Decision

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Eastern HVDC – Conditional Decision: Final Needs Case

Subject	Details
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Following our 30 March 2022 consultation on the Final Needs case, this document confirms our decision to approve the Final Needs Case for proposed Eastern HVDC electricity transmission projects, conditional on Eastern HVDC obtaining the necessary planning consents. This document also confirms our decision on the regulatory delivery model for the Eastern HVDC and includes an update on the Large Project Delivery arrangements.

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Eastern HVDC

In March 2022 we published a consultation on our views on the two Final Needs Case (FNC) submissions from National Grid Electricity Transmission, SP Transmission and Scottish Hydro Electric Transmission plc (the three electricity transmission owners that own and operate the transmission network in Great Britain) for the proposed 'Eastern High Voltage Direct Current' Link (Eastern HVDC) [1].

The Eastern HVDC projects are proposed electricity transmission projects to construct two high voltage direct current links, with capacity of 2GW each, down the east coast from Scotland to the north-east of England. The purpose of the Eastern HVDC projects is the transmission of electricity generated in Scotland down past the congested network around the border to England. At an estimated cost of £3.4bn for the two links, the Eastern HVDC projects would be the largest electricity transmission investment project in the recent history of Great Britain.

The proposal for the Eastern HVDC projects consists of two separate reinforcement projects:

- **Torness to Hawthorn Pit subsea HVDC link**, Network Options Assessment (NOA) code E2DC, prepared by a joint project team from SP Transmission (SPT) and National Grid Electricity Transmission (NGET), expected to be operational from 2027; and
- **Peterhead to Drax subsea HVDC link**, NOA code E4D3, prepared by a joint project team from Scottish Hydro Electric Transmission plc (SSENT) and National Grid Electricity Transmission (NGET), expected to be operational from 2029.

Due to similarity in most elements (e.g. approach to delivery, Cost Benefit Analysis (CBA) methodology), the close interaction between the two projects, and because the Initial Needs Case (INC) stage focused on both projects together, we consulted on both projects together at the FNC stage. The consultation document and this decision document, where relevant, highlight the difference between the two proposed links, E2DC and E4D3. This is to reduce repetition and more broadly reduce the amount of information for stakeholders to review.

[1] Eastern HVDC - Consultation on the project's Final Needs Case and Delivery Model | Ofgem

Final Needs Case Assessment

We are satisfied that there is sufficient evidence to demonstrate the needs case for the Eastern HVDC projects. Having taken into consideration the eight consultation responses received, and considering the projected increase in renewable generation on the pathway to achieving the Scottish and UK Governments' legally binding Net Zero goals, we are satisfied that there remains a need for both links.

In our INC consultation for the Eastern HVDC projects, we were satsified that NGET, SPT and SSENT had progressed the most economic and efficient options based on all the information available at that time. We consider that the subsequent CBA undertaken by NGET, SPT and SSENT as part of their FNC submissions suitably considered all feasible options and demonstrated that the two proposed HVDC projects remain the options that deliver greatest benefit for consumers.

Assessment of suitability for late competition models

In line with our Final Determinations for the RIIO-2 period for Electricity Transmission (RIIO-ET2), as the Eastern HVDC projects are being considered under the Large Onshore Transmission Investment (LOTI) mechanism, we have assessed the suitability of the projects for 'late model' competition. Our view is that the projects as a whole meet the criteria for late model competition (new, separable, and high value).

From our assessment, we did not envisage a scenario where either the Competitively Appointed Transmission Owner (CATO) model or Special Purpose Vehicle (SPV) model could be applied to the Eastern HVDC projects without causing material delay to these critical investments. In addition, the indicative results of the analysis carried out for the Competition Proxy model (CPM) included in our FNC consultation did not support the use of CPM for these projects. Therefore we maintain that the E2DC and E4D3 links should be delivered within LOTI under the RIIO-ET2 framework.

Large project delivery

We remain of the view that Project Delay Charge (PDC) should apply to Eastern HVDC and we will continue to engage with NGET, SPT and SSENT on our approach to setting the PDC. We will consult further on the PDC at the Project Assessment stage.

Conditional approval of the Final Needs Case subject to planning consent

While this document confirms our approval of the FNC for each of the Eastern HVDC projects, such an approval is conditional on, and subject to, material planning consents being obtained for each corresponding Eastern HVDC link. We expect to continue engagement with NGET, SPT and SSENT regarding the next Project Assessment stage and to monitor the progress of the delivery programme.

1. Introduction

Context

1.1. Great Britain's (GB) onshore electricity transmission network is currently planned, constructed, owned, and operated by the three transmission owners: NGET in England and Wales, SPT in the south of Scotland, and SSENT in the north of Scotland. We regulate these network companies through the RIIO (Revenue = Incentives + Innovation + Outputs) price control framework. For offshore transmission, we appoint transmission owners (OFTOs) using competitive tenders.

