kV Substation is a critical node on the Main Interconnected Transmission System (MITS). It enables secure transfer of power from north to south under times of high renewable generation output, as well as south to north transfer for security purposes at times of reduced renewable generation output.

The need case for significant intervention due to (non-load related) asset condition considerations was set out and agreed as part of the RIIO-T2 price control process.

The RIIO-T2 scheme SPNLT2099[6] was developed to address the following condition issues at Longannet 275kV Substation:

- *Lead Assets* - The fourteen remaining Reyrolle type OIBR80 air-blast circuit breakers, which are of 1968/69 manufacture, have been assessed to have an End of Life (EoL) score of 10.44 or higher at the end of the RIIO-T2 period (without intervention), necessitating major intervention/ replacement in the RIIO-T2 period. These circuit breakers have a design unique to Longannet and spare parts/ refurbishment materials are not available from the Original Equipment Manufacturer (OEM).
- *Non-Lead Assets* - The non-lead assets in the existing substation building (disconnectors, instrument transformers, earth switches etc.) have operational and maintenance issues, with difficulty in procuring spares for equipment which was similarly designed specifically for Longannet 275kV Substation. Based on condition assessment of all non-lead assets, it has been determined that significant intervention is required.
- *Civil Assets* - Assessment of the substation building has identified condition issues which require major intervention or complete replacement in the RIIO-T2 period.

LSpC 3.29 provides an uncertainty mechanism which can be triggered to provide funding for non-load related assets interventions. Given the uncertainty around the emerging wider load related requirements at the time the RIIO-T2 price control was being established, and their potential interaction with non-load related requirements at Longannet, scheme SPNLT2099 is identified as an "Uncertain non-load related" project in LSpC 3.29 Uncertain Non-Load Related Projects Re-opener and Price Control Deliverable Appendix 1.

The RIIO-T2 scheme SPNLT2063[7], which relates to the major refurbishment of the two 275kV 620MVA series reactors at Longannet, manufactured in 1969, is similarly identified as an "Uncertain non-load related" project in LSpC 3.29 Appendix 1.

Schemes SPNLT2099 and SPNLT2063 shall be superseded by this proposal; related re-opener applications under LSpC 3.29 will not be submitted.

4.3 Key Project Drivers - Load Related

In June 2019, the UK parliament passed legislation introducing a binding target to reach net zero greenhouse gas emissions by 2050. In Scotland, the Scottish Parliament has committed Scotland to becoming a net zero society by 2045. The timely connection of low carbon generation, such as onshore and offshore wind, will play a vital role in reaching these legislated net zero targets.

The UK Government announced in October 2020 its commitment to make the UK a world leader in green energy and boosted the UK Government's previous 30GW target for offshore wind to 40GW by 2030. The current Scottish Government ambition is 20GW of onshore wind and 11GW of offshore wind in Scotland by 2030. Further commitments, by the UK Government in October 2021, to decarbonise the power system by 2035, as well as British Energy Security Strategy[8] published April 2022 (which raises the UK Government ambition to 50GW of offshore wind by 2030), further support the requirement for investment in the existing electricity transmission system to enable the timely connection and integration of the required renewable generation sources.

[6] RIIO-T2 Engineering Justification Papers (spenergynetworks.co.uk)
[7] RIIO-T2 Engineering Justification Papers (spenergynetworks.co.uk)
[8] British energy security strategy - GOV.UK (www.gov.uk)

On 9th September 2021, the Department for Business, Energy & Industrial Strategy (BEIS) announced a £265m[9] budget per year for the Contracts for Difference (CfD) Allocation Round 4, which launched on 13th December 2021 and concluded on 7th July 2022. For the first time since 2015, established technologies, including onshore wind, were able to bid. Given lowering technology costs and a favourable subsidy regime, this will support a considerable number of onshore renewables projects to successfully transition from project inception and development through to energisation[10]. The next CfD auction, Allocation Round 5, is due to open in March 2023, with annual auction rounds expected thereafter.

4.3.1 Offshore Wind Connections - ScotWind

The results of the ScotWind leasing process, a programme managed by Crown Estate Scotland to lease areas of the seabed around Scotland for offshore wind farm development, were announced on the 17th January 2022[11]. In summary:

- 17 projects with a capacity totalling 24.8GW were selected out of a total of 74 applications, and have been offered option agreements which reserve the rights to specific areas of seabed.
- A total of just under £700m will be paid by the successful applicants in option fees and passed to the Scottish Government for public spending.
- Initial indications suggest a multi-billion pound supply chain investment in Scotland.
- Of the 17 projects selected in January 2022, 6 are in the ScotWind East region[12] with a combined capacity of 10.5GW and option fees totalling £324.5m, of which 3 are in the East 1 Zone, with a combined capacity of 6.7GW and option fees totalling £199.8m.

Since the announcement of the initial ScotWind leasing results in January 2022, an additional 2.7GW of offshore wind has been leased in an area East of Shetland, taking the total ScotWind generation to 27.6GW.

The ScotWind results underline both the scale of development potential off the north and east coasts of Scotland and the commitment from industry to delivering the investments in energy infrastructure necessary to meet Net Zero targets. Off the north and east coasts of Scotland in particular, there is very high potential for offshore wind generation, in areas illustrated by the BEIS/ Ofgem Offshore Transmission Network Review[13] (OTNR) Generation Map[14].

ScotWind offshore developments are expected to contribute towards the Scottish Government ambition of 11GW of offshore wind by 2030 and make a significant contribution towards 2045 and 2050 Net Zero targets.

It is vital that the onshore transmission system is developed in a timely manner so as to enable the benefits of ScotWind to be realised and contribute to the Scottish Government's offshore wind ambition of 11GW by 2030.

[9] Biggest ever renewable energy support scheme backed by additional £265 million - GOV.UK (www.gov.uk)
[10] BEIS - Electricity Generation Costs (2020)
[11] Crown Estate Scotland - ScotWind offshore wind leasing delivers major boost to Scotland's net zero aspirations
[12] Sectoral Marine Plan for Offshore Wind Energy
[13] Offshore Transmission Network Review
[14] OTNR - Generation Map

4.3.2 Future Energy Scenarios

Each year, NGESO produces a set of Future Energy Scenarios (FES) for use by the Transmission Owners (TO's) as network investment planning backgrounds. Through application of the criteria set out in the NETS SQSS, the FES provide an indication of the capacity requirements of the system based upon the potential future connection of generation and changing demand profiles.

The north to south power transfer requirements on all of the northern transmission system boundaries increase significantly over the coming years due to the connection of new renewable generation throughout Scotland as part of the energy transition to meet legislated Net Zero targets. This trend is clearly demonstrated by the transfer requirements on the boundary between the SHET and SPT areas (Boundary B4), and through the central belt of Scotland in the SPT area (Boundary B5).

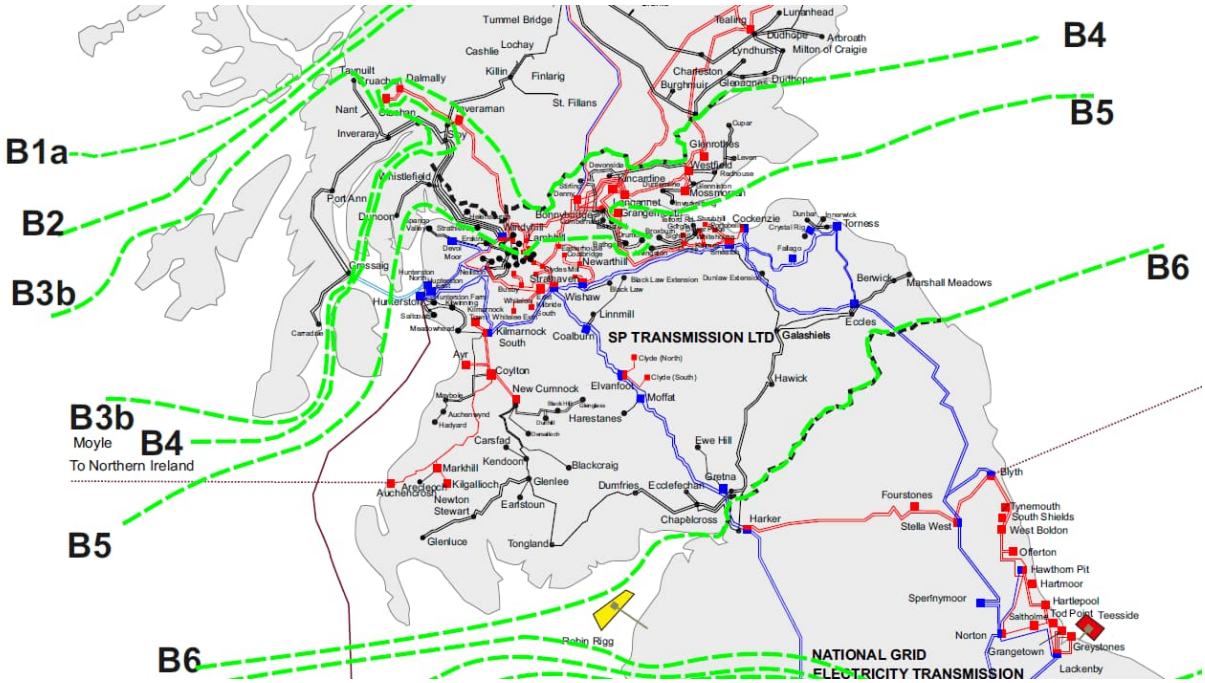

Figure 1: Network boundaries across SPT's network

Figure 2 indicates the 2021 FES and 2022 FES required transfer capability on the B4 boundary. Existing capability is already exceeded, broadly consistent with all Scotland and North England boundaries, driven by generation developments under the Connect and Manage regime, with the difference becoming extremely pronounced by the mid to late 2020s in all scenarios.

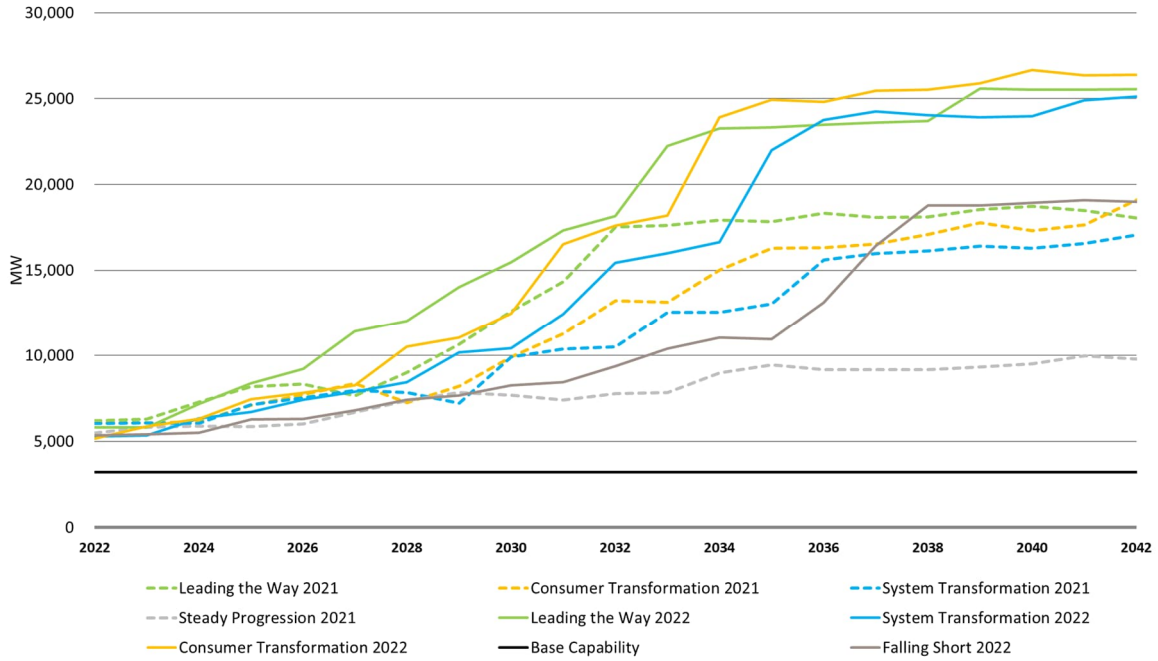

Figure 2: Required Transfer and Base Capability for boundary B4

The current capability of transmission network boundary B4 is approximately 3,200MW. Figure 2 above shows a required transfer of up to 15.5GW by 2030 and up to approximately 25GW by 2035.

Figure 3 indicates the 2022 FES required transfer capability on the B5 boundary. The trends above are similar to those on the B4 boundary and are predominantly due to the connection of onshore and offshore wind across the north of Scotland. Generation connecting in the north of the SPT area and parts of SHE Transmission's Argyll and Kintyre area will drive further increase in the required transfer capability on this boundary.

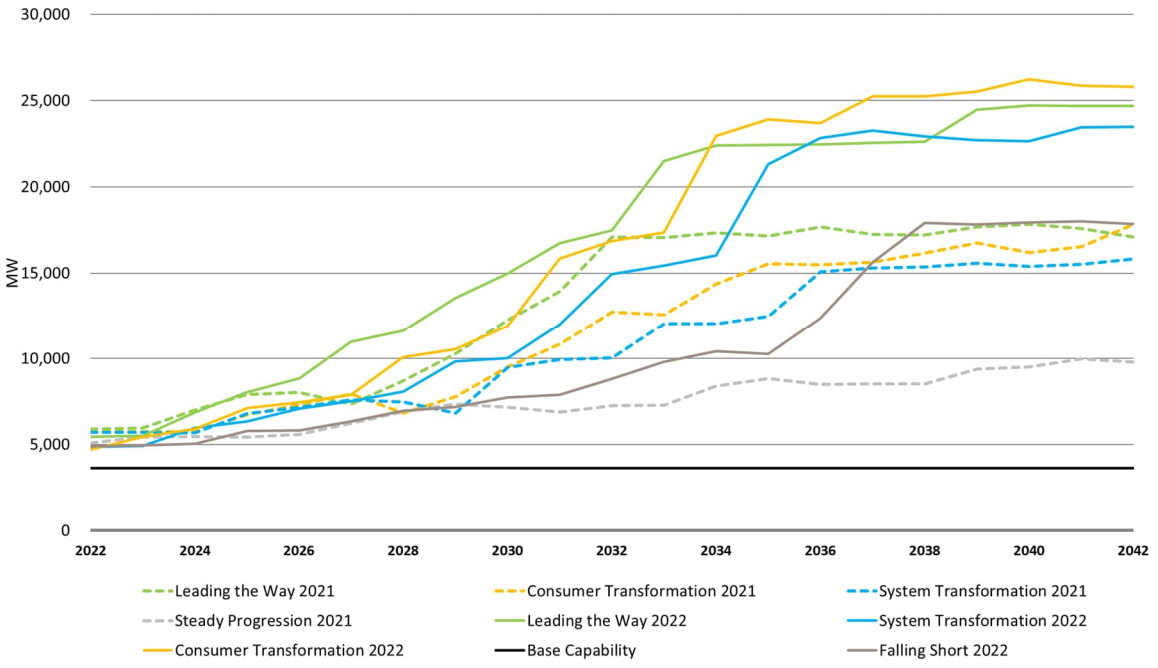

Figure 3: Required Transfers and Base Capability for boundary B5

The current capability of transmission network boundary B5 is approximately 3,600MW. Figure 3 above shows a required transfer of up to 15GW by 2030 and up to approximately 24GW by 2035.

Figures 2 and 3 show that in the coming years the unconstrained boundary flows on B4 and B5 are set to increase significantly. In order to maintain an efficient and economic transmission system whilst economically integrating additional renewable generation, significant system reinforcement is required in an unprecedented timeframe.

4.3.3 Network Options Assessment (NOA)

The Network Options Assessment process (ref. Standard Licence Condition C27) demonstrates the need to make significant investment in the capability of the existing transmission system through Scotland and the north of England to accommodate significant growth in renewable generation. This is required to maintain and operate an economic and efficient transmission system. It is critical that the network is ready to accommodate the scale of projected renewable capacity growth, required to support legislated Net Zero targets, whilst also enabling significant constraint savings.

