Scottish & Southern Electricity Networks

SSEN Transmission

RIIO-T2 Business Plan T2BP-EJP-0050

Tealing 275kV Busbar

Engineering Justification Paper

1 Executive Summary

Our paper A Network for Net Zero – Scenarios sets our methodology for determining the Certain View. The Certain View is every activity and investment that we propose to undertake during the RIIO-T2 period where there is compelling evidence of need. This encompasses capital investment to grow the network and accommodate new renewable generators.

This paper identifies the need to carry out transmission works at Tealing 275kV substation to accommodate the connection of Firth of Forth Offshore Windfarm which has a Transmission Entry Capacity of 1075MW. The primary driver for this scheme is Load.

Firth of Forth has had a longstanding firm connection offer for 1,075MW into Tealing 275kV busbar with a date of 1st October 2022. The customer recently requested to advance this connection date to October 2021. Due to Connect and Manage[1], the north to south power flows on our network have significantly increased since initially contracting. The ESO indicated challenges with managing the system for the earlier connection date. In line with our ambition to provide a network connection tailored to meet our customers' requirements and in line with our goal to deliver every connection on time; a flexible solution was included in the Firth of Forth Transmission Owner Construction Agreement (TOCA) which was signed in September 2019.

Following a process of optioneering and detailed analysis under the Connection Infrastructure Options Note (CION) process, the proposed scope of works is:

- Install an operational intertrip scheme for the advanced connection period between 31st October 2021 and 1st October 2022. For the planned or unplanned outage of named circuits, Firth of Forth will be instructed to ramp their output to 0MW or tripped.
- Replacement of all existing 275kV, 2500 Amp rated busbars with 4000 Amp equivalents. The new Tealing 275kV busbar will comprise two bus couplers, one bus section and busbar selection on all feeder bays.

[1] National Grid - Connect and Manage Guidelines, March 2013

- Install three new fully selectable 275kV Air Insulated Switchgear (AIS) cable bays to facilitate the connection of Firth of Forth Offshore Windfarm via a platform extension.

This scheme delivers the following outputs and benefits:

- Connect 1075MW of renewable offshore wind to the SHE Transmission Network in line with our goal to transport the renewable electricity that, in total, powers 10 million homes

- Provide a network connection tailored to meet our customers' requirements and in line with our goal to deliver every connection on time.

The cost to deliver this scheme is £38.93m and the works are planned to be completed during the RIIO-T2 period.

The Firth of Forth Offshore Windfarm Connection is not flagged as eligible for early or late competition due it being under Ofgem's £50m and £100m thresholds respectively.

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Name of Scheme/Programme	Tealing 275kV Busbar
Primary Investment Driver	Growth (Load)
Scheme reference/ mechanism or category	SHT2000, SHT2026
Output references/type	LRT2SH2000
Cost	£38.93m
Delivery Year	2022
Reporting Table	C0.7 Load Master Data
Outputs included in RIIO T1 Business Plan	Yes

3 Introduction

This Engineering Justification Paper sets out our plans to undertake works at Tealing 275kV Busbar during the RIIO-T2 period (April 2021 to March 2026). The planned work is at Tealing substation as shown on the map overleaf:

The Engineering Justification Paper is structured as follows:

Section 3: Need

This section provides an explanation of the need for the planned works. It provides evidence of the primary and, where applicable, secondary drivers for undertaking the planned works. Where appropriate it provides background information and/or process outputs that generate or support the need.

Section 4: Optioneering

This section presents all the options considered to address the "need" that is described in Section 3. Each option considered here is either discounted at this Optioneering stage with supporting reasoning provided or is taken forward for Detailed Analysis in Section 5.

Section 5: Detailed Analysis

This section considers in more detail each of the options taken forward from the Optioneering section. Where appropriate the results of Cost Benefit Analysis are discussed and together with supporting objective and engineering judgement contribute toward the identification of a selected option. The section continues by setting out the costs for the selected option.

Section 6: Conclusion

This section provides summary detail of the selected option. It sets out the scope and outputs, costs and timing of investment and where applicable other key supporting information.