1.2. NGET, SPT and SSENT are currently regulated under the RIIO-ET2 price control, which took effect from 1 April 2021 and will run for 5 years. Under the NGET, SPT and SSENT's licence conditions, the LOTI mechanism allows for us to assess the need for, and efficient cost of, large and uncertain electricity transmission reinforcement projects. All projects that are submitted for assessment via LOTI during the RIIO-T2 period are to be considered for their suitability for delivery through one of the late competition models.

1.3. Network investment is informed by the Future Energy Scenarios (FES), and the NOA, which are developed and published annually by the ESO[2]. A key focus of the FES 2020 used in the analysis for the Eastern HVDC is the inclusion of the legally binding UK Government Net Zero targets, to be achieved by 2050[3]. The transition to a Net Zero economy will see increased demand on transmission boundary capability, which need to be facilitated by critical network reinforcements.

1.4. The joint project teams of NGET, SPT and SSENT submitted the Eastern HVDC INC in October 2020. We published our Decision[4] in November 2021. In that Decision we confirmed that we were satisfied that there was a clear and demonstrable consumer benefit in the Eastern HVDC projects progressing and we were satisfied that NGET, SPT and SSENT have made a clear and demonstrable case for their approach to date on the two proposed HVDC links (E2DC and E4D3) that form the Eastern HVDC project.

[2] In April 2019 National Grid ESO became a legally separate business within National Grid PLC.
[3] https://www.legislation.gov.uk/uksi/2019/1056/contents/made
[4] Eastern HVDC - Decision on the project's Initial Needs Case and initial thinking on its suitability for competition | Ofgem

Stages of our LOTI assessment

1.5. Following the approval of eligibility, the LOTI assessment process consists of three main stages:

- **Initial Needs Case (INC)** – The usual focus of our assessment at this stage is to review the technical and/or economic requirement for projects, the technical options under consideration, and the TOs' justification for taking forward its preferred option for further development.

- **Final Needs Case (FNC)** –The focus of our assessment at this stage is to confirm the need for the Eastern HVDC projects, by checking that there have been no material changes in technical and/or economic drivers that were established in the INC.

- **Project Assessment (PA)** – If the FNC is approved, the TOs will then need to apply for a Project Assessment Direction. The focus of our assessment at this stage is the assessment of the proposed costs and delivery plan that the TOs have in place for the Eastern HVDC projects, with a view to potentially specifying in the TOs' licenses a new LOTI output, a LOTI Delivery date, and setting the efficient cost allowances that can be recovered from consumers for delivery of the Eastern HVDC projects.

Final Needs Case Consultation

1.6. The joint project teams of NGET, SPT and SSENT submitted the two FNCs for the respective Eastern HVDC projects in December 2021. On 30 March 2022, we published our FNC consultation. The consultation covered three broad areas:

- Our assessment of the FNC for the Eastern HVDC projects reinforcement options

- Our updated assessment of and minded-to position on the delivery model for the Eastern HVDC projects

- Our position on any Large Project Delivery (LPD) mechanisms applying to the Eastern HVDC projects.

1.7. Eight stakeholders responded to the consultation[5]. The respondents included NGET, SPT and SSENT, the ESO, an investor[6], a generator[7], a consumer representative group and a private individual. Five responses directly answered the nine questions set out in the consultation.

1.8. The responses addressed six overarching themes:

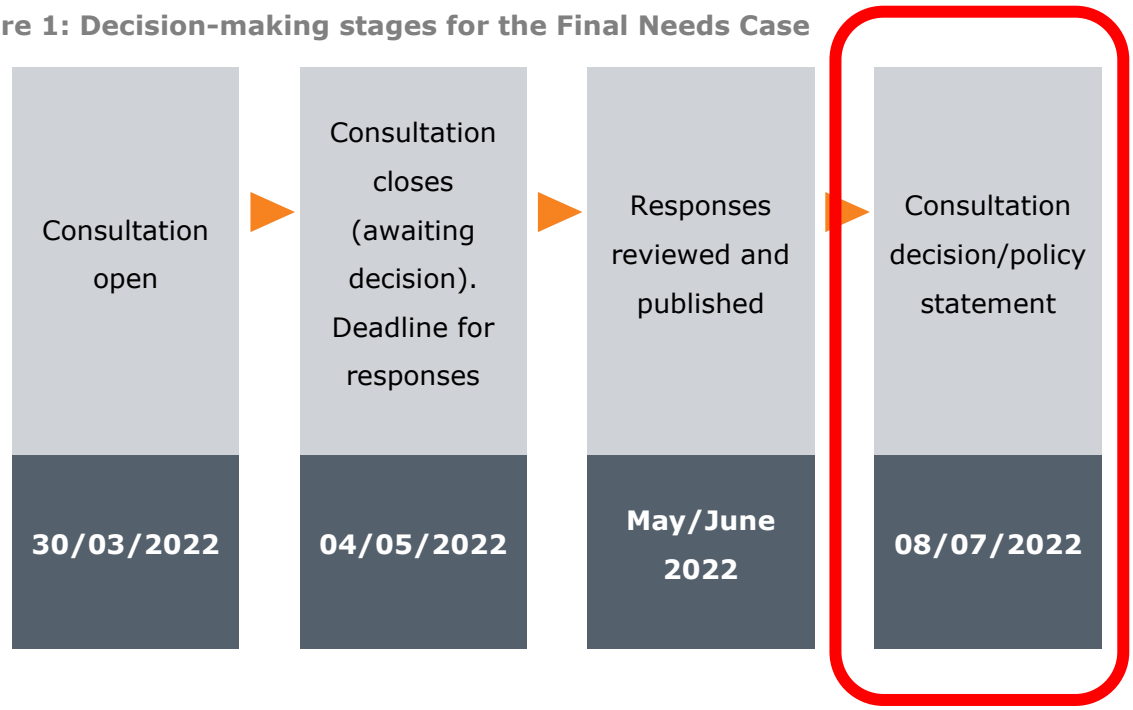
- The need for the Eastern HVDC projects
- Reinforcement options and planning consent risks
- Early construction/activity funding
- The interaction of the Eastern HVDC projects with the Holistic Network Design (HND) for the offshore network and associated onshore network
- Delivery model
- Large Project Delivery (LPD) policy/mechanism