The 2021/22 NOA Report, published in January 2022, supports the proposal in this paper to progress the replacement of Longannet 275kV Substation with a new 400kV substation to the north of Kincardine (ref. NOA7 code LWUP), giving the project a "Proceed" recommendation. This recommendation continued to be supported through the NOA Refresh, published in July 2022.

Furthermore, the 2021/22 NOA Report and associated NOA Refresh recommended that additional network investment projects across the B4 and B5 boundaries are also required as part of a wider strategy comprising a series of co-ordinated projects, enabled by the development of Kincardine North 400kV Substation, to maximise transfer capability via existing transmission overhead line routes (ref. NOA codes DWUP, DLUP, TKUP, BDUP and LCU2). These dependent projects will continue to be developed and will be the subject of separate regulatory submissions.

4.4 Alignment with RIIO-T2 Strategic Goals

As described in our RIIO-T2 plan[15] for the five-years to the end of March 2026, to mitigate the impacts of climate change and achieve a low-carbon energy system requires a level of focused effort and commitment never seen before. The mass electrification of transport and heat has only started and there is a huge amount required to build on the timely progress already made in the electricity sector.

Energy networks are critical to achieving the wider Net Zero emissions targets and with continued engagement with consumers, network users and our wider stakeholders, we've set a progressive plan in place to facilitate a Net Zero future. Our RIIO-T2 plan sets out four strategic goals – informed by our stakeholder priorities – that will keep us moving towards this sustainable future. These goals and their alignment with the development of Kincardine North 400kV Substation, are summarised in Figure 4.

Further detail regarding how this proposal aligns to our four Strategic Goals is outlined below:

Take a leading role in delivering a Net Zero future that is consistent with government objectives.

Kincardine North 400kV Substation will enable both increased transmission capacity and the amount of renewable generation connected to the GB electricity network, contributing towards a reduced reliance on fossil fuel electricity generation sources.

[15] SP Energy Networks RIIO-T2 Business Plan

Deliver the benefits of increased cost-efficiency to network users and consumers by continually innovating and applying whole system solutions.

Kincardine North is a significant new 400kV substation development near Kincardine. Integrating load and non-load related drivers in an economic, efficient and co-ordinated manner, its purpose is to facilitate increased power transfer into and through the SPT network from renewable developments across the north of Scotland and enable the decommissioning of Longannet 275kV Substation, which is now approaching end of life.

SPT's intention is to construct Kincardine North 400kV as a GIS substation employing alternative Insulation and Interrupting Gases, avoiding the addition of SF_6 to SPT's inventory, as far as technology maturity permits. This is in accordance with SPT's RIIO-T2 Environmental Action Plan[16].

Maintain world-leading resilience and system operability to ensure security of supplies throughout the energy transition.

The works will help maintain system resilience and operability by replacing existing assets that are approaching end of life, while enabling additional transmission capacity as well as the capability to connect new sources of renewable generation, with demand for network capacity expected to increase significantly following the recent ScotWind leasing round announcement.

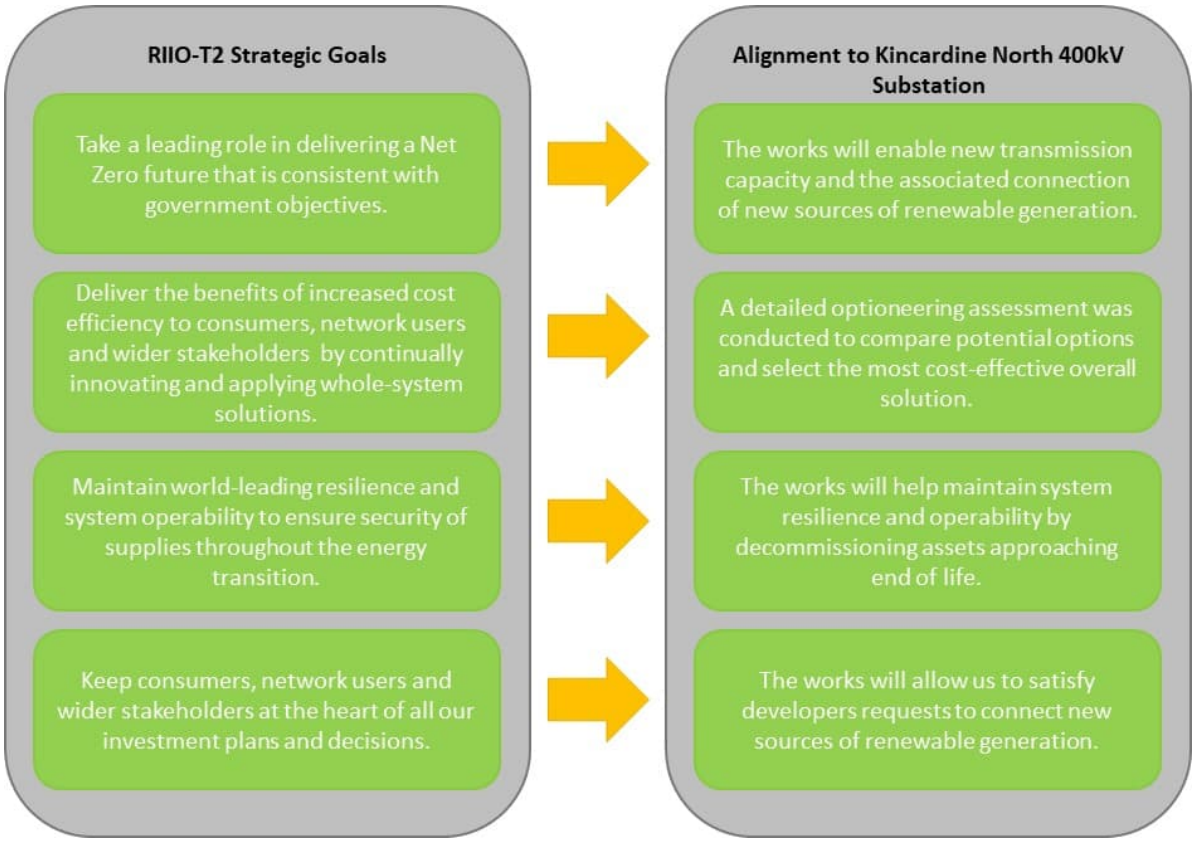

Figure 4: Alignment of the Kincardine North 400kV Substation Proposal with SPT RIIO-T2 Strategic Goals

[16] https://www.spenergynetworks.co.uk/userfiles/file/RIIO-T2_Annex_7_Environmental_Action_Plan.pdf

Keep network users and consumers at the heart of all our investment plans and decisions.

The completion of Kincardine North 400kV Substation is required to maintain and operate an economic and efficient transmission system, and allow SPT to satisfy network users' requests for connection, consistent with our statutory and licence responsibilities.

Key stakeholders will be consulted during the development of the proposed solution and we will continue to engage with stakeholders throughout the project development and delivery process.

The completion of Kincardine North 400kV Substation will continue to align with our future strategic ambitions.

5. Assessment of Options

5.1 Existing System Configuration

Existing transmission assets in the Kincardine / Longannet area are indicated in Figure 5 below.

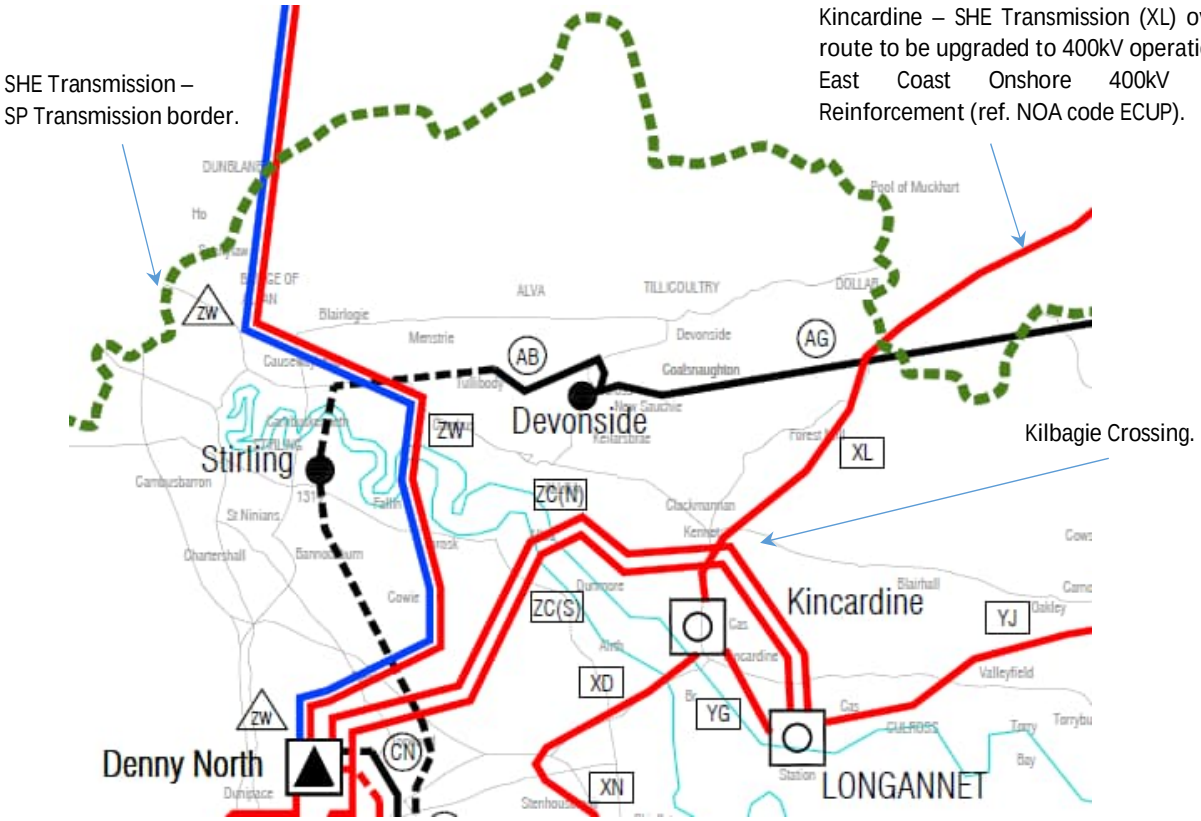

Figure 5: Geographic Indication of Transmission Configuration in Kincardine / Longannet Area[17]

Longannet 275kV Substation is connected via four double circuit overhead line routes operating at 275kV. It is an indoor Air Insulated Switchgear (AIS) substation configured in a "1 ½ switch" arrangement.

As detailed Figure 6, Longannet 275kV Substation connects the following circuits:

- Clyde's Mill 275kV
- Denny North No.1 275kV
- Denny North No.2 275kV
- Easterhouse 275kV
- Kincardine No.1 275kV
- Kincardine No.2 275kV
- Mossmorran 275kV
- Westfield 275kV
- Longannet Mechanically Switched Capacitor with Damping Network (MSCDN) No.1
- Longannet MSCDN No.2

[17] Assets indicated in blue operate at 400kV, assets in red operate at 275kV and assets in black operate at 132kV.

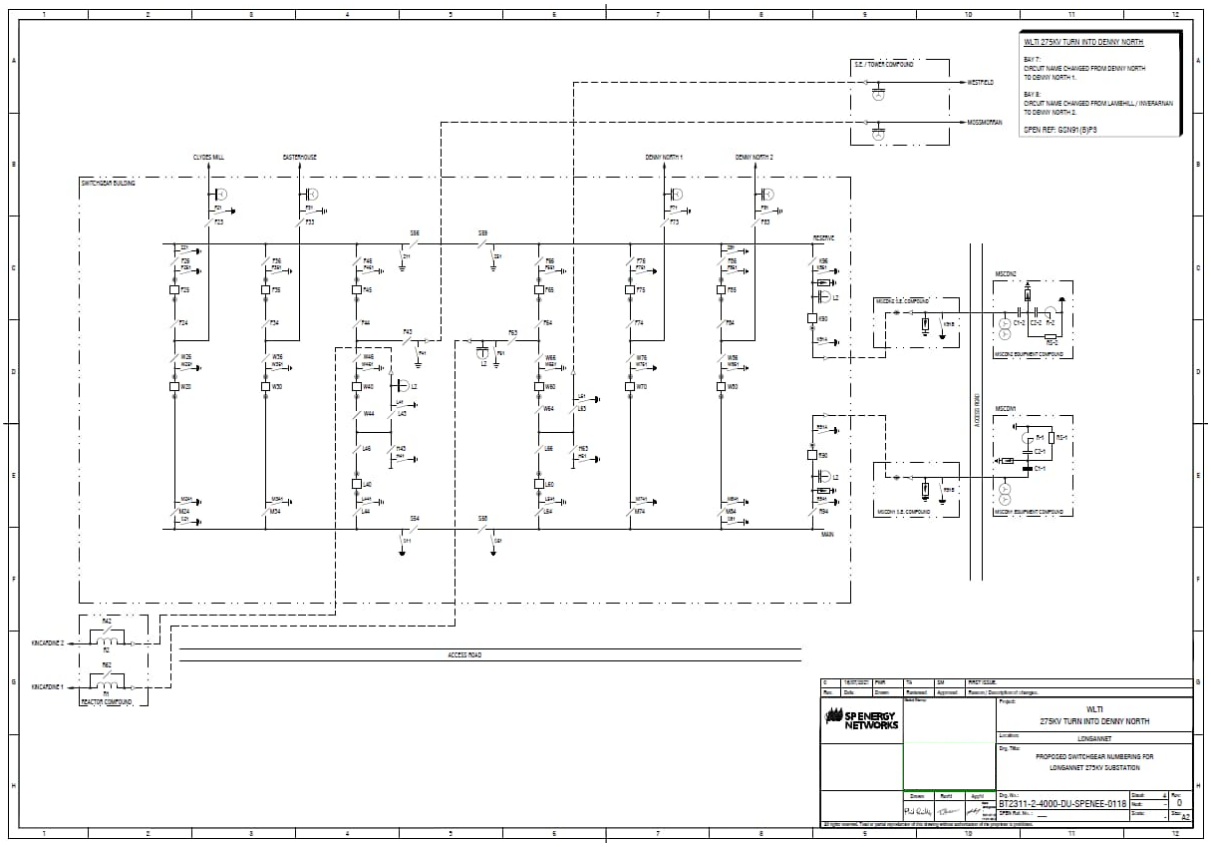

Figure 6: Existing Configuration – Longannet 275kV Substation

Kincardine 275kV Substation is connected via three double circuit overhead line routes operating at 275kV. It is an indoor GIS substation configured in a double busbar arrangement.

The existing substation and wider site is located immediately adjacent to the Firth of Forth. The ground levels within the existing substation vary between approximately 1.1m and 2.2m Above Ordnance Datum (AOD). Due to its location and topography, the Kincardine 275kV Substation compound is at significant risk and vulnerable to flooding from the Firth of Forth. The GIS building has therefore been designed and constructed on a 5m high structure (delivering a 6.2m AOD protected level) to mitigate flood risk to all critical equipment.