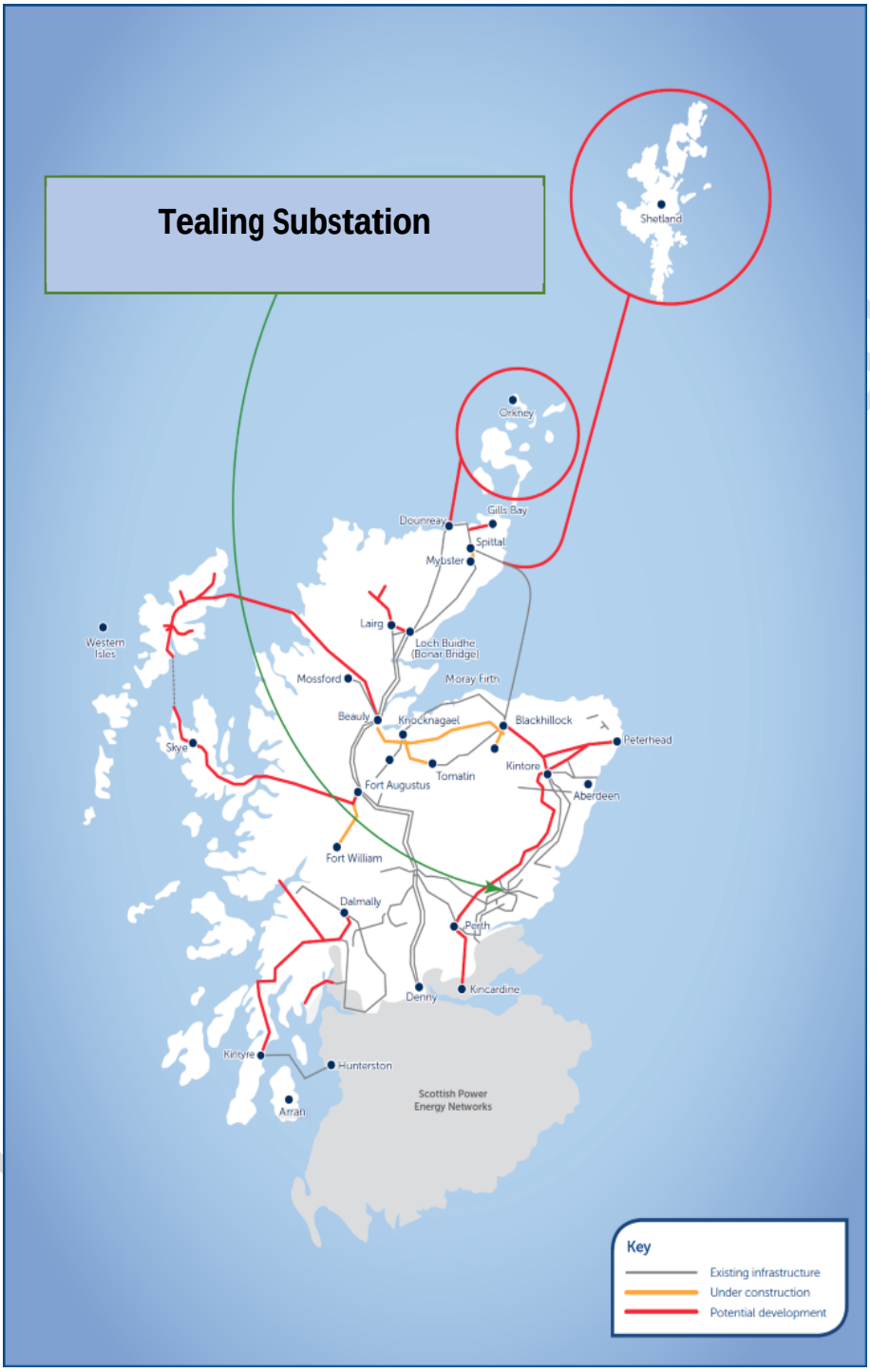
Section 7: Price Control Deliverables and Ring Fencing

This section provides a view of whether the proposed scheme should be ring-fenced or subject to other funding mechanisms.

Section 8: Outputs included in RIIO-T1 Business Plan

This section identifies if some or all the outputs were included in the RIIO-T1 Business Plan and provides explanation and justification as to why such outputs are planned to be undertaken in the RIIO-T2 period.

Figure 1: SHE Transmission Network Map and Location of Works



4 Need

This section provides an explanation of the need for the planned works. It provides evidence of the primary and, where applicable, secondary drivers for undertaking the planned works. Where appropriate it provides background information and/or process outputs that generate or support the need.