1.9. All non-confidential responses to our consultation are published on our website alongside the decision.

[5] Eastern HVDC - Consultation on the project's Final Needs Case and Delivery Model | Ofgem
[6] The investor respondent is an independent transmission investing company
[7] The generator respondent is a renewable electricity generator

This document

Figure 1: Decision-making stages for the Final Needs Case



1.10. This document consists of five chapters and is set out as follows:

- Chapter 1: Introduction
- Chapter 2: Responses on the FNC and our views – this provides a summary of key responses to our consultation that address the FNC, discusses the main points that were raised and how we considered these in reaching our decision
- Chapter 3: Our competition model considerations
- Chapter 4: Our approach to Large Project Delivery (LPD)
- Chapter 5: Decision on the FNC and next steps

Related publications

1.11. RIIO-2 Final Determinations: [RIIO-2 Final Determinations for Transmission and Gas Distribution network companies and the Electricity System Operator | Ofgem]

1.12. LOTI Re-opener Guidance: Large Onshore Transmission Investments (LOTI) Re-opener Guidance | Ofgem

1.13. Eastern HVDC Initial Needs Case Consultation: Eastern HVDC - Consultation on the project's Initial Needs Case and initial thinking on its suitability for competition | Ofgem

1.14. Eastern HVDC Initial Needs Case Decision: Eastern HVDC - Decision on the project's Initial Needs Case and initial thinking on its suitability for competition | Ofgem

1.15. Eastern HVDC Final Needs Case Consultation: Eastern HVDC - Consultation on the project's Final Needs Case and Delivery Model | Ofgem

2. Final Needs Case and our views

Section summary

This chapter summarises the key design choices NGET, SPT and SSENT have made to date on the Eastern HVDC projects and the CBA underpinning the need for, and design of, the Eastern HVDC projects. It sets out our views on these as presented in our March 2022 consultation and summarises the key consultation responses. Finally, it sets out our decision to approve the FNC and our reasons for that decision.

Overview of NGET, SPT and SSENT's joint proposal

2.1. We assess any FNC submission(s) to: determine the progression and changes to the project since the INC; and reach a final view on whether or not the projects as proposed are needed. Through this process we assess whether the key drivers of the need for the project remain, and whether the optimum design and cost of the project has changed since the INC stage.

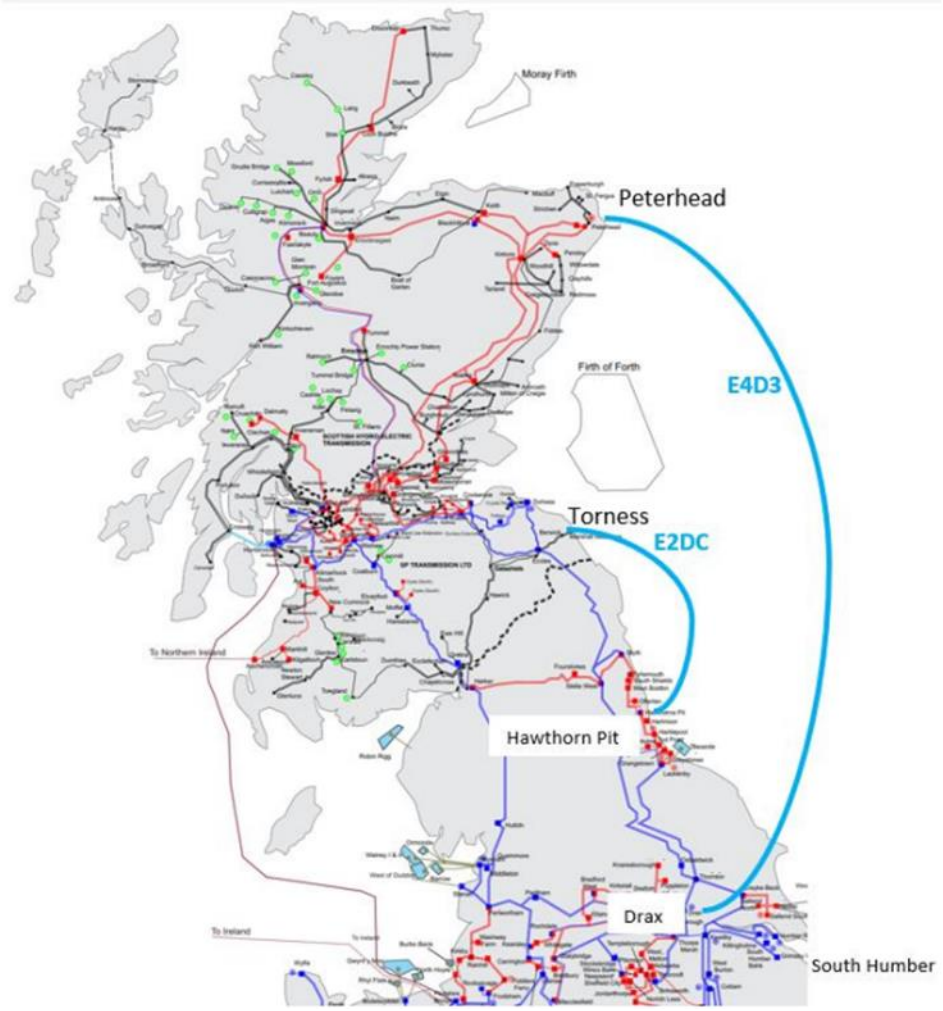
2.2. NGET, SPT and SSENT submitted two separate FNC submissions for the proposal to progress the development of two subsea HVDC links, with capacity of 2GW each, see Figure 2:

- One from Torness in Scotland to a connection point on the existing network at Hawthorn Pit in the North-East of England to be completed in 2027[8] – identified with the Network Options Assessment code E2DC and submitted by NGET and SPT; and

- One from Peterhead in North East Scotland to a connection point on the existing network at Drax in North Yorkshire to be completed in 2029 – identified with the Network Options Assessment code E4D3 and submitted by NGET and SSENT.

[8] with a 40% probability

Figure 2 - The TOs' indication of preferred schemes for Eastern HVDC projects.



2.3. The two FNC submissions are supported by a single CBA carried out by the ESO, as well as recommendations from the annual NOA process and report[9].

2.4. NGET, SPT and SSENT's analysis currently estimates the capital costs for E2DC and for E4D3 are £1,294m and £2,105m, respectively. The projects are estimated to be completed by 2027[10] and 2029, respectively.

2.5. Appendix 1 outlines the information provided in our March 2022 consultation on why the project has been brought forward, how NGET, SPT and SSENT arrived at these preferred options, and the options that were considered in the CBAs. The results of the

[9] Further information on the NOA can be found here: Network Options Assessment (NOA) | National Grid ESO
[10] with a 40% probability

CBAs are also included, along with justification for NGET, SPT and SSENT's proposed options.

Our assessment and decision on the FNC for the Eastern HVDC projects

Is Eastern HVDC necessary?

Consultation position

2.6. In the consultation we explained that we were satisfied that there is a clear consumer benefit in the Eastern HVDC projects progressing. We further explained that delaying delivery of substantial reinforcements in this area could cause a significant detriment to consumers in terms of additional constraint costs.

Consultation responses and our consideration of them

2.7. Of the eight stakeholders that responded to this consultation, five respondents agreed that the two proposed HVDC links represented the optimum means to address the network needs, one disagreed and three expressed no view.

2.8. One respondent recognised that the justification of the Eastern HVDC proposal is driven by the need to reduce constraint costs between Scotland and England. They pointed out that forecast generation is based on assumptions made under current market arrangement which they consider is leading to excess renewable generation in Scotland.

2.9. The respondent flagged that these arrangements are currently being reviewed by the UK Government and the ESO and may change to give generators stronger signals to locate elsewhere (e.g. off the shores of England and Wales). One option that is being considered is moving to "locational marginal pricing" (LMP). The respondent says that under these revised market arrangements it is not clear that the Eastern HVDC would be required.

2.10. They expressed that in contrast to the Western HVDC at the time, the Eastern HVDC projects are not necessary to provide Scotland with any additional capacity as Scottish demand can be met with the existing transmission system, and that storage could provide additional security of supply for when the wind is not blowing.

2.11. This point was a consideration in our assessment of the FNC of Eastern HVDC. We recognise that the Department for Business, Energy and Industrial Strategy (BEIS) are currently undertaking a Review of Electricity Market Arrangements. We further note that

the ESO have recently published an update on their Net Zero Market Reform programme which presents their assessment and conclusions from the third phase of their programme, including "…that nodal pricing offers superior outcomes for Value for Money, Consumer Fairness, Adaptability and Full Chain Flexibility."[11]

2.12. We are in the process of assessing the costs and benefits of implementing locational pricing in the GB wholesale electricity market, which we expect to conclude in Autumn 2022.

2.13. We recognise the possibility of introducing locational pricing (or any other reform focused on locational signals) in the wholesale electricity market having implications on future network decisions. We therefore agree in principle that any reform to wholesale market arrangements could potentially impact the needs case for proposed network upgrades.