As detailed Figure 7, Kincardine 275kV Substation connects the following circuits:

- Currie 275kV
- Grangemouth 275kV
- Longannet No.1 275kV
- Longannet No.2 275kV
- SHE Transmission Fetteresso No.1 275kV (Future Alyth 275kV)
- SHE Transmission Fetteresso No.2 275kV (Future Alyth 275kV)

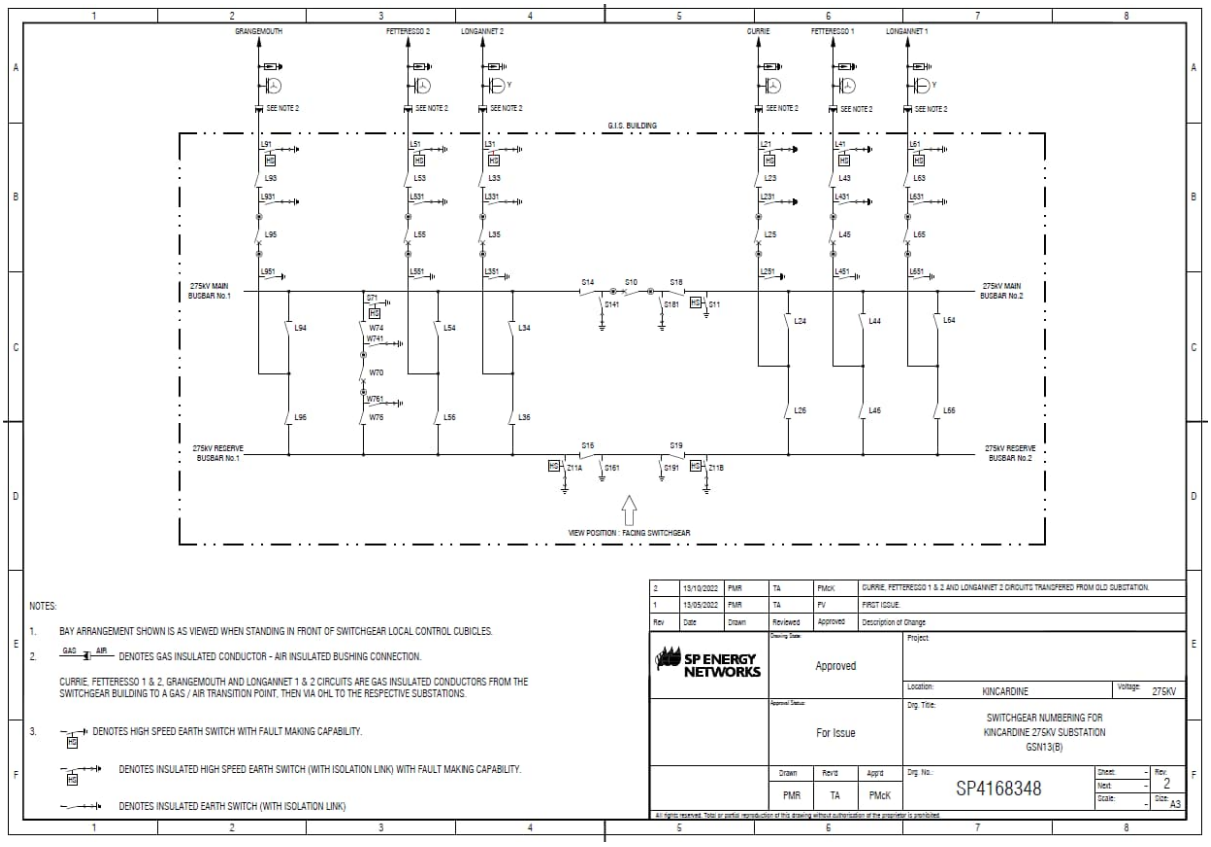

Figure 7: Existing Configuration – Kincardine 275kV Substation

5.2 Authorised System Configuration – Price Control Deliverables

As detailed in Section 4.3.2, there is a significant deficit between the existing capability and required capability on boundaries B4 and B5. The following two projects, defined as Price Control Deliverables (PCDs) in LSpC 3.9 Appendix 1, are presently in delivery and will begin to increase the capability on these boundaries:

Table 4: Summary of WLTI and ECU2 Projects, as per LSpC 3.9

Scheme Name	Output	Delivery Date
Windyhill to Lambhill to Longannet 275kV Circuit (ref. NOA Code WLTI)	B5 boundary capability uplift of 120MW: Turn in the Windyhill to Lambhill to Longannet 275kV circuit into Denny North 275kV Substation.	30th September 2023
East Coast 275kV Upgrade (ref. NOA Code ECU2)	B4 boundary capability uplift of 800MW: Reprofiling of the existing eastern circuits between the boundary of the Transmission Area and Kincardine, and the boundary of the Transmission Area and Longannet, via Westfield, Mossmorran and Glenrothes.	31st December 2023

It is noteworthy that the Windyhill to Lambhill to Longannet 275kV scheme (ref. NOA Code WLTI) was completed and commissioned in December 2022.

The following project, defined as Price Control Deliverables (PCDs) in LSpC 3.9 Appendix 1, is not yet in construction in the SPT area, but will further increase the capability of the B4 boundary to approximately 4,200MW:

Table 5: Summary of ECUP Project

Scheme Name	Output	Delivery Date
East Coast Onshore 400kV Incremental Reinforcement (ref. NOA Code ECUP)	Progression towards a B4 boundary capability uplift of 400MW: Uplift to be provided by upgrading the 275kV infrastructure on the east coast for 400kV operation.	31st March 2026

Within the SPT area, the ECUP project, which is to complete by 31st October 2026, presently includes:

(i) Installation of 4 x 400/275kV 1100MVA transformers at the existing Kincardine 275kV Substation site;
(ii) Re-insulation, re-profiling and uprating to 400kV operation the existing circuits on the XL overhead line route from Kincardine to the SHET Transmission border.

The ECUP scope of work does not include provision of 400kV circuit breakers or the replacement of the 1961 vintage (core only greased) twin Zebra ACSR overhead line conductor system on XL route. Due to condition, the conductor replacement on XL Route was a planned RIIO-T3 non-load project.

ECUP was included within the RIIO-T2 plan submitted to Ofgem and supported in the Final Determination, with a 2026 completion date early in the RIIO-T3 period.

As described in Section 6.2, the scope of the East Coast Incremental 400kV Reinforcement project will be modified to ensure an economic, efficient and co-ordinated overall programme of works.

5.3 Planned System Configuration – HND/ NOA Projects

Following the ESO's publication of the HND and NOA7 Refresh on 7th July 2022, the following projects were highlighted for progression within SPT's network area.

Table 6: Status within HND – Required for 2030 Targets

NOA7R Code	Description	NOA7 EISD
DNEU	Installation of a new 400/275kV 1000MVA Supergrid transformer (SGT2) at Denny North 400kV substation.	2025
DWUP	Establish a 400kV single circuit corridor south from Kincardine North, on existing overhead line (OHL) routes, to Wishaw substation or Clyde's Mill substation.	2026
E2DC	Establish a High Voltage Direct Current (HVDC) subsea link from a new Branxton 400kV Substation (near Torness) to Hawthorn Pit in the northeast of England. Branxton will facilitate the connection of offshore renewable developments as well as the reinforcement of capacity between Scotland and England.	2027
LWUP[18]	*Establish a new 400kV substation north of Kincardine and connect to Denny North at 400kV, integrating load and non-load related investment drivers and enabling significant reinforcement of transfer capacity through central Scotland.*	*2027*
VSRE	Replace existing OHL conductor on the strategic east-west Strathaven - Smeaton (XH/XJ route) corridor with modern high temperature low sag (HTLS) conductor.	2027
DWNO	Establish a new 400kV OHL from Bonnybridge substation to an existing OHL north of Glenmavis, together with associated substation works, conductor replacement and voltage uprating on existing OHL routes.	2028
EHRE	Replace existing OHL conductor on the southern (Elvanfoot - Harker) section of the strategic north-south Strathaven - Harker (ZV route) corridor with modern high temperature low sag (HTLS) conductor.	2028

[18] This project.

NOA7R Code	Description	NOA7 EISD
BDUP	Uprate the Beauly - Denny OHL route to double circuit 400kV operation.	2029
DLUP	Establish a new 400kV substation at Windyhill and a 400kV single circuit corridor, on existing overhead line routes, between Windyhill, Lambhill and Denny North.	2029
VERE	Replace existing OHL conductor on the northern (Strathaven - Elvanfoot) section of the strategic north-south Strathaven - Harker (ZV route) corridor with high temperature low sag (HTLS) conductor.	2030
TGDC	Creation of a second new High Voltage Direct Current (HVDC) Eastern subsea link from the SPT area, to south of the Humber estuary, in the northeast of England, together with associated onshore works.	2031
TKUP	Establish new 400kV substations at Mossmorran, Westfield and Glenrothes to establish a 400kV double circuit corridor, on existing overhead line routes, between Kincardine North and the SSEN Transmission Tealing substation. Scope includes further works within the SSEN-T area.	2032

Table 7: Status within NOA7 – Proceed

NOA7R Code	Description	NOA7 EISD
CMNC	Creation of a new 400kV double circuit OHL route and associated substation infrastructure from southeast Scotland to the northwest of England.	2033
WCNC	Creation of a new 400kV double circuit OHL route and associated substation infrastructure from southwest Scotland to the northwest of England.	2036
TLNO	Creation of a new 400kV double circuit OHL route and associated substation infrastructure from east central Scotland to the northeast of England.	2037

Table 8: Status within NOA7 – Hold

NOA7R Code	Description	NOA7 EISD
LCU2	Establish a 400kV single circuit corridor south from Kincardine North, on existing OHL routes, towards the Strathaven - Smeaton (XH/XJ route) corridor, west of Edinburgh and Currie/ Smeaton substations.	2031

Table 9: Status within NOA7 – Do Not Start

NOA7R Code	Description	NOA7 EISD
CVUP	Establish a 400kV single circuit corridor south from Clyde's Mill to Strathaven on existing OHL routes, with associated substation development at Clyde's Mill, Strathaven and near East Kilbride.	2031

As described in our response to Ofgem's consultation on Accelerating Onshore Electricity Transmission Investment, dated 6th September 2022, due to the rapidly changing energy landscape, projects recommended to 'hold' or 'do not start' in one NOA may already be 'late' when assessed against the requirements of the next iteration of the ESO's FES. With work already well underway on the HND Follow Up Exercise, to ensure an additional circa 17GW of ScotWind generation can be accommodated on the network, we anticipate one specific project in SPT's area currently with a 'hold' signal (LCU2) and one specific project currently with a 'do not start' signal (CVUP), will change to 'proceed', informed by FES 2023 and the HND Follow Up Exercise.

Particularly in the case of the LCU2 project, referenced above, there is also a need to deliver non-load related asset replacement on the associated overhead line routes within the RIIO-T3 period. For this reason, we are continuing to review and refine the scope and timing of these works with a view to continuing to integrate load and non-load related drivers in an economic, efficient and co-ordinated manner minimising system access requirements.

5.4 Planned System Configuration - Third Party Developments

5.4.1 Kincardine Grid Services

The Kincardine Grid Services complex is a planned development (with consent under Section 36 of the Electricity Act 1989)[19] on land adjacent to the A876 at Kincardine. It comprises three elements, each with a connection agreement:

- Kincardine Battery Storage Facility - 200MW Transmission Entry Capacity (TEC)
- Kincardine Energy Storage Facility - 200MW TEC
- Fife Grid Services Facility – 2 x 150MVA Synchronous Compensators

The three developments above will be connected via a shared solution involving the construction of one new bay of 275kV GIS switchgear at Kincardine 275kV Substation together with a short (approx. 0.9km) section of 275kV underground cable.

5.4.2 Alcemi Devilla

The Alcemi Devilla Battery Energy Storage Facility is a planned development on land within Devilla Forest, near Kincardine. The planned development, which has a connection agreement for 500MW TEC, does not currently have consent under Section 36 of the Electricity Act 1989. The development is currently planned to connect to existing overhead line infrastructure near the Longannet site.

5.5 Overview of Options

This section provides a description of the options considered to integrate load and non-load related drivers in an economic, efficient and co-ordinated manner, facilitating increased power transfer into and through the SPT network from renewable developments across the north of Scotland and enabling the decommissioning of Longannet 275kV Substation, and details the key considerations.

Table 10 below presents a summary of the options considered. These build on the options and conclusions detailed in the RIIO-T2 Business Plan Engineering Justification Paper relating to the Longannet 275kV Switchgear Replacement (ref SPNLT 2099), the detail of which is not repeated here.

Table 10: Options Summary

	Option	Outcome of Initial Review	Reason for Rejection
1	Do Nothing or Delay	Rejected	A 'Do Nothing' or 'Delay' option is not credible in relation to this project and would be inconsistent with SPT's various statutory duties and licence obligations. Timely progression of the replacement of Longannet 275kV Substation and the uprating of transfer capability through the SP Transmission system is crucial to ensure continued security and reliability of supply, while alleviating constraints on the GB transmission system, enabling growth in renewable electricity and support the transition to Net Zero emissions in the most economic way.

[19] Scottish Government - Energy Consents Unit - Application Details

	Option	Outcome of Initial Review	Reason for Rejection
2	New 400kV substation at Longannet.	Proposed for Further Consideration	-
3	New 400kV substation at/ near Kincardine.	Proposed for Further Consideration	-
4	New 400kV and 275kV AIS or GIS substations at/ near Letham.	Rejected	The development of new 400kV and 275kV substation and overhead line infrastructure near Letham, on the western side of the Firth of Forth, would involve a significantly greater scope of work as compared to Options 2 or 3, with both cost and programme implications.

Options 2 and 3 provide feasible solutions. These options are discussed in further detail in the following sections.

5.5.1 Works Common to Options 2 and 3 - XL Route Overhead Line Conductor System

Aligned with the approach being taken by SHE Transmission as part of the East Coast 400kV Incremental Upgrade project, on the much longer (185km) section of overhead line route north of the SHE Transmission - SP Transmission border to Alyth, Tealing, Fetteresso and Kintore, both Options 2 and 3 propose the concurrent re-insulation and re-conductor of the 10.5km section of XL route from the SHE Transmission - SP Transmission border to Kincardine.

Utilising the system access to these circuits, available as part of the ECUP project delivery sequence, to replace the 1961 vintage (core only greased) twin Zebra ACSR overhead line conductor is considered to be the most economic, efficient and co-ordinated strategy, noting also that the ability to access these circuits at a later date will be increasingly constrained as other circuits impacting the boundary are taken out of service as part of later stages of reinforcement (e.g. ref. NOA codes BDUP and TKUP).

It is proposed that the existing conductor system on XL route is replaced with a modern equivalent twin Totara AAAC conductor system, with maximum operating temperature of 90°C, delivering a winter post-fault continuous rating of 2000MVA per 400kV circuit.

5.5.2 Option 2 - New 400kV Substation at Longannet

This option involves constructing a new 10-bay 400kV GIS substation at Longannet, located in proximity to the existing 275kV substation. The 400kV switchgear would be capable of future extension. The 400kV busbar configuration would be equipped with two bus couplers and two bus section circuit breakers. Two 400/275kV 1100MVA inter-bus transformers would be connected radially to Kincardine 275kV Substation via two new underground cable circuits. Each of the underground cable circuits would require two cables per phase to provide the required thermal capacity.

Existing overhead line entries would be diverted locally and new Air and Gas Insulated Busbar (GIB) established. The Longannet – Westfield (YJ) overhead line route would be connected to the Longannet – Kincardine (YG) route. The overhead line arrangement at the "Kilbagie crossing", where the XL overhead line route crosses both ZC(N) and ZC(S) routes, would also require significant re-configuration.

The existing Longannet 275kV Substation would be decommissioned and building demolished.

To retain connectivity to Clyde's Mill and Easterhouse 275kV Substations, the existing Longannet – Clyde's Mill and Longannet - Easterhouse 275kV circuits would be turned in to Kincardine via the ZC(S) and XL overhead line routes.

The proposed arrangement would readily facilitate the future transfer of circuits from 275kV to 400kV operation. The site is adjacent to the Firth of Forth, and flood mitigation measures would be necessary to protect the new substation.