4.1 Growth Need

We are required at all times to plan and develop our transmission system in accordance with the National Electricity Transmission System Security and Quality of Supply Standard (SQSS), and, the System Operator Transmission Owner Code (STC). Furthermore we are obliged to provide adequate transmission capacity to facilitate connections to customers in the north of Scotland who wish to connect to, and use, the transmission system in order to participate in the national wholesale electricity market.

[redacted] is developing the 1075MW Firth of Forth Offshore Windfarm located 27km from the Angus coast line on the East of Scotland.

The Firth of Forth development falls under the Offshore Transmission Regime. The developer is undertaking an Offshore Transmission Development User Works (OTSDUW) build which will then be transferred to a competitively appointed Offshore Transmission Owner (OFTO). This means the developer will design and build the assets up to the point of interface with the main transmission system, and then the offshore transmission assets will transfer to the OFTO following a competitive tender.

The connection of Firth of Forth Offshore Windfarm was subject to the Connection and Infrastructure Options Note (CION) process[2]. The CION records the output of the work between the Developers, TOs and NGESO to identify the overall economic, efficient and coordinated connection option. NGESO is responsible for coordinating the development of the CION document, however, each party is responsible for the accuracy of any information they provide.

[2] National Grid ESO - Connection Infrastructure Options Note Guidance Note

The Connection and Use of System Code (CUSC) is the contractual framework for connection to, and use of, the NETS. CUSC section 13 deals with the identification of Enabling Works to be included in an Offer made under the Connect and Manage Arrangements. Enabling works as a minimum will include those Transmission Reinforcement works required to meet among other technical criteria; the Pre-fault Criteria set out in Section 2 of the NETS SQSS and enable the ESO to operate the NETS in a safe manner.

The Connect and Manage (C&M) transmission access regime allows generators to connect in advance of the completion of the wider transmission reinforcement works but not before completion of the identified Enabling Works. Connection of generators ahead of the completion of Wider Works means that parts of the Transmission System will not be compliant with the NETS SQSS until these works are completed. Under this transmission access regime, C&M derogations from the planning criteria of NETS SQSS are required to allow these generators to connect ahead of the completion of the Wider Works. The TO submits a C&M derogation report as part of an associated TO Connection Offer. These C&M derogations are subject to the ESO approval. The Enabling, Wider and Derogated Wider works are entered into the developers' connection agreements with the ESO. We submitted a derogation report as part of the associated Firth of Forth offer, this was accepted by NGESO.

4.1.1 Connection Advancement

Firth of Forth has had a longstanding contracted firm connection for 1,075MW into Tealing 275kV busbar with a date of 1st October 2022. In March 2019, the customer requested an earlier connection date of October 2021, one year ahead of their contracted position (1st October 2022). NGESO informed Firth of Forth that an advanced connection would likely increase constraint costs and that any advancement would therefore be acceptable on a non-firm basis only. To facilitate the earlier connection date, we engaged ScottishPower Transmission (SPT) and National Grid Electricity System Operator in the development a flexible solution comprising an operational intertrip scheme. This is in line with our ambition to provide a network connection tailored to meet our customers' requirements and in line with our goal to deliver every connection on time. This process concluded in the Firth of Forth Transmission Owner Construction Agreement (TOCA)being signed in September 2019 for a two stage offer:

- Stage 1 – Connection of 1,075MW – 31st October 2021 (Non-Firm)

- Stage 2 – Connection of 1,075MW – 1st October 2022 (Firm)

The transmission Enabling Works required to be complete ahead of the Firth of Forth connection are categorised as 'Sole Use Enabling Works', 'Shared Use Enabling Works' and 'One Off Works'. These works are referenced in the TOCA.

Sole Use Enabling Works - Local system infrastructure which is being developed, designed and built solely for the benefit of the user making the application and requiring this to connect to the existing transmission system.

Shared Use Enabling Works - Local system infrastructure which is being newly developed and built for the benefit of multiple applicants, or which is existing infrastructure being upgraded to accommodate new applicants in addition to existing users, effectively triggering the requirement for an increase in capability on the existing system.

One Off Works - To provide or modify a connection, the transmission licensee may be required to carry out works on the transmission system that, although directly attributable to the connection, may not give rise to additional connection assets. These works are defined as "one-offs". One off works are assigned where a cost cannot be capitalised into either a connection or infrastructure asset, typically a revenue cost or where a non-standard incremental cost is incurred as a result of a User's request, irrespective of whether the cost can be capitalised.