2.14. That said, at the time of this FNC there is no indication of when any decision will be reached on the future market arrangements. If such a change is enacted in the future, it is not clear exactly what impact it will have on the future location of renewable generation, or the costs of connecting it. This makes it difficult to assess the likely impact on projects like Eastern HVDC until further analysis is undertaken as the potential changes are further considered.

2.15. In the context of this uncertainty, and in particular in the context of Eastern HVDC, while recognising the possibility of future reform to the electricity wholesale market, we consider that there is a greater and more immediate risk of consumer detriment in delaying Eastern HVDC. Based on the analysis carried out by the ESO the impact of one year delay to both projects may lead to a detriment of c. £400m, and 2 years' delay may lead to c. £800m due to constraint costs.

2.16. Furthermore, we recognise the electricity system is already subject to constraints and any reform is unlikely to impact existing generation or generation that is already in advanced stages towards connection to the system. We are satisfied that there is sufficient evidence to demonstrate that additional boundary transfer capability will be required across the border between Scotland and England ahead of 2030 regardless of changes to future wholesale market arrangements.

[11] See Phase 3: Assessment and Conclusions Publication. Net Zero market reform | National Grid ESO

2.17. We will continue to monitor the progress of any market reforms when considering future reinforcement projects that may be impacted by it.

Reinforcement options considered, technical design and costs

Consultation position

2.18. We were satisfied that NGET, SPT and SSENT's optioneering process followed a logical approach and we did not identify any options that have been inappropriately excluded from the CBA for the Eastern HVDC projects.

2.19. We considered NGET, SPT and SSENT had provided a clear account of the options considered and we were satisfied that NGET, SPT and SSENT have responded to NOA signals in a reasonable way to ensure that appropriate options could be assessed in a timely manner.

2.20. We considered the options included in the ESO's CBA for the Eastern HVDC projects were appropriate and reflect the outcome of the NOA 2020/21 analysis. We noted that one of the onshore options that appeared in the Initial Needs Case was no longer considered a stand alone alternative at the FNC. The reason not to consider the onshore alternative was that this project will be needed in addition to the other projects considered.

2.21. We were content with the approach taken by NGET, SPT and SSENT to identify options, to assess risks and benefits and their approach to mitigating the risks identified. We were content that the technical designs put forward meet the requirements of industry codes and standards (SQSS) and will support the preferred option of 2GW additional capacity as approved in the INC.

2.22. We considered that the costs provide an appropriate basis under which to robustly compare the options at this stage, while recognising that these current cost estimates remain indicative ahead of the procurement process. We reviewed the factors used to develop the cost estimates for the different shortlisted options such as the cable unit costs, base costs for converter stations and assumed overhead costs. We were satisfied that these factors have been applied in consistent manner that allows the shortlisted options to be objectively compared.

Consultation responses and our consideration of them

2.23. Four respondents agreed with the technical design and costs of the preferred options.

2.24. NGET, SPT and SSENT identified the need for clarity in relation to funding early construction activity. They said that some activity will need to take place ahead of the formal Project Assessment, hence before any funding will be secured/allowed by Ofgem. They flagged that this early activity funding will be needed to secure timely delivery and avoid delays. Specifically NGET, SPT and SSENT explained that they are not in a position to spend at risk without some form of comfort from Ofgem.

2.25. We appreciate in principle that NGET, SPT and SSENT's concerns around committing expenditure to large projects ahead of planning consents being secured. Particularly, in circumstances where planning consent is not able to be secured for projects and no mechanism exists to to recover this expenditure. We are taking account of these concerns and intend to consult during Q3 of 2022 on whether to introduce a package of potential changes to speed up the regulatory approval process for onshore transmission network investment.

2.26. One respondent stated that there may be options beyond E2DC and E4D3 which should not be discarded until planning consent has been given to develop the necessary projects.

2.27. The respondent was also concerned that local planning processes have not been completed and that, if they are not approved, Ofgem's 'conditional' decision would cause the TOs to restart the LOTI process for further options creating unnecessary delays. NGET, SSENT and SPT had concerns regarding the FNC decision and the project's planning consents. They highlighted that waiting for planning consents to be attained before making the FNC decision introduces delays and delivery risks.

2.28. We recognise that there is a possibility that planning consent may not be granted for either link. If planning consent for either or both links was not obtained, we expect, as a minimum, the TOs would need to restart certain aspects of the planning process. Our understanding is that revisiting aspects of the planning process with an updated submission could take up to 12-18 months. In such a case the TOs will have sufficient time to engage with Ofgem to update their FNC submission.

2.29. We also note that in parallel to the planning process NGET, SPT and SSENT will be engaging with potential suppliers, progressing procurement activities. Allowing additional options to be progressed is likely to add uncertainty to such activity and provide limited gain as it would not be feasible or economically efficient for the NGET, SPT and SSENT to start a tender process for additional, alternative options in case their preferred option does not received DCO approval.