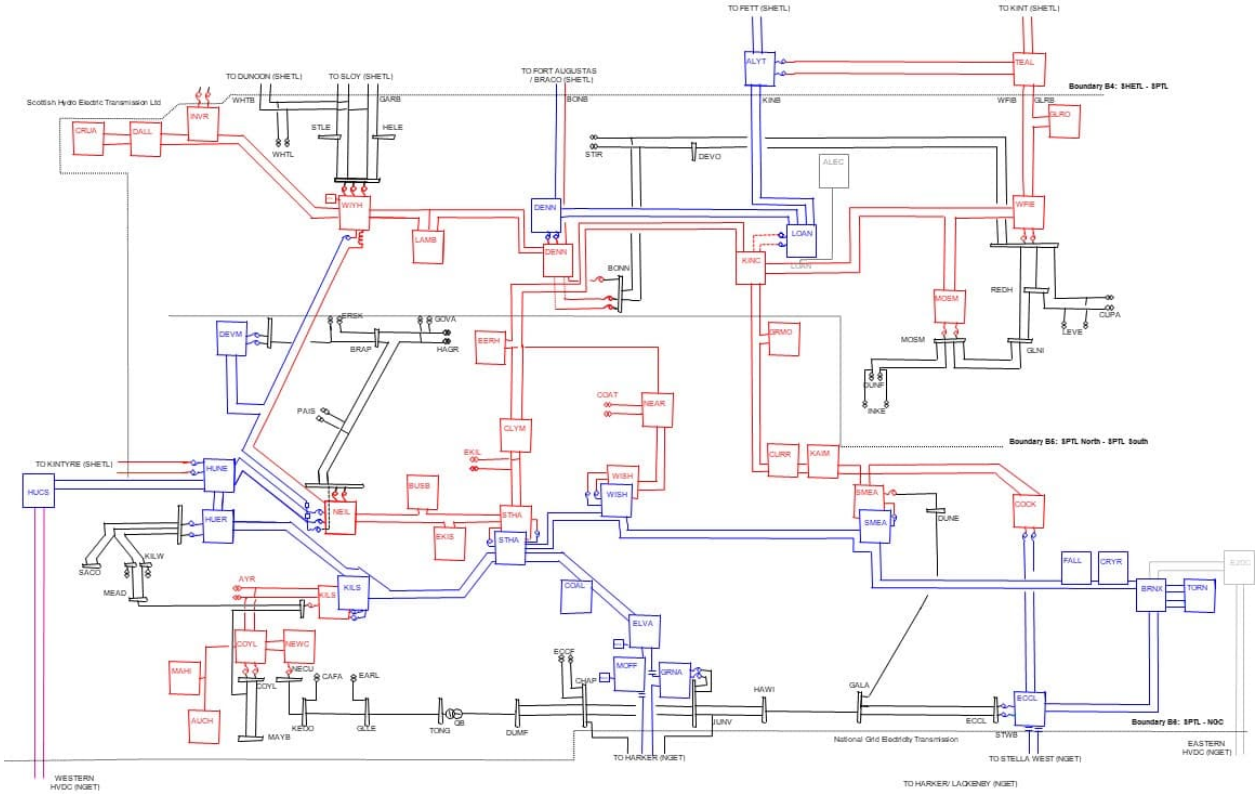

Figure 7: Option 2 Single Line Diagram - Longannet 400kV Substation[20]

5.5.3 Option 3 - New 400kV Substation at/ near Kincardine

This option involves constructing a new 10-bay 400kV substation at, or in proximity to, the existing Kincardine substation site. The 400kV substation would be capable of future extension. Existing overhead line entries would be diverted locally and new Air and Gas Insulated Busbar (GIB) established. The 10-bay 400kV busbar configuration would be inclusive of, and equipped with two bus couplers and two bus section circuit breakers. The new 400kV substation would be connected to the existing Kincardine 275kV Substation via two 400/275kV 1100MVA inter-bus transformers (these transformers forming part of the ECUP project).

As indicated in Figure 8, the 400kV double circuit from Alyth would connect into the site via the existing XL route. A 400kV double circuit between Kincardine and Denny would be established by uprating the existing ZC(N) overhead line route to 400kV operation. To retain connectivity to Easterhouse and Clyde's Mill, the existing Longannet–Easterhouse circuit and Longannet – Clyde's Mill circuit would be turned in to Kincardine via the ZC(S) and XL overhead line routes to form a Kincardine–Easterhouse 275kV circuit and Kincardine – Clyde's Mill 275kV circuit.

[20] Note that Figure 7 includes an indication of the NOA project DNEU, indicated here as a second 400/275kV inter-bus transformer at Denny North. The DNEU project is currently expected to be funded via the VDUM and does not form part of this MSIP Re-opener application.

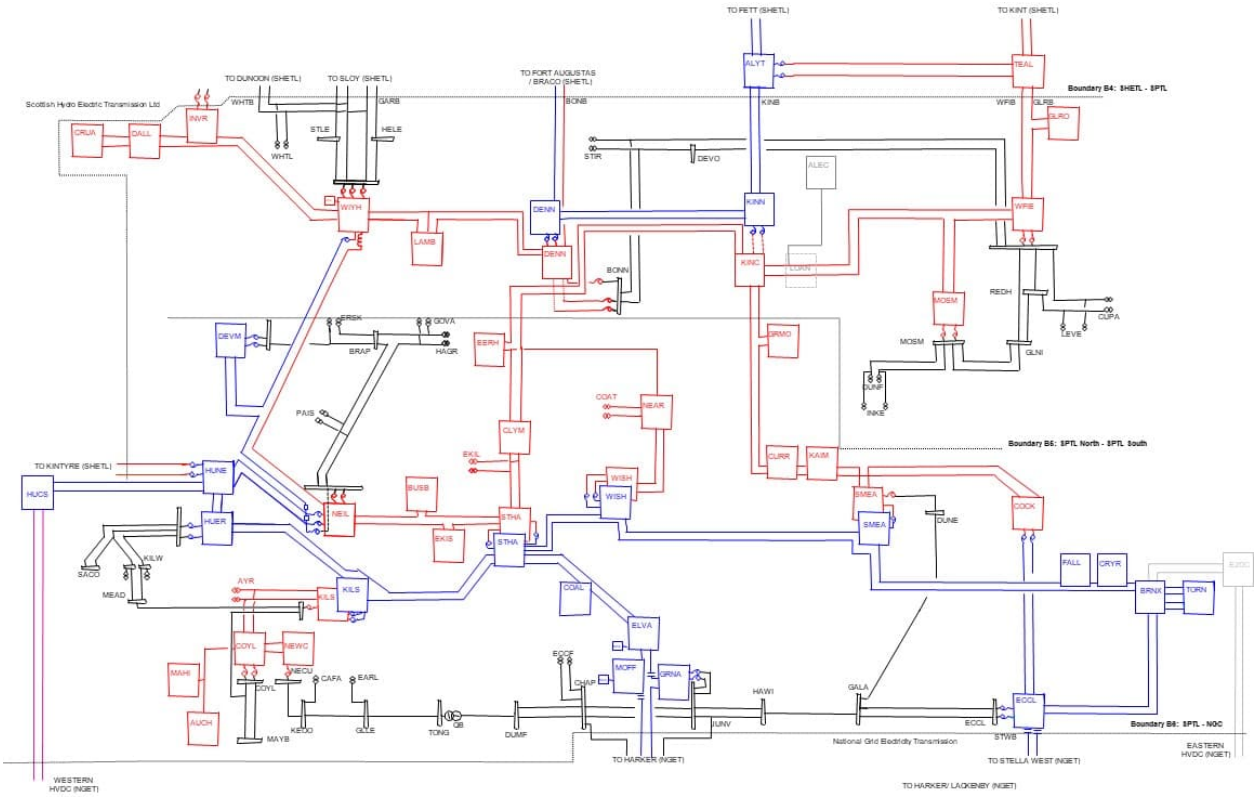

Figure 8: Option 3 Single Line Diagram – Kincardine/ Kincardine North 400kV Substation[21]

The existing Longannet 275kV Substation would be decommissioned and the building demolished. The existing (outdoor) Longannet MSCDN's would be retained in situ on site pending their re-energisation radially from Kincardine as part of the East Coast Onshore 400 kV Phase 2 reinforcement (ref. NOA code TKUP) or alternatively their relocation to a new site, so as to be able to continue to provide voltage support under high power transfer conditions.

The Kincardine (YG) overhead line route would be connected to the Mossmorran/ Westfield (YJ) route at the Longannet site so as to retain connectivity.

The establishment of a new 400kV substation at or in proximity to Kincardine would involve the existing ZC(N) and ZC(S) overhead line routes being de-energised, in the short-term, east from the Kilbagie crossing (approx. 1.5km north of Kincardine), to Longannet. These routes would be retained for re-energisation as part of later stages of system reinforcement (ref. NOA code TKUP, for example) and would not be dismantled and removed.

5.5.3.1 Option 3a - Kincardine

In order to establish the new 400kV substation at the existing Kincardine site, two new double circuit overhead line or underground cable routes, each approximately 1.5km, would require to be established from the Kilbagie crossing to Kincardine in order to retain connectivity from the ZC(N) and ZC(S) overhead line routes west to Denny North, Easterhouse and Clyde's Mill substations.

[21] Note that similar to Figure 7 above, Figure 8 includes an indication of the NOA project DNEU, indicated here as a second 400/275kV inter-bus transformer at Denny North. The DNEU project is currently expected to be funded via the VDUM and does not form part of this MSIP Re-opener application.

As part of later stages of system reinforcement (ref. NOA code TKUP, for example), up to two further double circuit overhead line or underground cable routes, each similarly of 1.5km in length, could require to be established from the Kilbagie crossing to Kincardine, in order to retain connectivity from ZC(N) and ZC(S) overhead line routes east to the Longannet site, Mossmorran and Westfield.

Initial connectivity requirements to facilitate a new 400kV substation on the existing Kincardine site are indicated in Figure 9.

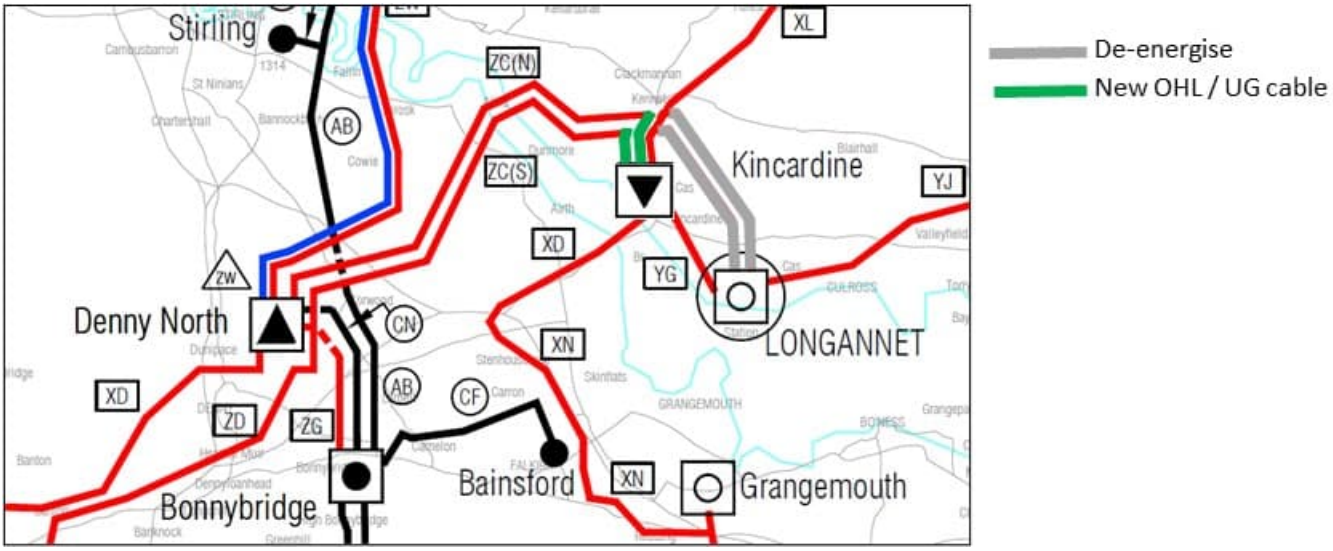

Figure 9: Option 3a – Indication of Initial Connectivity Requirements for new 400kV substation at Kincardine

Substation Works – Kincardine 275kV substation has recently been rebuilt as an indoor GIS substation with extensive flood protection measures. Significant civil work would be required in order to mitigate flood risk and protect any new 400kV assets. The extent of the civil works necessary for flood mitigation would have significant cost, programme, environmental and operational impacts, as the transformers and associated auxiliary equipment could not be protected in a similar way to the existing GIS equipment.

Two options were considered to ensure that the new 400/275kV 1100MVA inter-bus transformers and associated auxiliary equipment would be installed above the flood level:

- Importing material to create an approx. 5m high platform on which the 400/275kV 1100MVA inter-bus transformers and associated auxiliary equipment and would be located; and
- Installing all equipment on structures to raise them above the flood level.

The first of these options was deemed impractical due to the cost, programme and environmental impact associated with building up the substation platform. The typical maximum gradient on roads for transformer delivery is 1:12, meaning that an access road of around 60m would be required to get to the required level. Due to the ground conditions, this is also likely to settle over time and so piles may be required to prevent differential settlement. The space required to get a suitably graded access road to the required platform level would be extremely challenging.

The second option was also deemed to be impractical due to the cost and programme implications.

Due to the footprint of the new substation, the plant required, and the associated flood protection requirement, this option could not be accommodated within the land available at the Kincardine site.

Overhead Line and Underground Cable Works - To provide the required circuit configuration, two new double circuit connections would require to be constructed initially to connect the new substation at Kincardine to the existing ZC(N) and ZC(S) Routes in the Kilbagie area, with another two new double circuit connections potentially required at a later date. It is considered likely that these would require to be achieved via underground cable sections.

By virtue of existing OHL and other infrastructure in the area, environmental constraints including close proximity to the Firth of Forth Special Protection Area (SPA), Site of Special Scientific Interest (SSSI) and Ramsar site, Ancient Woodland, Scheduled Monuments and Garden and Designed Landscapes, as well as the planned Fife Grid Services complex, a new Supergrid double circuit OHL connection is unlikely to be achievable and any associated Section 37 consent application is highly likely to be challenged. This would have significant impact on project programme and consequently the provision of additional north to south transmission capacity in the period to 2030, as well as the timely removal of end of life assets.

Each of the underground cable circuits would require at least two underground cables per phase to provide the required thermal capacity and would also require cable sealing end compounds adjacent to new terminal towers on ZC(N) and ZC(S) routes. Given the size of underground cables at 275kV and 400kV, and the spacing requirements between circuits, it would be extremely challenging to route and install these circuits from the existing overhead line routes to the new substation at Kincardine.

This option was therefore rejected prior to a detailed cost estimate being prepared due to its feasibility, scope of work and therefore capital cost relative to the alternatives.

5.5.3.2 Option 3b – Kincardine North

Establishing the new 400kV substation approximately 1.5km north of the existing Kincardine site, to the southwest of the Kilbagie crossing (where the XL overhead line route crosses under the ZC(N) and ZC(S) overhead line routes), has a number of significant advantages relative to its establishment on the existing Kincardine site:

- The area is above the flood plain associated with the Firth of Forth, therefore this option removes the requirement for the significant civil works which would be required in order to mitigate flood risk and protect the new assets were they to be established at Kincardine.
- Only one new double circuit connection, approximately 1.5km, would require to be established from the new 'Kincardine North' site to Kincardine in order to deliver the required connectivity. These circuits would operate at 275kV and connect the two 400/275kV 1100MVA inter-bus transformers at Kincardine North to the existing Kincardine site. For the reasons summarised in Section 5.5.3.1 above, these are expected to be achieved via underground cable sections.
- As part of later stages of system reinforcement (ref. NOA code TKUP, for example), the ZC(N) and ZC(S) overhead line routes east to the Longannet site, Mossmorran and Westfield would be readily turned in to the new 400kV substation without the need for further double circuit connections from Kincardine North to Kincardine.

Connectivity requirements to facilitate a new 400kV substation at Kincardine North are outlined in Figure 10. As indicated, the development of a new 400kV substation at Kincardine North would readily facilitate the future transfer of circuits from 275kV to 400kV operation.