5 Optioneering

5.1 CION Options

This section presents all the options considered to address the "need" that is described in Section 3. Each option considered here is either discounted at this Optioneering stage with supporting reasoning provided or is taken forward for Detailed Analysis in Section 5.

The CION process evaluates the respective transmission options required which leads to the identification and development of the overall efficient, coordinated and economical connection point. This work commenced in 2010 and assessed the connection at six different connection points. The options included Tealing and Arbroath in the SHE Transmission licence area and Cockenzie, Branxton, Crystal Rig & Torness in SPT's licence area. The CION[3] concluded that Tealing was the most economic point of connection for the 1,075MW, Firth of Forth Offshore Windfarm.

It should be noted that the CION commenced in 2010 and was reviewed in 2013. The options costs and dates for each option were accurate at the time of writing. Should a material change to the Firth of Forth connection trigger a review of the CION, the dates, costs and options would need to be reviewed against the current contracted position.

5.2 Delivery Options

A delivery options assessment was carried out to determine how best to upgrade the existing 2500A busbars at Tealing 275kV substation. These options assessed the best technical solution while taking into account whole life asset costs and looking for the most economically viable option. The delivery options considered are shown in Table 1. The appraisal of these options is summarised in the Detailed Analysis Section of this report.

[3] Phase One Interim Offshore Connections and Infrastructure Options Note (CION)

Table 1: Tealing 275kV Busbar Upgrades Delivery Options

Option	Tealing 275kV Busbar Delivery Option	Option Progressed
1.	Replacement of busbar conductors and Current Transformers (CT) so as not to alter the existing substation footprint.	No
2.	Replacement as offline build Air Insulated Switchgear (AIS).	No
3.	Replacement as offline build Gas Insulated Switchgear (GIS).	No
4.	Replacement of busbar conductors, CTs and structures in stages at their current position.	Yes
5	Replacement of existing busbar with new busbar in the location currently occupied by the 275kV reserve busbar.	No

6 Detailed Analysis

This section considers in more detail each of the options taken forward from the Optioneering section. Where appropriate the results of Cost Benefit Analysis are discussed and together with supporting objective and engineering judgement contribute toward the identification of a selected option. The section continues by setting out the costs for the selected option.

6.1 Cost Benefit Analysis

As part of the CION process, a Cost Benefit Analysis (CBA) was carried out by NGESO on the four connection site options (on Arbroath, Tealing, Cockenzie and Branxton) progressed to Detailed Analysis. This assessment considered the cost for the Transmission Owner, the cost to the developer and also the impact on network as a result of Firth of Forth connecting at each of the proposed sites.

The results of the CION process concluded that Tealing 275kV busbar was the optimal connection site for the 1075MW Firth of Forth Offshore Windfarm.

We have continued to work closely with [redacted] throughout the development of their connection into Tealing 275kV substation. This has included the change from HVDC technology to HVAC, supporting the assessment of the Harmonic Studies to inform their filter design, incorporating an additional feeder bay (three bays in total), the development of an operational intertrip and accelerating works to accommodate the early connection into Tealing 275kV busbar.
At the request of the developer, the connection to Tealing 275kV busbar will be via three fully selectable 275kV Air Insulated Switchgear (AIS) cable bays.

6.2 Tealing 275kV Busbar Upgrade Delivery Strategy

The CDM Regulations require designers to consider the construction activity and how to design out inherent risks. The optioneering phase of this project has taken into account the whole life cycle of the project and what residual risks remain.

Option 1 includes the replacement of busbars only. This is a technically very challenging when considering the outage requirements. In order to create the space to work safely, outages would be required on adjacent bays and at times a full circuit outage would be necessary. Tealing was constructed in the 1970's and is not designed to current standards where double circuits are installed

either side of the bus-section breaker. At Tealing this means double circuits to Kintore and Westfield sit next to each other in the substation. Proximity outages to replace busbars in this area would result in taking out the second circuit to its respective remote end. This would mean extensive double circuit outages throughout delivery of Option 1.

Common to all options considered for the Tealing 275kV Busbar Upgrade are the challenges associated with the requirement for extensive construction outages. Project interface and outage co-ordination discussion with the ESO and SPT has been established and is ongoing. All efforts will be taken to minimise construction outages whilst ensuring that the works can be delivered safely. The construction outage requirements have formed a major part of the project's decision making on which option to carry forward.