Decision

2.30. We remain satisfied that NGET, SPT and SSENT have considered an appropriate range of technical options to come to the preferred options of E2DC and E4D3. They meet the industry codes and standards, and we understand that the costs are indicative. NGET, SPT and SSENT have provided sufficient justification to demonstrate that they have undertaken an adequate risk assessment and considered relevant mitigation actions to manage the risks they have identified.

2.31. We appreciate the concerns in respect to early construction/activities expenditure and their view that without it, there is a risk of delay to the Eastern HVDC projects.

2.32. At present, funding under LOTI is only approved at the Project Assessment stage, which is designed to be aligned with the procurement process for each LOTI project. It does not provide for the funding of construction activity ahead of PA for any LOTI project, including the Eastern HVDC projects.

2.33. The UK Government's recent British Energy Strategy[12], committed to "ensuring Ofgem expedites its approvals process to build networks in anticipation of major new sources of generation and demand". In this context, we will be consulting over the summer on ways to adjust the LOTI regulatory framework in ways that will support expediting progression of the projects while protecting consumers and ensuring regulatory oversight is not compromised. Our expectation is that this consultation will consider whether there is a case for providing certainty for TOs that efficient costs incurred ahead of planning approval will be able to be recovered from consumers.

Final Needs Case Assessment - Cost Benefit Analysis

Consultation position

2.34. We were satisfied that the CBA supported the need for investment on this part of the network and justifies NGET, SPT and SSENT's progression of E2DC and E4D3 as the preferred options for the reinforcement pathway for the Scotland and the North of England region. We were content that when considered as part of a wider strategy of system

[12] https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy

reinforcements E2DC and E4D3 display the highest net present value (NPV) across each Future Energy Scenarios and are the least worst regret (LWR)[13] options.

2.35. We were satisfied that the CBA demonstrates that E2DC and E4D3 are the most efficient options overall, when compared against a suitably wide range of alternative options and sensitivities. We noted that much of the relative benefit of the options is driven by the earlier Earliest in Service Date (EISD) compared to the other options, particularly when looking at E2DC. However, we were comfortable that based on the sensitivity analysis carried out (that considers delays to the EISDs of all options) both E2DC and E4D3 remain the most appropriate options.

2.36. In their respective submissions, NGET, SPT and SSENT noted that any delay in delivery of one year to the EHVDC projects would lead to additional constraint costs of up to £409m, with up to £225m for E2DC alone in the first year of delay. Given the material impact of delay to delivery, we expected NGET, SPT and SSENT to continue to progress the Eastern HVDC projects in a timely manner that will ensure that the full benefits of the projects can be realised.

Consultation responses and our consideration of them

2.37. NGET, SPT and SSENT agreed with our conclusions. One respondent was unclear as to the reasoning for delays in the EISDs for E2DC and as such did not have confidence in this solution.

2.38. One respondent highlighted their concerns over the robustness of the CBA given the level of confidence that NGET, SPT and SSENT seem to have in meeting the EISDs. The probability of meeting the EISD of 2027 for E2DC is cited by NGET, SPT and SSENT as being 40%, with the probability of delivering the project by February 2028 referenced as being 50%. The probability of delivery by July 2028 is referenced as being 80%. In this context, without sight of the probabilities associated with the alternative options, the respondent felt it was difficult to be fully comfortable that the optimum solution was being taken forward.

[13] LWR is a decision-making tool that makes recommendations based on which options/strategy produce the least 'regret' across all analysed scenarios.

2.39. The probability of delivering the projects to certain timescales was based on modelling exercise which took into account a range of risks such as seabed condition, planning consent and manufacturing issues.

2.40. We note that the E2DC link has had a EISD of 2027 in the NOA since 2018. It has been assessed in the NOA, and the CBA carried out at the INC based on this delivery date. Our FNC assessment is based on the project being delivered by the EISD. At this point, and with the current available evidence, we do not expect the delivery date of Eastern HVDC to deviate from the EISD.

2.41. We expect NGET, SPT and SSENT to finalise the delivery date at the Project Assessment stage and include supporting evidence. We will continue to engage with NGET, SPT and SSENT and to monitor the delivery programme for E2DC and E4D3 given the associated costs.

2.42. One respondent highlighted that the operational and maintenance costs were not included in the ESO's CBA that was submitted with the FNC and that they may impact the value assessment, resulting in a less accurate representation of the value the project would provide to the energy system than if these costs had also been included.

2.43. In the FNC submissions, operational costs were included as sensitivities for the CBA scope. When assessing the transmission links options, the option cost estimates excluded operation and maintenance costs as NGET, SPT and SSENT outlined that they were unlikely to be significantly different between the options. For both projects, they are considered for the shortlist of options post-optioneering to provide more details on the actual costs of the project, including operational costs.

2.44. We do not consider that including operational and maintenance costs in the CBA, would lead to a different outcome. We are comfortable with this approach. The options that were considered[14] in the CBA were of similar basic design: offshore HVDC subsea cables with a capacity of 2GW which included converter stations on both sides of the cables. The difference between the options related mainly to the landing point and length of offshore

[14] Note that one onshore option (which may be the single option with very different O&M costs) was included in the CBA at the INC stage has now been removed from the CBA as it is no longer considered an alternative. The NOA 2019/20 and NOA 2020/21 flagged the onshore option is needed on top of the offshore links and hence can no longer be considered as a stand alone alternative to the offshore links.

cable and onshore cable, with limited differences in onshore connection point to the AC system.