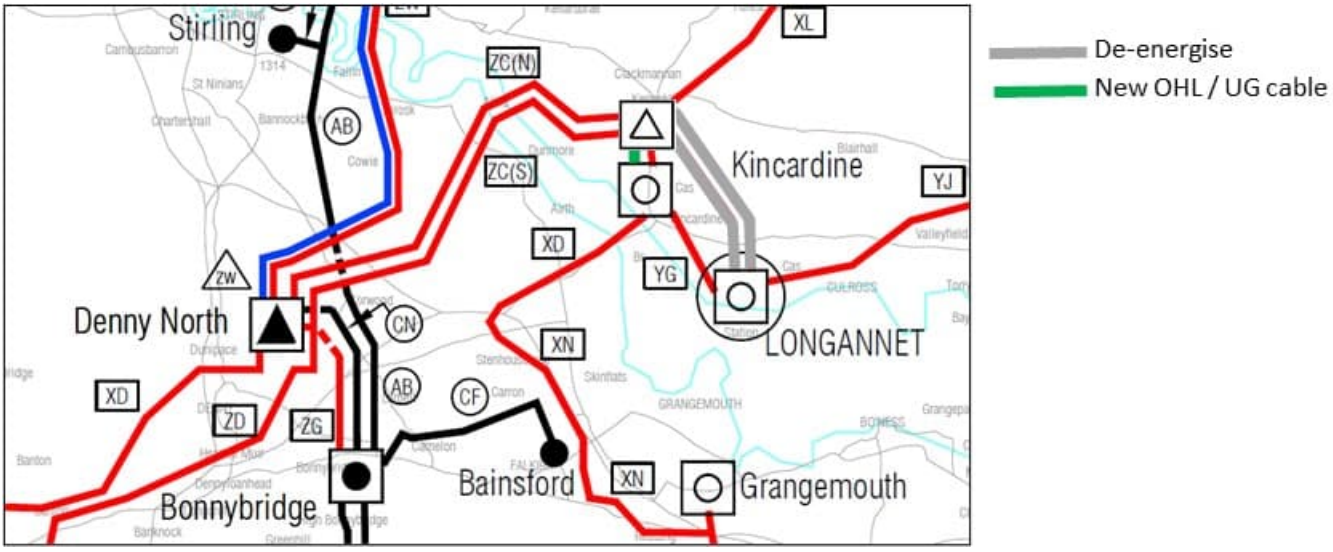

Figure 10: Option 3b – Indication of Connectivity Requirements for new 400kV substation at Kincardine North

5.6 Option Assessment

As described in our RIIO-T2 Business Plan Annex 8[22], while most engineering justification papers have a CBA aligned with the RIIO-T2 CBA model, projects in the following categories do not:

- Live projects rolling over from RIIO-T1, since they have already initiated, with decisions made during the previous price control.
- Customer connection projects, as the proposed approach is based on agreement with the connecting party as they will bear a sizeable proportion of the costs incurred.
- TO Reinforcements associated with new connections, where the options considered are evaluated purely based on the lowest cost solution, which meets the project objectives, as the benefits are all comparable.
- Projects justified through the Network Options Assessment Process as these are subject to an extensive and rigorous CBA process by the Electricity System Operator who can consider market options, and different options which may be offered by Transmission Owners.

Projects in the four categories above have an associated document (this MSIP Re-Opener application in respect of Kincardine North 400kV Substation) explaining the feasible options and the reasoning behind the selection of the preferred investment option.

The short-listed options relating to the economic, efficient and co-ordinated development of the transmission system in the Kincardine/ Longannet area to facilitate increased power transfer into and through the SPT network from renewable developments across the north of Scotland and enable the decommissioning of Longannet 275kV Substation, are described in Section 5.5 while Table 11 summarises the key benefits and disadvantage of each option.

An assessment of fault infeed indicates a requirement to operate the Main and Reserve Busbar systems at Kincardine 275kV Substation normally split so as to contain the fault infeed within the capability of the switchgear pending completion of the East Coast Onshore 400 kV Phase 2 reinforcement (ref. NOA code TKUP).

[22] Annex 8 - Cost Benefit Analysis Methodology (spenergynetworks.co.uk)

Both Option 2 and Option 3 enable a 4,200MW transfer capability on boundary B4, as planned as part of the East Coast Incremental 400kV Reinforcement (ECUP), and remove and replace the existing Longannet 275kV Substation.

Option 3b is therefore the preferred investment option to integrate load and non-load related drivers in an economic, efficient and co-ordinated manner, facilitating increased power transfer into and through the SPT network from renewable developments across the north of Scotland and enabling the timely decommissioning of Longannet 275kV Substation.

Several alternative locations to the north of Kincardine and in relative proximity to the Kilbagie crossing have been considered for the proposed Kincardine North 400kV GIS Substation. None of these locations are capable of accommodating a 400kV development utilising Air Insulated Switchgear (AIS). The alternative locations are estimated to involve an incremental cost of between [redacted] and [redacted] relative the proposed site, to the southwest of the existing Kilbagie crossing, as per Option 3b.

There is no market based alternative to the preferred investment option.

Table 11: Option Benefits, Drawbacks and Selection Outcome

	Option	Estimated Capital Cost[23]	Key Advantage	Key Disadvantage	Option Outcome
2	New 400kV Substation at Longannet.	[redacted]	The future uprating of circuits from 275kV to 400kV operation can be readily achieved.	Highest overall capital cost. Requirement for land purchase.	Rejected
3a	New 400kV Substation at Kincardine.	-	-	This option was rejected prior to a detailed cost estimate being prepared due to its feasibility (in particular associated with the requirement for significant flood mitigation works, with associated cost, programme, environmental and ongoing operational risk) and relative scope of work compared to the alternatives (including the requirement to construct a minimum of two double circuit connections from the Kilbagie crossing to Kincardine).	Rejected
3b	New 400kV Substation at Kincardine North.	£97.73m	Significantly lower capital cost relative to Option 2. Future uprating of circuits from 275kV to 400kV operation can be readily achieved. The requirement for significant flood mitigation works, and the associated cost, programme, environmental and operational risk is avoided relative to Option 3a.	Requirement for land purchase.	Proposed

[23] All values are estimated Direct capital costs in 2018/19 values.

6. Proposed Works

6.1 Scope of Works – Kincardine North 400kV Substation (ref. NOA code LWUP)

This Section 6.1 describes the scope of works to be undertaken as part of this MSIP Re-opener application.

6.1.1 Substation Works at Kincardine North 400kV Substation

The configuration of Kincardine North 400kV GIS Substation, proposed to be constructed adjacent to the existing Kilbagie crossing, approximately 1.5km north of Kincardine, is indicated in Figure 11.

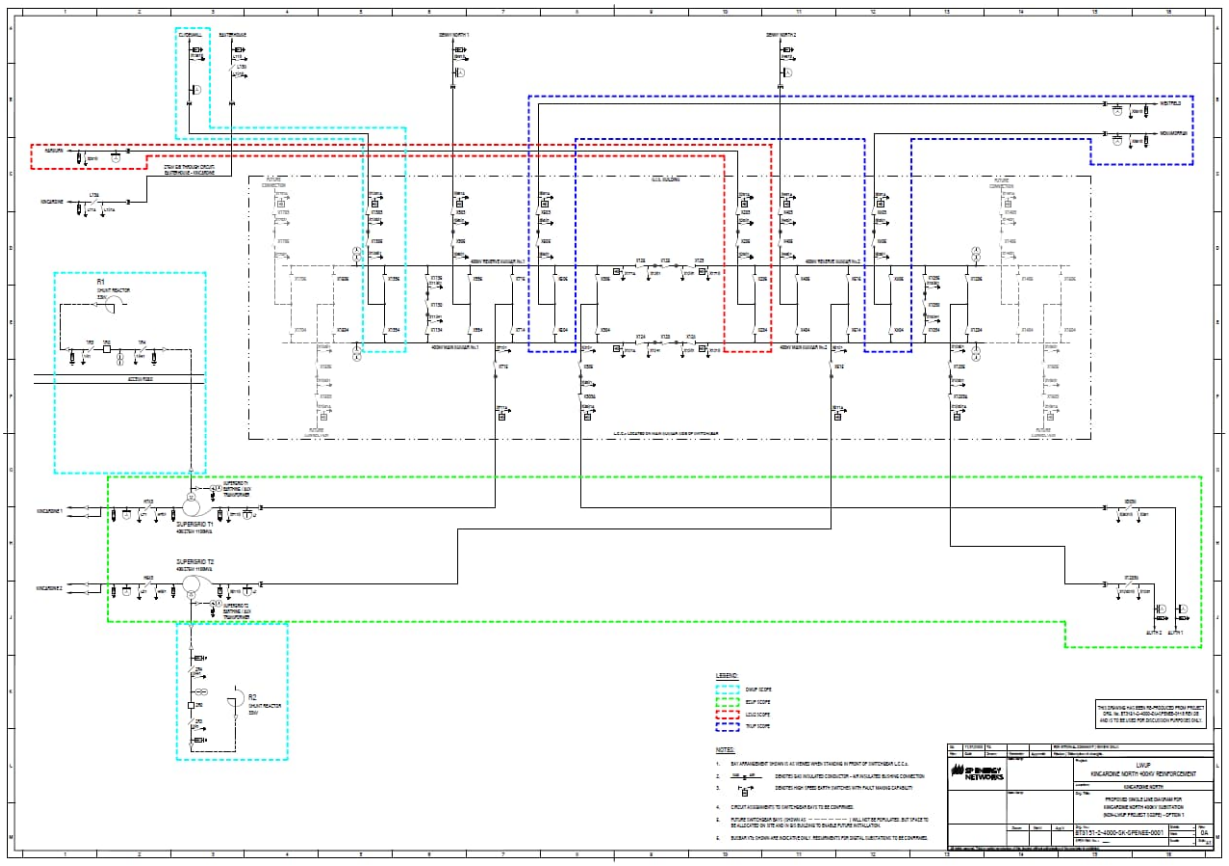

Figure 11: Option 3b – Connectivity Requirements for Kincardine North 400kV Substation

The new Kincardine North 400kV GIS Substation will initially connect the following circuits:

- SHE Transmission Alyth No.1 400kV
- SHE Transmission Alyth No.2 400kV
- Denny North No.1 400kV
- Denny North No.2 400kV
- Kincardine No.1 400kV
- Kincardine No.2 400kV

The substation will be equipped with two bus section circuit breakers and two bus coupler circuit breakers, providing security and operational flexibility.

The detailed design of the site will incorporate provision for the termination of a further eight circuits:

- Subject to separate regulatory approval(s), and noting the associated NOA recommendations, it is proposed that four of these eight bays form part of the initial GIS contract award and site development (two bays for NOA7 project TKUP, one bay for NOA7 project DWUP, one bay for NOA7 project LCU2).
- It is proposed that space is retained within the GIS building for two future feeder bays at each end of the GIS.

The size of the substation platform established as part of the initial stage of site development shall be minimised.

Space shall be retained within the wider site design for the connection of one 33kV 60Mvar air cored shunt reactor to the 33kV winding of each of the 400/275kV 1100MVA transformers. Installation of the shunt reactors and associated equipment shall form part of a separate project and approval.

Space shall also be retained within the wider site design for the future connection of reactive compensation equipment - the installation of such equipment does not form part of this project.

6.1.2 Substation Works At Kincardine 275kV Substation

The proposed configuration of Kincardine 275kV GIS Substation is indicated in Figure 12, requiring the provision of two new bays of 275kV GIS switchgear as part of this project.

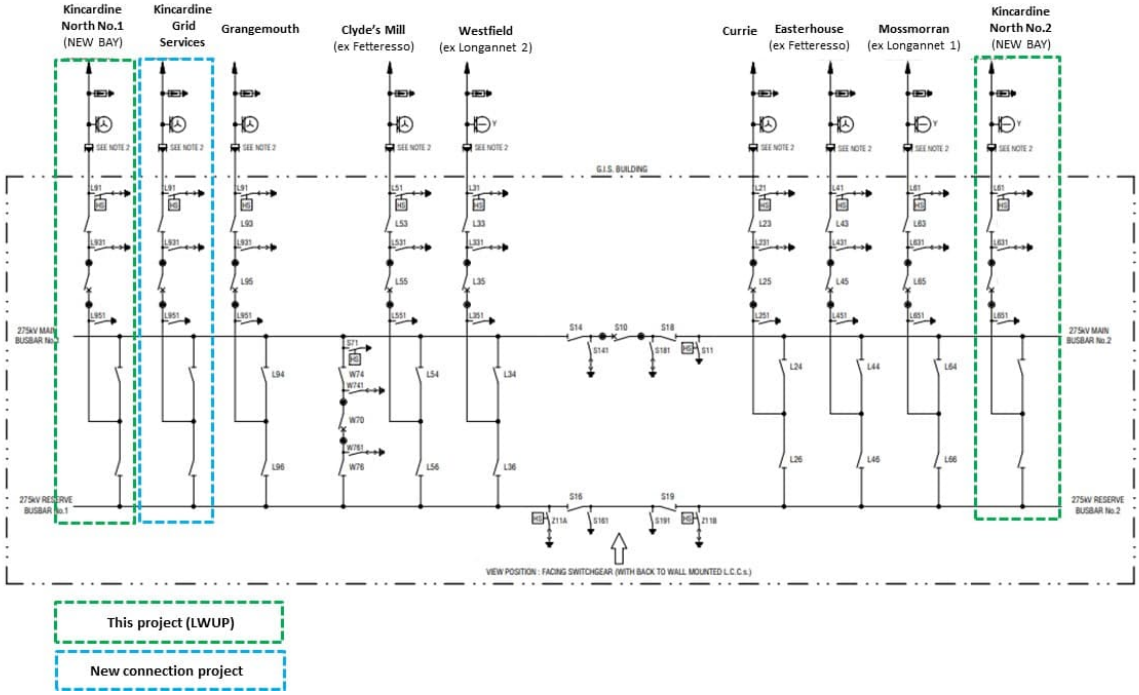

Figure 12: Option 3b – Connectivity Requirements at Kincardine 275kV Substation

Noting the potential for stranding in the short-term as a result of subsequent stages of reinforcement, opportunities to mitigate this risk will continue to be reviewed through detailed project design and development, as per Section 6.6.

6.1.3 Substation Works At Denny North 400/275kV Substation

At Denny North 400kV Substation, two new AIS switchgear bays will be established to terminate the Kincardine North No.1 and No.2 400kV circuits.

6.1.4 Substation Works At Longannet 275kV Substation

The existing Longannet 275kV Substation will be decommissioned and building demolished. The existing 275kV fluid filled cable systems at Longannet on the Kincardine and Mossmorran/ Westfield line entries will be de-energised and decommissioned, as will the 275kV series reactors on the Kincardine line entries.

Noting the interaction with the progress of prospective of third party developments in the area, the two existing 275kV 225Mvar MSCDNs at Longannet, which are located outdoors and adjacent to the main substation building, will be retained in situ pending their re-energisation radially from Kincardine 275kV Substation as part of the East Coast Onshore 400kV Phase 2 reinforcement (ref. NOA code TKUP) or alternatively pending their relocation to a new site under a separate project, so as to be able to continue to provide voltage support under high power transfer conditions.

6.1.4.1 Advanced Works

Longannet substation was constructed in the late 1960s. The Persistent Organic Pollution regulations (POP Regs) require all oil filled equipment installed prior to 1987 be tested for PCB contamination and contaminated equipment disposed of by 31st December 2025. Any asset that cannot be tested must be assumed to be contaminated and by law disposed of by this date.

The CVTs on site are in the main original and utilise oil filled capacitors which are sealed for life and cannot therefore be tested for PCB contamination. There is therefore a requirement to replace these units in advance of substation decommissioning and building demolition. The replacement units shall be recovered for application elsewhere on the SPT system upon their decommissioning as part of the final substation decommissioning and in advance of building demolition.

6.1.5 Overhead Line Works

6.1.5.1 Works on XL Route

The existing conductor system on XL route, from the SHE Transmission - SP Transmission border to Kincardine North shall be replaced with a modern equivalent twin Totara AAAC conductor system, with maximum operating temperature of 90°C, delivering a winter post-fault continuous rating of 2000MVA per 400kV circuit. This is aligned with the approach being taken by SHE Transmission.