The approach required scrutiny of all existing high and low level structures and bar supports. There was the expectation all existing concrete structures, built in the mid 1970's, are in satisfactory condition. However, it was determined after carrying out invasive surveys all supporting structures should be included within the scope to ensure their lifespan is in line with design requirements.

An additional factor in the options assessment for this project was the anticipated construction phase risk of working directly next to existing structures. At multiple locations, existing structures would be undermined throughout construction. This imposed significant scrutiny on the condition and existing records of these structure's foundations and all substructure. Based on this, it is necessary that all new plant should be self-supporting with new foundations, clear of any existing structure or foundation.

Having considered all competing attributes in respect of the five identified proposals it was agreed by the project team that Option 4 is taken forward to conclusion. This was based on minimal land acquisition, lower exposure risk when working in a live environment and lower cost technology. This option also has the added advantage of redeveloping the existing footprint and replacing all structures to ensure the 275kV substation is built to SSEN's current standards with a 40-year design life, in place of the old busbar. A single line diagram of the Tealing 275kV Busbar is shown in Appendix A.

The preferred solution is Option 4; Replacement of busbar conductors, CTs and structures in stages at their current position. To meet the contracted date of 31st October 2021, construction works will begin in April 2020.

Summary of Benefits of the preferred Option 4;

- It limits the reliance on SF6 insulating gas in GIS substations,
- Maximises safe working areas within the live substation for the duration of delivery project.
- Allows the whole 275kV substation to be upgraded giving a 40 year lifespan.
- Minimises the need for extensive circuit outages throughout the construction duration.
- Makes use of the existing footprint limiting the size of extension required.
- Limits the need for future non-load related repair works in future years on adjacent plant.

On 20 September 2019, the UK Government announced the provisional results of the third CfD allocation round. In the context of the north of Scotland transmission system, Firth of Forth were among the generators that were successful in the allocation round.

6.3 Network Study Overview

The requirement for the Tealing 275kV Busbar upgrade was identified by System Planning & Investment through a point loading assessment on the busbar. This involves the detailed modelling of the busbar and circuit configuration so that the loading on the bar can be observed for a number of credible network configurations. With a double busbar, there are many permutations of busbar and circuits configurations which means that it is not practicable to determine prospective loading on each section of the busbar for each configuration.

The Tealing 275kV busbar is an existing asset on the SHE Transmission network. Similarly, to a transformer, cable or overhead line, a busbar has a thermal capability limit. The thermal capability of the existing Tealing 275kV busbar is 2500A. SHE Transmission have undertaken a point loading assessment on the 275kV busbar and have recommended that the existing asset be replaced with a busbar rated at 4000A to safely accommodate the increased current capacity following the connection of Firth of Forth, 1,075MW.

A snapshot of the busbar point loading study results are shown in Appendix B to illustrate the extent of overloading under credible network conditions. These results show a current loading for a reserve busbar outage of 2518 Amps. This is increased to 2917 Amps with a reserve busbar outage and a single

circuit outage on the circuit between Fetteresso and Kincardine (SY2/YZ2). These loadings are based on the assumption that Firth of Forth will not input more than 358MW (1,075MW divided by 3) on each feeder bay. This the minimum criteria for this assessment, SHE Transmission has not assumed a TEC restriction on any single bay within the TOCO; it is permissible (but unlikely due to cost and constructability) that Firth of Forth could size and configure the OFTO network to input 1,075MW into a single feeder bay. This would further exacerbate the overloads presented in Appendix B.

The existing 2500A double busbar is constructed with one bus coupler and one bus section, this will be replaced with a new 4000A rated busbar complete with one bus section and two bus couplers. This will ensure that the rating of the busbar is suitable to accommodate the 1,075MW connection of Firth of Forth, improves the operational flexibility and provides capacity for future connections at Tealing. System analysis has indicated that future connections on the Tealing 275kV busbar will likely require reinforcement of the 275kV circuits between Tealing – Glenrothes/Westfield (rated at 780MVA Summer pre-fault following completion of East Coast Onshore 275kV upgrade in 2023).