Wider Network Reinforcements - Offshore Transmission Network Review

Consultation position

2.45. We recognised how the Eastern HVDC projects might interact with the Offshore Transmission Network Review (OTNR), particularly the Holistic Network Design (HND). While we did not consider future offshore network co-ordination would have a material impact on the consumer benefit and the need case for the two links covered by the Eastern HVDC projects, we considered it prudent to check whether any alternative route options or material changes are recommended to E2DC or E4D3 due to the HND before making our FNC decisions.

Consultation responses and our consideration of them

2.46. One stakeholder agreed that considering these projects in the context of wider network reinforcements is appropriate. The generator agreed with our consultation view that "there is no reason to think that future offshore network co-ordination will have a material impact on the consumer benefit case for the TOs". NGET, SPT and SSENT largely agreed that the HND was unlikely to impact these projects.

2.47. In their consultation responses, NGET, SPT and SSENT raised concerns as to our decision to wait for the HND outcome before deciding on the FNC. NGET and SSENT noted that the HND would not change the proposed cable routes and our FNC Decision should not be linked to the HND decision.

2.48. We considered the responses and engaged with the ESO to further develop our understanding potential impact of the HND on Eastern HVDC. We are content that the Eastern HVDC will be needed regardless of the HND results, and based on the draft HND which was made available to us we are satisfied that there is not expected to be any effect on the Eastern HVDC design as a result of the HND.

Final Needs Case Decision: need and optioneering

2.49. We remain satisfied that the FNC demonstrates that the Eastern HVDC projects are necessary and will deliver significant benefits for consumers by allowing additional renewable generation to connect to the network and reduce constraint costs. The technical

options considered are clear and demonstrable and the CBAs are robust. Combined, it appears the TOs have appropriately come to the preferred options of E2DC and E4D3.

2.50. In our consultation we said that we will consider providing a FNC decision for the Eastern HVDC projects that is conditional on NGET, SPT and SSENT obtaining the necessary planning consents for Eastern HVDC.

2.51. We did not consider that it would be appropriate for a unconditional FNC decision to be made prior to the outcome of the planning consent process, which is conducted by different parties under a different legislative framework and is entirely separate to the regulatory approval process.

2.52. We maintain this view. Our FNC decision is conditional and subject to planning consent being obtained for the Eastern HVDC.

2.53. We are satisfied that making a conditional FNC decision, in the case of Eastern HVDC, is in the interests of consumers. We are satisfied that there is a need to mitigate as far as practical any delays to the delivery of Eastern HVDC and to provide sufficient certainty that they need in order to progress both links at this stage.

2.54. The next two chapters will cover our view on delivery model and LPD.

3. Delivery model considerations

Section summary

This section summarises our assessment of whether the Eastern HVDC projects meet the criteria for competition and whether to apply a late competition model. It sets out our views as presented in our March 2022 consultation and summarises the key responses to that consultation. Finally, it sets out our decision to retain the Eastern HVDC projects within the LOTI mechanism as part of the RIIO-ET2 framework.

Background

3.1. Competition in the design and delivery of energy networks is a central aspect of RIIO-ET2. Competition has a key role to play in driving innovative solutions and efficient delivery that can help meet the decarbonisation targets at the lowest cost to consumers. All projects that meet the criteria for competition and are brought forward under an uncertainty mechanism will be considered for potential delivery through a late competition model.

Our consultation on competition models

Consultation position

3.2. In line with our assessment at the Initial Needs Case stage, we concluded that the Eastern HVDC projects met the criteria for late model competition.

3.3. We explained that we could not reasonably envisage implementing either the Competitively Appointed Transmission Owner (CATO) model or Special Purpose Vehicle (SPV) model for Eastern HVDC without causing the delay of such critical investments. Our view was that given the indicative results of the CPM analysis, we were inclined to retain the E2DC and E4D3 links within the LOTI mechanism within the RIIO-2 framework.

Consultation responses and our consideration of them

3.4. We note that NGET, SPT and SSENT, the generator and consumer representative group were all in agreement with our decision to keep the Eastern HVDC projects under RIIO. NGET, SPT and SSENT agreed that the CATO model or the SPV model would not be appropriate for Eastern HVDC.

3.5. We note one respondent would like the SPV model to be applied. This would be in lieu of the Future System Operator and onshore competition, which the respondent considered the SPV model would address the industry's conflicts of interest. They stated that should the the SPV model be applied consumers could enjoy over £600 million of benefits, which they have based on Ofgem's Impact Assessment estimation of 18.7% savings.

3.6. We agree that potential benefits to delivering this model through a competition model exist. However, we must balance any potential benefits against any increased risk of significant delays and delay costs. As set out in the NGET, SPT and SSENT FNCs, Eastern HVDC's forecast annual constraint costs are c. £225m for E2DC in its first year of delay and c. £184m for E4D3 in its first year of delay. We consider that there remains insufficient evidence to demonstrate that the application of a competition model for Eastern HVDC would be in the interests of consumers.