The existing conductor system on XL route, from ZC(S) at Kincardine North, to Kincardine, shall be replaced with a modern equivalent conductor system delivering a continuous rating of not less than that achieved by a twin Araucaria AAAC conductor system with maximum operating temperature of 90°C, so as not to restrict the 1500MVA per 275kV circuit capability of the 275kV circuits to Easterhouse and Clyde's Mill 275kV Substations. While subject to detailed engineering, a High Temperature Low Sag (HTLS) conductor system may be the most economic and efficient solution for this application.

6.1.5.2 Works at Longannet

The Kincardine (YG) overhead line route will be connected to the Mossmorran/ Westfield (YJ) route at the Longannet site, utilising overhead line connections, so as to retain connectivity.

6.1.5.3 Works at Kincardine North

ZC(N) and ZC(S) and XL overhead line routes shall be diverted as required in order to achieve the line entries required to Kincardine North 400kV Substation. Through detailed project design and informed by site surveys, integrating both overhead line and substation design, the extent of the local overhead line works will seek to mitigate associated environmental impacts and wider project programme risks.

6.1.6 Cable Works

The existing 275kV fluid filled cable systems at Longannet on the Kincardine and Mossmorran/ Westfield line entries will be de-energised and decommissioned as part of this project.

Design and installation of two 275kV cable circuits, each approximately 1.5km in route length, from Kincardine North 400kV Substation to Kincardine 275kV Substation, to be connected to Kincardine North SGT1 and SGT2. One cable circuit shall be designed for a summer continuous rating of 1100MVA, in line with the continuous rating of the Kincardine North transformers. The second circuit shall be designed for a summer continuous rating of 1500MVA, in line with the rating of the existing Longannet – Easterhouse 275kV circuit. This marginally increased rating will enable the Kincardine - Easterhouse 275kV circuit to be transferred to this cable section, and one of the Kincardine North SGT circuits to be transferred to one side of the XL route OHL at a later date, should it be necessary, so as to remove the risk of a Kincardine – Easterhouse 275kV / Kincardine North – Harburn 400kV double circuit fault outage, which would have a significant impact on boundary B5 transfer capability.

Opportunities to mitigate this risk will continue to be reviewed through detailed project design and development, as per Section 6.6.

6.1.7 Civil Engineering Works

Kincardine North 400kV switchgear will be of an indoor GIS design. The primary civil engineering works forming part of the LWUP project will comprise:

- The design and construction of the GIS building;
- The design and construction of the site civil platform in this area and in the area of the ZC(N) and ZC(S) overhead line entries;
- The design and construction of foundations and structures necessary to support the equipment within the areas above; and
- Enabling works to achieve the above e.g. works to facilitate temporary and/or enduring accesses for construction, operation and maintenance purposes.

6.2 Scope of Works – East Coast Incremental 400kV Reinforcement (ref. NOA code ECUP)

Within the SPT area, the ECUP project, which is to complete by 31st October 2026, was originally planned to include:

- Installation of 4 x 400/275kV 1100MVA transformers at the existing Kincardine 275kV Substation site;
- Re-insulation, re-profiling and uprating to 400kV operation the existing circuits on the XL overhead line route from Kincardine to the SHET Transmission border.

ECUP was included within the RIIO-T2 plan submitted to Ofgem and supported in the Final Determination, with a 2026 completion date early in the RIIO-T3 period.

In order to ensure an economic, efficient and co-ordinated overall programme of works, the original scope of works will be revised. This Section 6.2 summarises the revised scope of works to be undertaken as part of the East Coast Incremental 400kV Reinforcement project (ref. NOA code ECUP).

6.2.1 Substation Works at Kincardine North

Within the SPT area, the ECUP project, will include installation of 2 x 400/275kV 1100MVA transformers at the Kincardine North 400kV Substation site and all associated Air Insulated Switchgear and Air Insulated Busbar connections on the following circuits:

- SHE Transmission Alyth No.1 400kV;
- SHE Transmission Alyth No.2 400kV;
- Kincardine North SGT1 / Kincardine No.1; and
- Kincardine North SGT2 / Kincardine No.2.

6.2.2 Civil Engineering Works

The primary civil engineering works forming part of the ECUP project will comprise:

- The design and construction of the new site civil platform in the areas summarised in Section 6.2.1 above;
- The design and construction of foundations and structures necessary to support the equipment within the areas summarised in Section 6.2.1 above; and
- Enabling works to achieve the above e.g. works to facilitate temporary and/or enduring accesses for construction, operation and maintenance purposes.

6.2.3 Overhead Line Works at Kincardine North

Within the SPT area, the ECUP project, will include:

- Re-insulation, re-profiling and uprating to 400kV operation the existing circuits on the XL overhead line route from Kincardine to the SHET Transmission border; and
- Diversion of the XL OHL route into the Kincardine North site in order to achieve the line entries required to facilitate the following connections:

  - SHE Transmission Alyth No.1 400kV;
  - SHE Transmission Alyth No.2 400kV;
  - Kincardine North SGT1 / Kincardine No.1; and
  - Kincardine North SGT2 / Kincardine No.2.

Through detailed project design and informed by site surveys, integrating both overhead line and substation design, the extent of the local overhead line works will seek to mitigate associated environmental impacts and wider project programme risks.

6.3 Environmental and Consent Related Works

SPT will take a co-ordinated approach to all aspects of these works in view of the need to deliver an overall and integrated solution which recognises potential interaction and cumulative impacts.

The Kincardine North 400kV Substation project requires planning consent from Fife Council. Section 37 consent will be required to facilitate the overhead line uprating works and diversions required on ZC(N), ZC(S) and XL routes at the Kincardine North site. Section 37 consent will also be required on YG and YJ routes at the Longannet site.

A Pre-Application Notification is planned to be submitted to Fife Lothian Council in May 2023, followed by public consultation in September 2023. A full and formal planning application is planned to be submitted to Fife Council in February 2024.

6.4 Stakeholder Engagement

SPT's Stakeholder Engagement Plan for Kincardine North 400kV Substation will be closely aligned to our wider Stakeholder Engagement commitments as outlined in our RIIO-T2 business plan. It will centre around timely engagement with a wide range of stakeholders to achieve mutually acceptable outcomes. We recognise that stakeholders' influence and interest in the project will vary as the project develops and that stakeholders' opinions may change over time.

6.5 Future System Development

Kincardine North 400kV Substation, which has been recommended to proceed by the Network Options Assessment (NOA) process and was identified by NGESO as 'Required for 2027' in the OTNR HND (ref. NOA code LWUP), is a key enabler for several dependent projects (ref. NOA codes DWUP, DLUP, TKUP, BDUP and LCU2).

Figure 13 indicates the configuration of the system upon completion of works forming part of this MSIP Re-opener application[24].

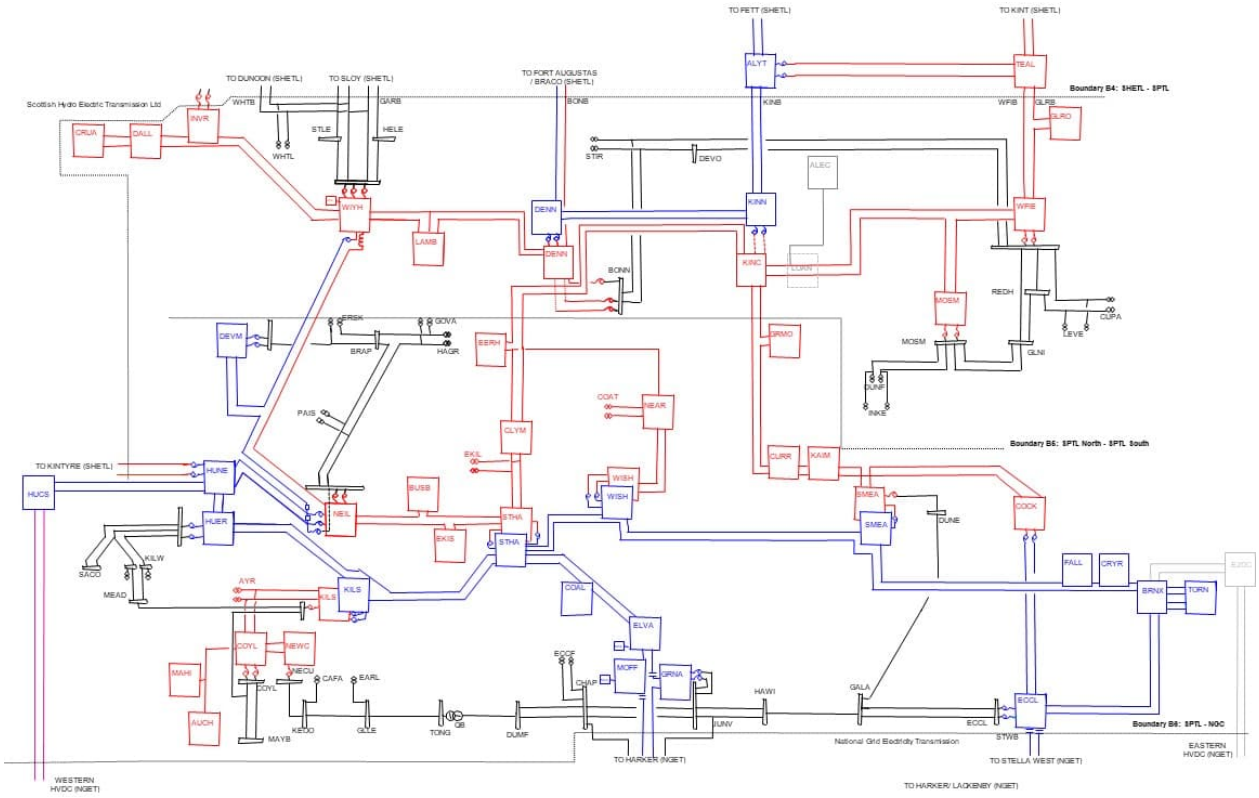

Figure 13:– Option 3b Single Line Diagram – Kincardine North 400kV Substation (LWUP)

While subject to ongoing detailed design, analysis and programming, Figures 14 to 21 provide an indicative view of system configuration (with a focus on the B4 and B5 boundaries) upon completion of each of the dependent NOA schemes referenced above.

Note that the delivery sequence of these future works remains subject to ongoing detailed design and separate regulatory approval(s). Figures 14 to 21 should therefore be considered to be indicative only.

[24] Note that Figure 13 includes an indication of the NOA project DNEU, indicated here as a second 400/275kV inter-bus transformer at Denny North. The DNEU project is currently expected to be funded via the VDUM and does not form part of this MSIP Re-opener application.

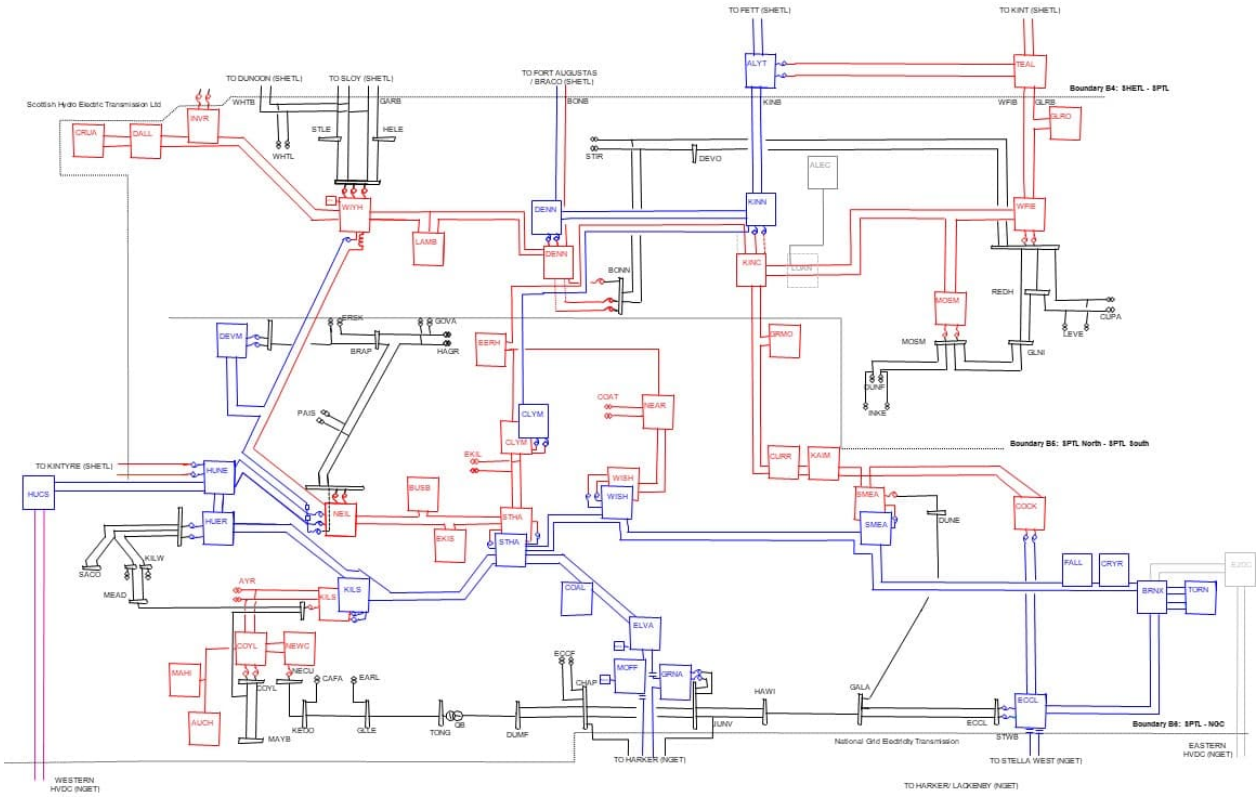

Figure 14: NOA Codes LWUP and DWUP (to Clyde's Mill 400kV Substation)

The merits of terminating the DWUP project at Clyde's Mill relative to Wishaw will be set out in a separate MSIP Re-opener application.

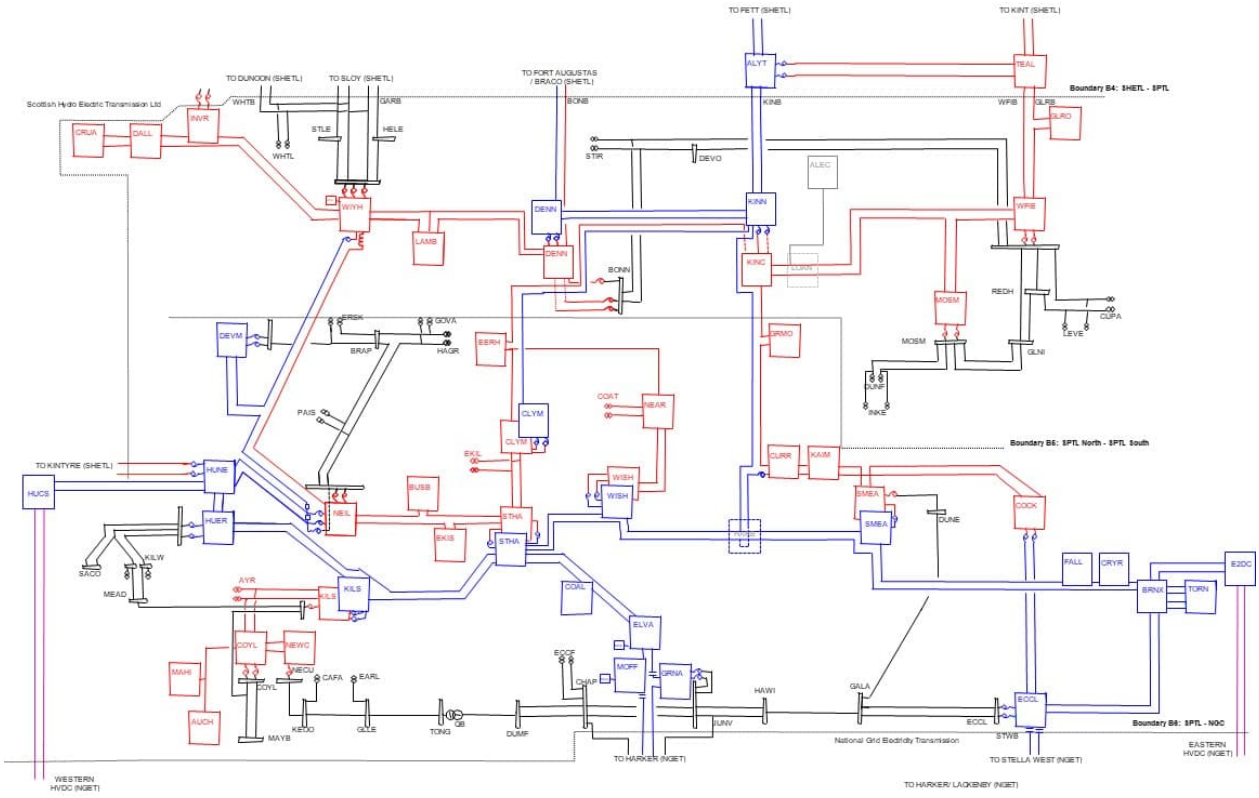

Figure 15: NOA Codes LWUP, DWUP (to Clyde's Mill) and LCU2 (part/ intermediate stage)

Figure 15 indicates a potential intermediate stage in the delivery of the LCU2 project, with a reduced scope of work intended to deliver a 400kV north to south connection in accelerated timeframes.