The loading on the Tealing 275kV busbar is not solely a result of the 1,075MW connection of Firth of Forth offshore windfarm. The busbar loadings are sensitive to the north to south flows and configuration of the wider network. [redacted]

– Although not observed in system studies for the current generation background, generation growth and other network development could eventually trigger the requirement to upgrade the Tealing 275kV busbar without the connection of Firth of Forth. It is the sum of the flows into Tealing 275kV busbar and the addition of Firth of Forth that result in the exceedance of the Tealing 275kV busbar 2500 Amp capability.

The existing busbar has one bus coupler and one bus section and a banking arrangement of SGTs. The new busbar will have dedicated feeder bays for all transmission circuits, full bus selectivity, two bus couplers and one bus section. This configuration will enhance the operational flexibility of Tealing 275kV substation; a strategic node on the Transmission system.

6.4 Transmission Owner Construction Agreement

The Transmission Owner Construction Agreement signed September 2019 comprise the one off, Sole Use and Shared Use Enabling Works as categorised in Table 3.

Table 2: Categorisation of Enabling Works

Category	Summary of Works	Justification
One Off Works	Operational Intertrip	Customer choice to advance connection ahead of contracted date of 1st Oct 2022. Requested by the ESO on the basis that the early connection will increase constraint costs.
	1x 275kV Feeder Bay	Customer choice to have three bays, above and beyond the requirements to comply with the NETS SQSS (two bays)
	Accelerated Works	Customer choice to advance the busbar project to minimise the impacts of the proposed intertrip during online construction.
Sole Use Enabling Works	2x 275kV Feeder Bay	NETS SQSS compliant connection. No Transmission Connection Assets as the interface point is with the offshore transmission owner (OFTO), not a user.
Shared Use Enabling Works	Tealing 275kV Busbar	Tealing 275kV busbar is an existing strategic node on the SHE Transmission network and provides a benefit to users of the system. It is the cumulative impact of existing users and Firth of Forth that result in the exceedance of the busbar rating. Enhancing the rating and reconfiguring the busbar to accommodate Firth of Forth at 1,075MW is therefore classified as Shared Use Enabling Works.

In line with our sustainability strategy commitments, whole life costs, losses, regional gross value add and the carbon impact of each of the options have also been assessed as part of our CBA (See Table 3).

Table 3: CBA Impact Table

Benefit category	Details	CBA value impact
Carbon impact – embedded carbon	Embedded carbon relates to carbon emissions associated with the manufacturing and production of the materials procured and installed as part of the project.	The discounted value of embedded carbon is estimated at around £0.5m over the lifetime of the assets.
Carbon impact – carbon displacement	Carbon displacement is determined through allocating a value to the displacement of fossil fuels from connecting new renewable generation.	The estimated annual discounted carbon abatement associated with the Transmission Entry Capacity of 1075MW for Firth of Forth is the region of £62m, according to the Scottish Governments Renewable Electricity Output Calculator[1] .
Regional Gross Value Add (GVA)	GVA is a measure of the value generated in an economy by any unit engaged in the production of goods and services. SHE Transmission has developed a tool to quantify the estimated regional GVA on the Scottish economy resulting from expenditure associated with the new generation connections enabled, and the work associated with SHE Transmission investments. Total GVA is calculated by measurements at three levels: 1. Direct GVA: value generated from direct project expenditure 2. Indirect GVA: value generated from employment of sub-contractors and demand for goods and services from suppliers down the supply-chain 3. Induced GVA: value generated from greater demand and spending on goods and services such as accommodation, food, fuel and retail by employees who are employed as a result of the direct and indirect impact.	The total direct regional GVA to the Scottish economy associated with the connection of the windfarm is estimated at £77m (discounted over estimated asset life). Indirect and induced GVA totals £65m (discounted). The direct GVA associated with the SHE Transmission expenditure is estimated at £6m (discounted), indirect and direct GVA totals £6m).

[1] https://www2.gov.scot/Topics/Statistics/Browse/Business/Energy/onlinetools/ElecCalc

6.5 Sensitivity Analysis

As outlined in our core RIIO-T2 business plan document, "A Network for Net Zero", we believe we have a critical role to play in delivering Net Zero ambitions in both the UK and Scotland. Therefore our plan has been carefully designed with the flexibility to deliver pathways to Net Zero. Our policy paper "Planning for Net Zero – Scenarios, Certain View and Likely Outturn" demonstrates that the investments which we are making are consistent with the UK Governments' net zero emissions by 2050 target. In preparing our RIIO-T2 Business Plan, we ensured that our Certain View provides flexibility for the north of Scotland transmission network to accommodate greater volumes of renewable generation connections during the RIIO-T2 period. The strategic investments included in the Certain View –on the East Coast and near Tummel–are critical to ensuring that flexibility. While the need for these investments can be evidenced now, timely delivery also maintains long term net zero emissions pathways. Our approach to using a 'Certain View' means that there is strong evidence-based need and justification that the load related works are necessary for connections of renewable generation. These works are necessary to meet our legal and regulatory obligations to provide a connection to any customer who requests it. See Table 4.