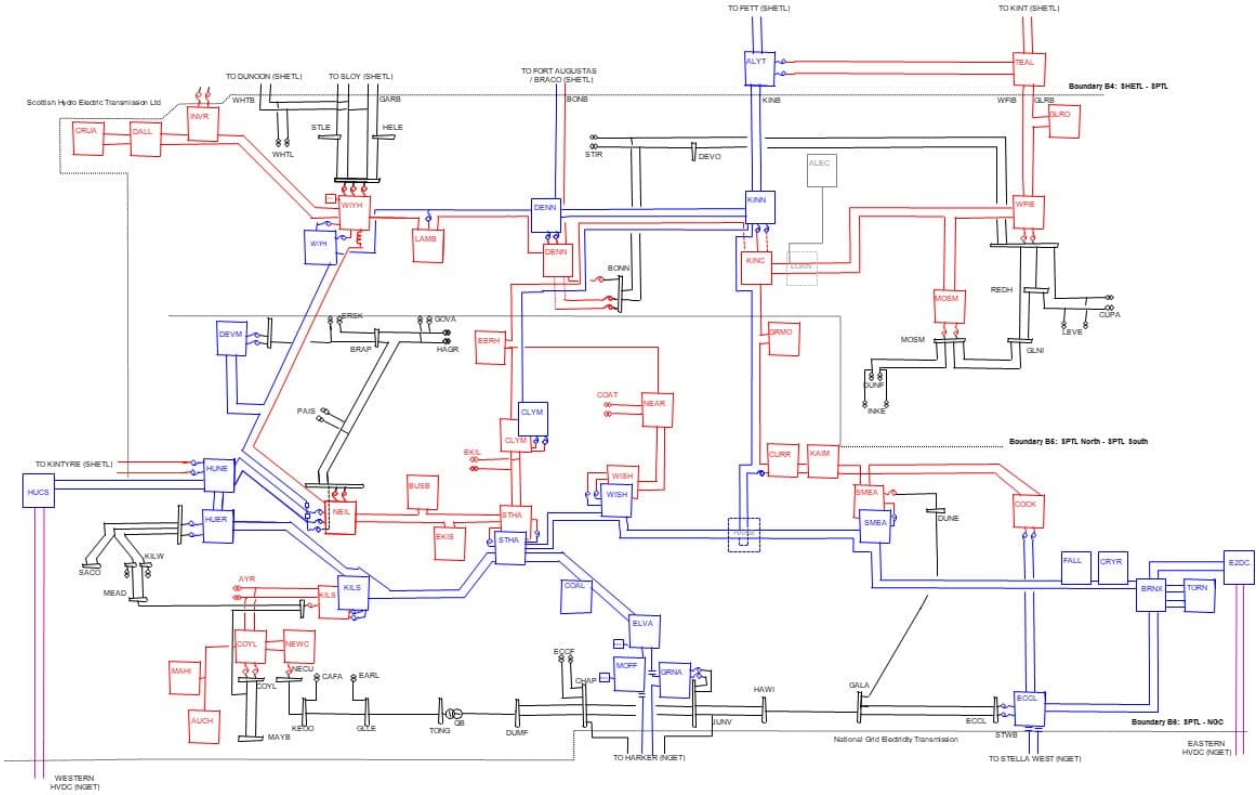

Figure 16: NOA Codes LWUP, DWUP (to Clyde's Mill), LCU2 (part) and DLUP

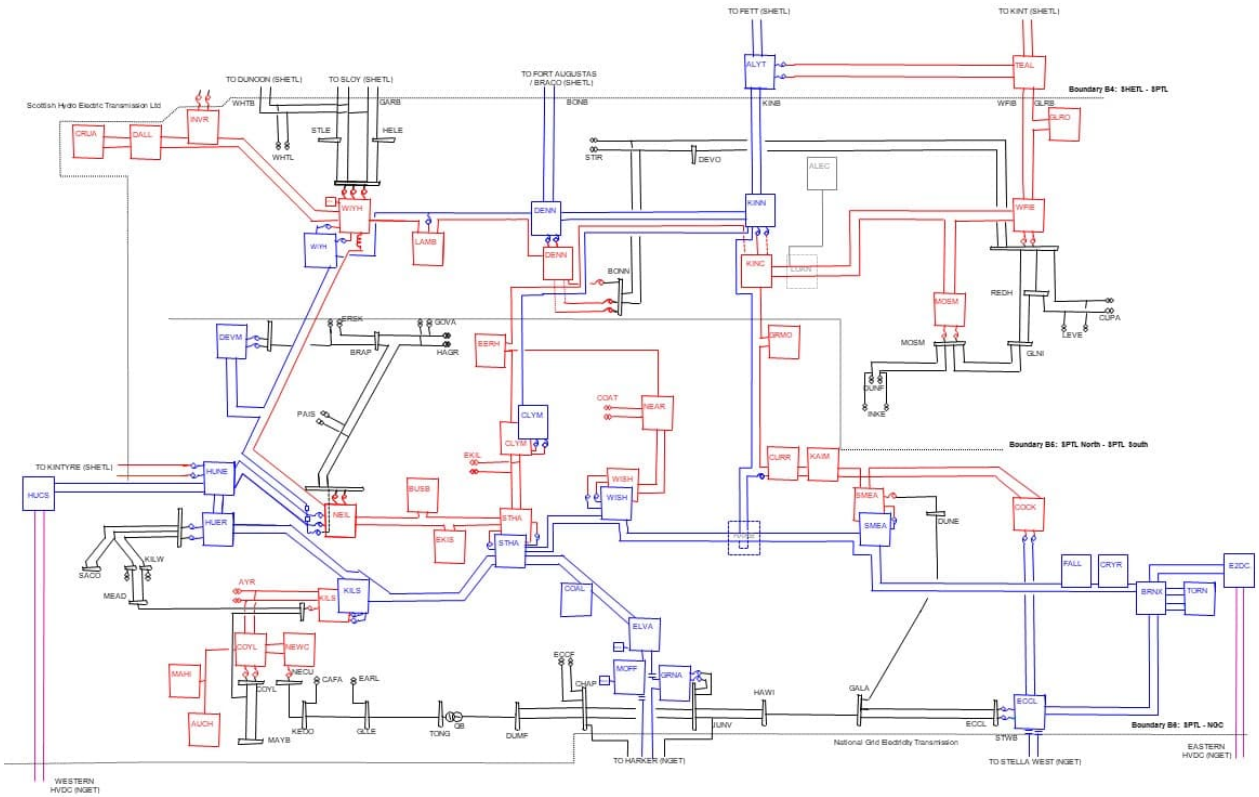

Figure 17: NOA Codes LWUP, DWUP (to Clyde's Mill), LCU2 (part), DLUP and BDUP

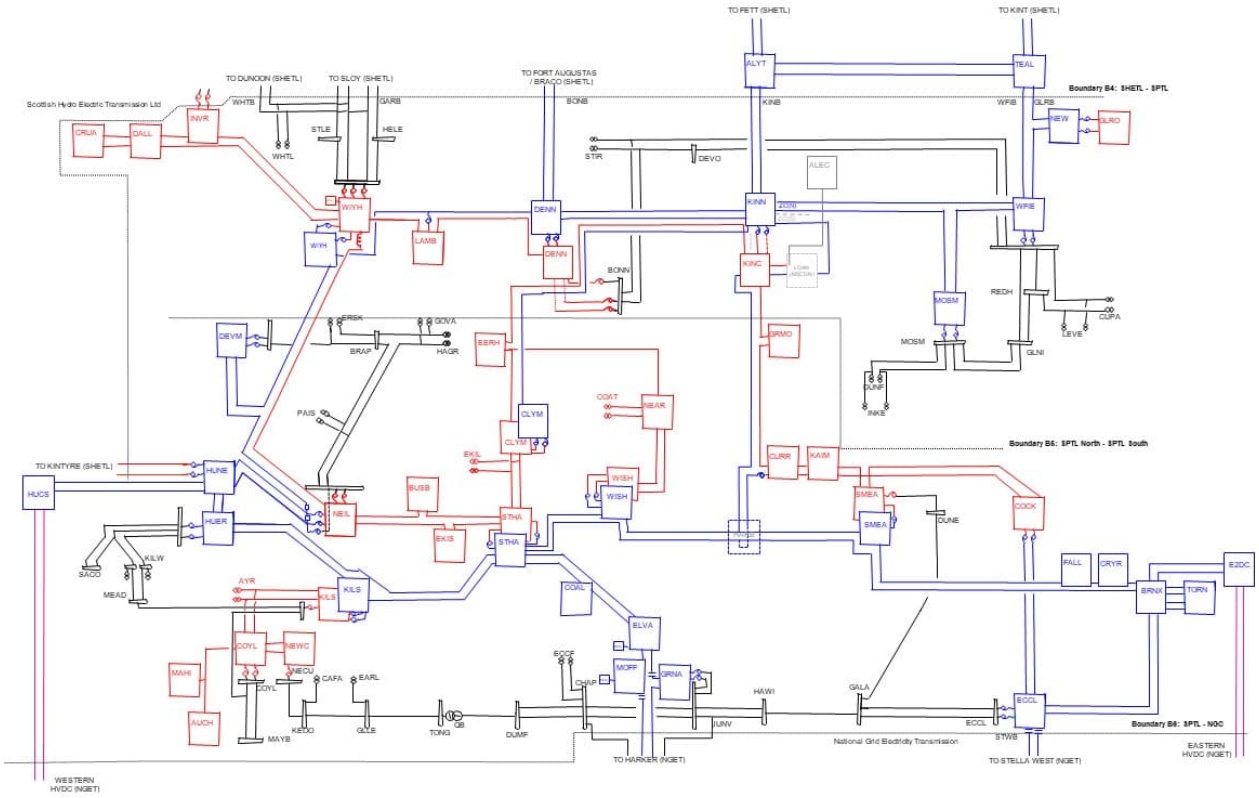

Figure 18: NOA Codes LWUP, DWUP (to Clyde's Mill), LCU2 (part), DLUP, BDUP and TKUP

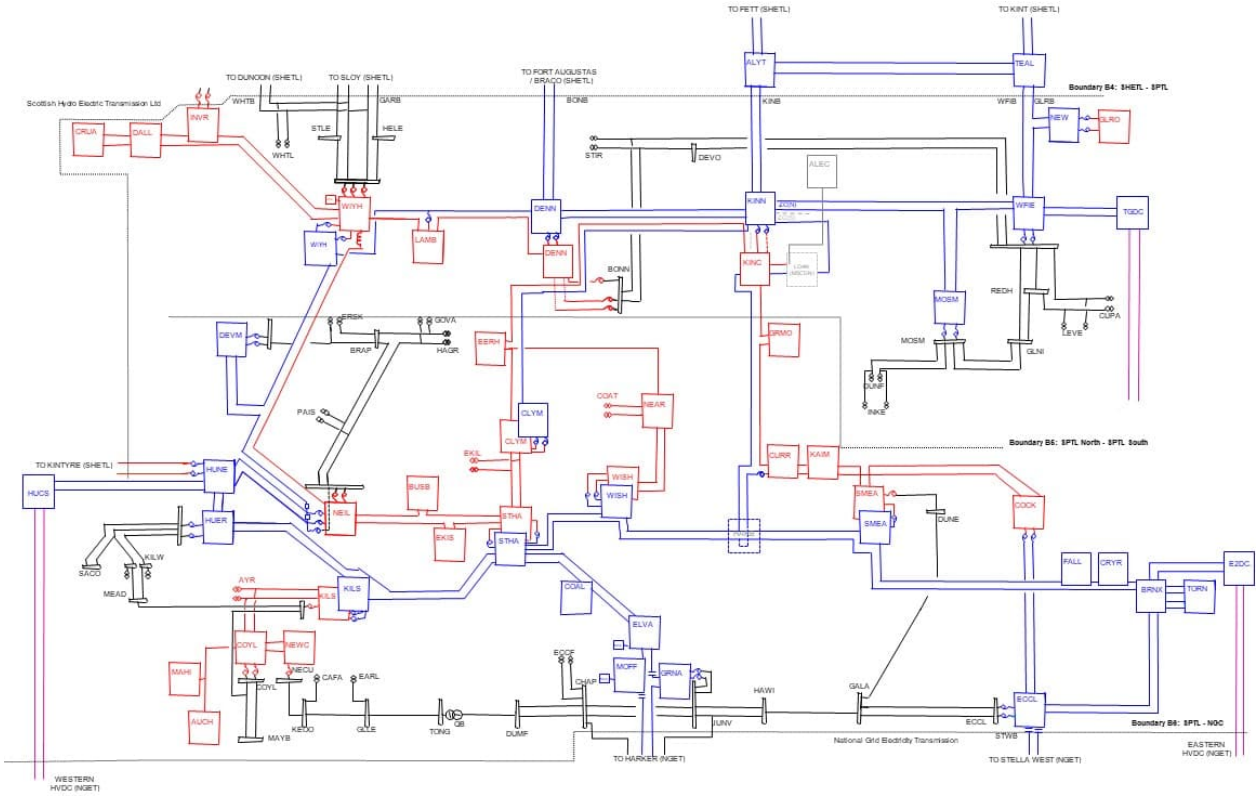

Figure 19: NOA Codes LWUP, DWUP (to Clyde's Mill), LCU2 (part), DLUP, BDUP, TKUP and TGDC