Table 4: Sensitivity Analysis

Sensitivity	Test and impact observed – switching inputs
Ongoing efficiency assumptions	Switching efficiency assumption: increased or decreased. Test would have no impact on (feasible) option selection, the options move in parallel and have no impact on ordering within CBA.
Demand variations	No significant demand variation forecast.
Energy scenarios	Sensitivities considered in the CION CBA assessment. As we have adopted a "Certain View" approach, as outlined in our "Planning for Net Zero – Scenarios, Certain View and Likely Outturn" policy paper, means that there is strong evidence-based need and justification that the load related works are necessary for connections of renewable generation. These works are necessary to meet our legal and regulatory obligations to provide a connection to any customer who requests it. Reference Section 3 for details.
Asset utilisation	As outlined in the energy scenarios section, we are anticipating increasingly more generation connecting to our Transmission network. As outlined in our "Planning for Net Zero – Scenarios, Certain View and Likely Outturn" policy paper our business plan has been carefully designed with the flexibility to

	deliver pathways to Net Zero. There is strong evidence-based need and justification that the load related works are necessary for connections of renewable generation. These works are necessary to meet our legal and regulatory obligations to provide a connection to any customer who requests it. We are unable to consider the known unknowns.
Timing / delivery	We have considered timing of investments as part of our CION CBAs.
Consenting / stakeholders	Where applicable we have considered consenting and stakeholder engagement as part of section 5 (Detailed Analysis) and the impact which this has had on the selection of the preferred solution.
Public policy / Government legislation	We have considered the impact of public policy, government legislation and regulations as part of the need (section 3), optioneering (section 4) and detailed analysis (section 5) and the impacts this has on the selection of the preferred solution. For example the projects have considered the impact of the UK Governments' Net Zero emission by 2050 target, SQSS and ESQCR.

6.6 Proposed Solution

Based on the results of the CION and the delivery options appraisal, Tealing 275kV Busbar is selected as the preferred connection site for Firth of Forth Offshore Windfarm. This is due to the comparably lesser enabling works required and the ability to deliver the connection by the developer's required connection date.

A Single Line Diagram (SLD) of the proposed connection at Tealing 275kV is shown in Appendix A.

The proposed works to connect Firth of Forth Offshore Wind Farm can be summarised as;

- Install an intertrip scheme which monitors eight circuits at eight different substations (3 SHE Transmission sites and 4 SPT sites). This requires installation of new one panel and relays at each location. During a fault outage and detection of a Line End Open (LEO) status on a named circuit, the intertrip scheme will trip Firth of Forth Windfarm. For planned outages on a named circuit, Firth of Forth will be instructed to ramp their output to 0MW or tripped. See Single Line Diagram in Appendix C.

- Replacement of all existing 275kV 2500A rated busbars with 4000A equivalents. The new Tealing 275kV busbar will comprise two bus couplers, one bus section and busbar selection on all feeder bays.

- Install three new fully selectable 275kV Air Insulated Switchgear (AIS) cable bays to facilitate the connection of Firth of Forth Offshore Windfarm via a platform extension.

6.7 Cost Estimate

The total cost for delivering the scope of works for the proposed solution is £38.93m.

Each Investment Decision Pack will contain a Cost Justification Paper that sets out how this total cost has been derived at both a scheme level and cost breakdown structure level.

6.8 Competition

The Firth of Forth Offshore Windfarm Connection is not flagged as eligible for early or late competition due it being under Ofgem's £50m and £100m thresholds respectively.

7 Conclusion

This Engineering Justification Paper confirms the need for undertaking construction works on the Tealing 275kV double busbar to accommodate the 1075MW connection of Firth of Forth Offshore Windfarm.

The proposed works include the rebuild of the 275kV AIS double busbar complete with two bus couplers, one bus section and busbar selection on all feeder bays. Three feeder bays are required to accommodate the connection of Firth of Forth 1075MW Offshore Windfarm.