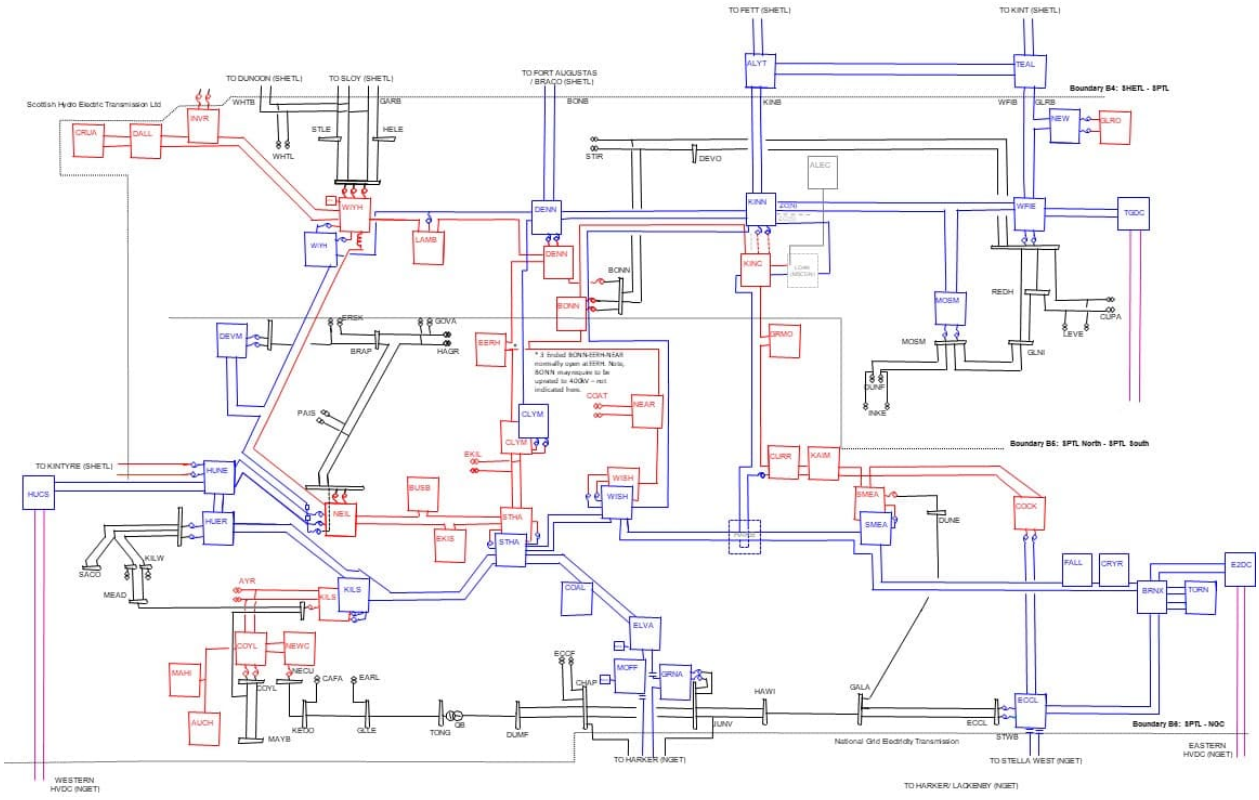

Figure 20: NOA Codes LWUP, DWUP (to Clyde's Mill), LCU2 (part), DLUP, BDUP, TKUP, TGDC and DWNO

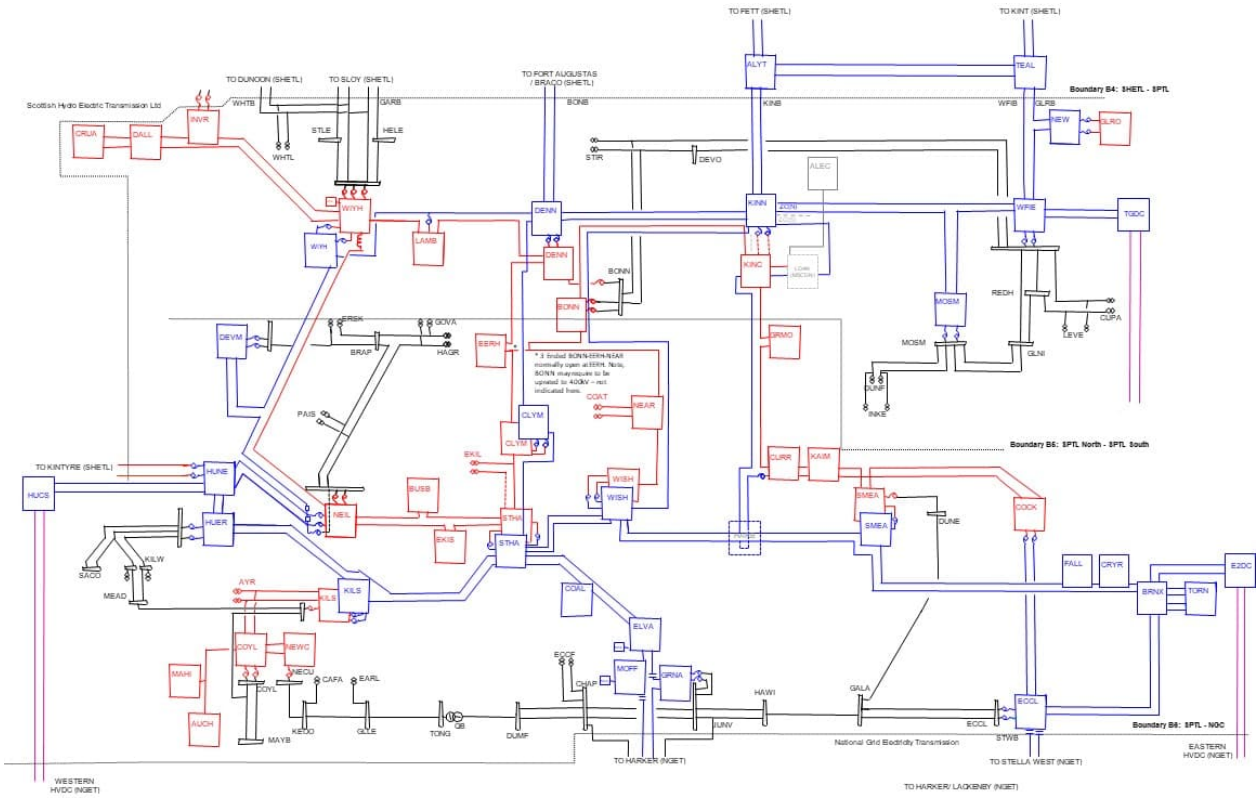

Figure 21: NOA Codes LWUP, DWUP (to Clyde's Mill), LCU2 (part), DLUP, BDUP, TKUP, TGDC, DWNO and CVUP

6.6 Further Optimisation of Scope of Works

Subject to the detailed design and integrated stage by stage sequencing of both LWUP and DWUP projects, and subject to the separate regulatory approval of the NOA project ref. DWUP, scope may exist to defer the installation of one of the two Kincardine North – Kincardine 275kV cable systems, and the associated 275kV GIS bay and GIB connections at Kincardine 275kV Substation, which at present forms part of the current (LWUP) scope of works as described in Section 6.1. These works have an estimated capital cost of [redacted].[25]

While project design and development will continue with these works in scope at this time, the scope to defer their delivery shall be assessed in detail as part of the ongoing project development process.

[25] Estimated Direct capital cost in 2018/19 values.

7. Project Cost Estimate

As agreed with Ofgem, a further (Stage 2) MSIP submission will be made at the right time relating to the associated amendments to the outputs, delivery date and allowances to be detailed in LSpC 3.14 Appendix 1. The detail in this section is therefore indicative pending that further submission.

7.1 Estimate Total Project Costs

Aligned with the format of the Re-Opener Pipeline Log, Table 12 details the expected energisation year and the current view of potential direct capital expenditure. The (RIIO-T2) allowances will be subject to the Opex escalator mechanism:

Table 12: Estimated Incidence of Expenditure

	Potential direct capex value per year, £m, 18/19 price base								
Energisation Year	Yr 21/22: direct capex	Yr 22/23: direct capex	Yr 23/24: direct capex	Yr 24/25: direct capex	Yr 25/26: direct capex	Yr 26/27 (T3): direct capex	Yr 27/28 (T3): direct capex	RIIO-T2 Total: direct capex	Total: direct capex
2027/28	0.01	0.13	3.14	18.09	34.35	37.04	4.97	55.72	97.73

7.2 Regulatory Outputs

The indicative primary asset outputs are identified in Table 13 below:

Table 13: Regulatory Outputs Table (Volumes)

Asset Category	Asset Sub-Category Primary	Voltage	Forecast Additions / Activity	Forecast Disposals
Kincardine North 400kV Substation:				
Circuit Breaker	CB (Gas Insulated Busbar) (ID)	400kV	10	0
Denny North 400/275kV Substation:				
Circuit Breaker	CB (Air Insulated Busbar) (OD)	400kV	2	0
Circuit Breaker	CB (Air Insulated Busbar) (OD)	275kV	0	2*
Other switchgear	Disconnector (AIS) (OD)	400kV	4	0
Other switchgear	Disconnector (AIS) (OD)	275kV	0	6*
Kincardine 275kV Substation:				
Circuit Breaker	CB (Gas Insulated Busbar) (ID)	275kV	2	0
Longannet 275kV Substation:				
Circuit Breaker	CB (Air Insulated Busbar) (ID)	275kV	0	16
Other switchgear	Disconnector (AIS) (ID)	275kV	0	46
Wound plant	Reactor	275	0	2
FACTS	FACTS Equipment	275	0	2*
Cable	Onshore: 1 core per phase	<=2500mm2	0	1.93km
Overhead Tower Line	Tower	275 kV	1	0
Kincardine North to Kincardine:				
Cable	Onshore: 2 core per phase	<=2500mm2	3.16km	0

Asset Category	Asset Sub-Category Primary	Voltage	Forecast Additions / Activity	Forecast Disposals
XL Route Conductor Replacement (South of Kincardine North):				
Overhead Tower Line	OHL (Tower Line) HTLS Conductor	400 kV	2.4km	2.4km
XL Route Conductor Replacement (North of Kincardine North):				
Overhead Tower Line	OHL (Tower Line) Conductor	400 kV	18.6km	18.6km
ZC(N) and ZC(S) Route Diversions to Kincardine North:				
Overhead Tower Line	OHL (Tower Line) Conductor	400 kV	0.6km	0.6km
Overhead Tower Line	Tower	400 kV	4	0
XL Route Diversion to Kincardine North:				
Overhead Tower Line	Tower	400 kV	3	1

** Assets to remain in situ for future re-energisation.*

Note that as part of this Stage 1 submission the table above is indicative of primary asset additions and disposals only and will be further developed at Stage 2 e.g. the uprating of overhead line assets from 275kV to 400kV operation, such as on ZC(N) route, is not indicated above, nor is the de- energisation of ZC(N) and ZC(S) east from Kincardine North, pending their future re-energisation in later stages of system reinforcement.

8. Delivery

We have applied our project management approach to ensure that this project work is delivered safely, and in line with the agreed time, cost and quality commitments. We have a proven track record of delivering essential transmission network upgrade projects and will draw upon this knowledge and experience to effectively manage these works. We have assigned a dedicated Project Manager to the works at every stage who will be responsible for overall delivery of the scope and is the primary point of contact for all stakeholders.

8.1 Delivery Schedule

A standard approach has applied to the planning phase of these works and that will continue for the reporting and the application of processes and controls throughout the lifecycle. Table 14 summarises the key milestones within the delivery schedule.

Table 14: Key Milestone

Milestone	Phase	Estimated Completion Date
1	ITT Issued for Long Lead Time Items (GIS Equipment)	June 2023
2	ITT Issued for Enabling Civil Works (Kincardine North Substation Platform)	August 2023
3	ITT Issued for Other Works (e.g. Civils, non-GIS plant, Installation, Commissioning)	September 2023
4	Planning Application Submission (Substation)	March 2024
5	Planning Application Submission (Overhead Line)	April 2024
6	Award Enabling Civil Works Contract (Kincardine North Substation Platform)	May 2024
7	Award GIS Contract	June 2024
8	Planning Decision Received (Substation)	August 2024
9	Works Start on Site	September 2024
10	Award Contract for Other Works (Civils, non-GIS plant, Installation, Commissioning)	September 2024
11	Planning Decision Received (Overhead Line)	April 2025
12	Transfer Existing Circuits	October 2026 – July 2027
13	Completion of Works	December 2027

Regular meetings with the Project and Construction Management Teams shall be undertaken to assess the ongoing effectiveness of the Project Management interfaces.

The Project Manager will facilitate internal Project Team Meetings, in which project progress and deliverables will be reviewed and any arising risks or issues will be discussed and addressed.

8.2 Risk and Mitigation

A Risk Register has been generated collaboratively during the initial design stages to identify any risks, which if realised, could result in deviation from the delivery plan. Mitigation strategies have also been developed to manage the risks identified and these will be implemented by the Project Manager. The risk register shall remain a live document and will be updated regularly. Currently, the top scheme risks are:

8.3 Quality Management

SPT adopts a "life cycle" approach to Quality Management in major project delivery. Our Management Systems are certified to ISO 9001, ISO 14001 and ISO 45001. Various areas applicable to these standards ensure a quality product is delivered. The significant areas detailed below:

8.3.1 Quality Requirements During Project Development

Any risk or opportunity that may affect the quality of the product are detailed in the Project Risk Register (that is noted in Section 6.5 above).

The suppliers of main equipment may also receive a Factory Acceptance Test Inspection when the asset is being built.

8.3.2 Quality Requirements in Tenders

Each contract that SPT issues has a standard format. Specifically in relation to quality, this will include a Contractors' Quality Performance Requirement (CQPR). This CQPR represents a specification that details roles and responsibilities for all parties during the works, frequency and format of reporting. It will also specify the document management process to be adhered to during the delivery of the project. In addition to the CQPR, each project has a contract specific Quality Management Plan, detailing the inspection and testing regime for works as well as the records to be maintained.

8.3.3 Monitoring and Measuring During Project Delivery

SPT Projects undertake regular inspections on projects and contractors to monitor and measure compliance with SPT Environmental, Quality and Health and Safety requirements, as detailed in the contract specifications for the work. All inspections are visual, with the person undertaking the inspection ensuring that evidence of the inspection and any actions raised are documented.

The following inspections are completed:

- Quality Inspections (monthly)
- Environmental Inspections (monthly, with weekly review by third party Environmental Clerk of Works)
- Safety Assessments & Contractor Safety Inspection (daily, with full time Site Manager)
- Project Management Tours (monthly)

The scope of audits and Inspections is to determine compliance with:

- Procedures & Guides
- Planned arrangements for ISO 9001, 14001 & 18001
- Legal and other requirements.

8.3.4 Post Energisation

SPT Projects and SPT Operations carry out a Defect Liability Period Inspection within the Contract Defect Liability Period with the aim of identifying any defects and rectifying them with the contractors.

9. Conclusion and Recommendations

This MSIP Re-opener application demonstrates the need to establish Kincardine North 400kV Substation, with works commencing in the RIIO-T2 period (April 2021 – March 2026) and completing in the RIIO-T3 period. This project will enable the timely and co-ordinated increase in power transfer into and through the SPT network from renewable developments across the north of Scotland and the decommissioning of Longannet 275kV Substation, which is now approaching end of life.

The works will also:

- Prepare the network for further planned increases in north to south transfer capability across Boundaries B4 and B5. Kincardine North 400kV Substation, which has been recommended to proceed by the Network Options Assessment (NOA) process and was identified by NGESO as 'Required for 2027' in the OTNR HND (ref. NOA code LWUP), is a key enabler for several dependent projects (ref. NOA codes DWUP, DLUP, TKUP, BDUP and LCU2); and
- Support the maximisation of transfer capability via existing transmission overhead line routes, prior to the construction of new overhead line routes e.g. Denny - Wishaw, helping to relieve thermal bottlenecks in the SPT network which can impact Scottish import and export capability.

The main conclusions of this submission are:

- The timely connection of low carbon generation, including onshore and offshore wind, will play a vital role in reaching legislated net zero targets, and is aligned with SPT's RIIO-T2 strategic goals.
- It is necessary to make significant investment in the capability of the existing transmission system through Scotland and the north of England to accommodate growth in renewable generation. This is required to maintain and operate an economic and efficient transmission system. It is critical to allow the network to keep pace with projected growth to support legislated Net Zero targets whilst also enabling significant constraint savings.
- Kincardine North 400kV Substation will require to be available prior to the decommissioning of Longannet 275kV Substation.
- An MSIP Re-opener application is required in respect of these works.

We, respectfully, request Ofgem's agreement to the following:

- The option being progressed addresses a clear customer need and represents value to UK consumers, therefore, the works should proceed based on the preferred solution (Option 3b).
- Efficient expenditure is fully funded, as necessary to maintain programme timelines and mitigate project delivery risk e.g. order long-lead equipment, prior to the second stage MSIP submission and assessment.

Appendix A - SP Transmission System, Geographic Overview