An operational intertrip scheme will be in service for the advanced connection period between 31st October 2021 and 1st October 2022. For the planned or unplanned outage of named circuits, Firth of Forth will be instructed to ramp down their output to 0MW or tripped.

This scheme delivers the following outputs and benefits:

- Connect 1075MW of renewable offshore wind to our transmission network in line with our goal to transport the renewable electricity that powers 10 million homes.
- Provide a network connection tailored to meet our customer's needs in line with our goal to deliver every connection on time.

The total cost for delivering the scope of works for the proposed solution is £38.93m and will be delivered in the RIIO T2 period.

8 Price Control Deliverable & Ring Fencing

As set out in our Regulatory Framework paper (section 1.12 and Appendix 3) we support a key principle from Citizens Advice – one that guarantees delivery of outcomes equivalent to the funding received - to ensure that RIIO-T2 really deliver for consumers. At the project level this means that if we don't deliver the output, or a materially equivalent outputs, we commit to returning the ex-ante allowance for the output not delivered.

This means that if the funding for Firth of Forth Offshore Windfarm Connection should be ring-fenced and if it does not go ahead, we will return the allowances of £38.93m in full (minus any justified preconstruction expenditure).

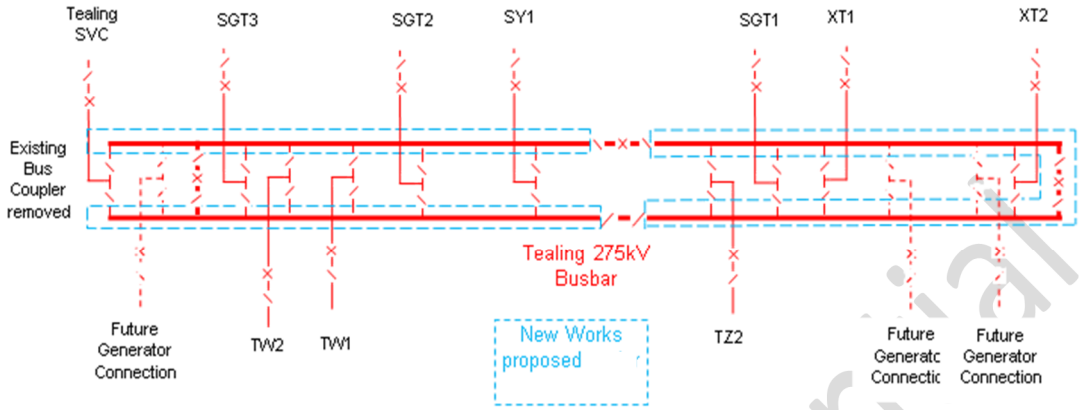
It also means that we commit to delivering 1075MW for the costs of £38.93m. If we do not deliver that 10750MW or a materially equivalent output, we commit to returning a proportion of the ex ante allowance. The detailed methodology should be decided at when developing the Close Out methodologies but should apply the same principles of uncertainty mechanisms - that any under delivery should be material.

9 Outputs included in RIIO T1 Business Plan

Although the Tealing Busbar was included as part of our ex-ante funding for the RIIO-T1 period, our view is we have significantly over delivered on the scope across all RIIO-T1 OFTO schemes due to the requirement to build a new Transformer double busbar substation to accommodate the Moray East Offshore Windfarm Renewables Limited scheme at New Deer. Our view is therefore that the Tealing 275kV scheme should be considered as a RIIO-T2 scheme with associated construction expenditure recovered fully in the RIIO-T2 period. This is detailed in our Project & Cost Efficiency Report for the Tealing 275kV busbar (T2BP-EST-007).

10 Appendices

11 Appendix A – Single Line Diagram showing ownership demarcation.



12 Appendix B: Tealing 275kV busbar Point Loading Study

Diagram Removed

Figure 2: Tealing 275kV Busbar SLD, Intact

Diagram Removed

Figure 3: Tealing 275kV Busbar, Reserve Bus Outage, Load Flow

Diagram Removed

Figure 4:Tealing 275kV Busbar, Reserve Bus Outage & Fetteresso - Kincardine Circuit Fault Load Flow

Appendix C: Firth of Forth Intertrip Scheme (between 31st Oct 2021 and 1st Oct 2022)

Diagram Removed