3.7. The stakeholder that disagreed is of the belief that there is no physical need for these projects and that they are not in the best interest of consumers. We addressed this point in Chapter 2.

Decision

3.8. We maintain our position to keep the Eastern HVDC links with the LOTI mechanism as part of the RIIO-2 framework. We cannot envisage implementing the CATO model or the SPV model for Eastern HVDC.

4. Large project delivery

Section summary

This section sets out a summary of our decision to apply a reprofiling and Project Delay Charge to the Eastern HVDC projects.

Background

4.1. In our RIIO-2 Final Determinations[15] we set out our approach to late delivery of large projects (>£100m) by TOs. We said that we will ensure TOs will not benefit from delay to delivery of those projects by using one of the following options:

i. If a project is delivered late, we will re-profile the allowances to reflect actual expenditure to avoid the network company benefitting from the time value of money; or

ii. Milestone-Based Approach – we will set project allowances based on the delivery of specific, pre-agreed, milestones. The allowances would only be granted following confirmation that a milestone had been delivered.

4.2. We also said that we will ensure consumers are protected from delay in delivery. We said we may therefore set a pre-agreed Project Delay Charge (PDC) for each day a project is delivered late.

Our consultation on large project delivery

Consultation position

4.3. To address the possibility of NGET, SPT and SSENT benefiting financially from any delay in delivery of the Eastern HVDC projects our preferred option in the case of a delay is to re-profile the allowances rather than using milestone approach to reflect actual expenditure to avoid the network companies benefitting from the time value of money.

[15] RIIO-2 Final Determinations for Transmission and Gas Distribution network companies and the Electricity System Operator | Ofgem, ET Annex (REVISED), page 32 onwards

4.4. We stated in our consultation that our current view is that there is a clear need to set a PDCs for the respective Eastern HVDC projects to protect the interests of existing and future consumers.

Consultation responses and our consideration of them

4.5. Four respondents, including NGET, SPT and SSENT, agreed that reprofiling is an appropriate mechanism for the Eastern HVDC projects as it would reflect the actual expenditure. NGET agreed that the milestone-based approach would not be appropriate for these projects.

4.6. Five respondents disagreed to some extent to our approach to Project Delay Charge (PDC).

4.7. NGET, SPT and SSENT were all in agreement that there should be incentives for the timely delivery of projects but have expressed concerns in relation to the justification, design and application of a PDC, including:

- whether a PDC would achieve a clear incentive for the TOs to encourage timely delivery of LOTI projects;
- the risk of PDC deterring innovation; and
- the need for clarity before Project Assessment on the level of PDC ahead of the TOs engagement with suppliers.

4.8. One respondent was in support of a PDC that incentivises delivery of the projects. They did not support a PDC that is linked to the actual value/impact of delay due to concerns that this would lead to increased risk for network company investments which may create additional costs for the consumer. They stated that the charge should instead be set at a lower level that will still incentivise prompt delivery.

4.9. We consider that a PDC for the Eastern HVDC links is justified.

4.10. In the context of the significance of the consumer detriment in a delay to Eastern HVDC, the strategic importance of the Eastern HVDC links and the industry and government focus on ensuring that key infrastructure that allows us to meet Net Zero, we consider that setting a PDC remains critically important to protect consumers in case of delay.

4.11. We recognise the importance of ensuring that the PDC arrangements reflect an appropriate balance of risk between consumers and the developing TOs that is in line with the wider LOTI and RIIO arrangements.

Decision

4.12. We remain of the view that it is appropriate to apply reprofiling and a PDC is justified these projects.

4.13. Following further engagement with NGET, SPT and SSENT, we recognise the importance of ongoing engagement with the companies on the level and calibration of PDC. We will continue to do this up until Project Assessment.

4.14. The PDC will be finalised following consultation as part of our Project Assessment.

5. Final Decision on the Final Needs Case and next steps

Section summary

This section sets out assessment of the condition for final approval of the LOTI FNC for the Eastern HVDC projects, subject to planning consent and confirms whether the condition has been met. This section also confirms next steps.

Final approval

5.1. We are satisfied that the FNCs for the Eastern HVDC projects have been made and through appropriate technical consideration and CBAs, NGET, SPT and SSENT have come to the preferred options of E2DC and E4D3.

5.2. We confirm that Eastern HVDC is to be delivered by NGET, SPT and SSENT through LOTI under RIIO as set out in Chapter 3.

5.3. We confirm reprofiling and a PDC will be applied to the Eastern HVDC. The arrangements for a PDC will be finalised following the Project Assessment consultation.

Next steps

5.4. We will confirm our FNC decision once the relevant planning consents for E2DC and E4D3 are confirmed. Our understanding from the FNC submissions is that the TOs expect planning consents for the Eastern HVDC projects to be approved in Q1 2023.

5.5. We expect the Project Assessment for E2DC to be submitted early 2023. We expect the Project Assessment for E4D3 to be submitted in Q2 2023.

5.6. We will continue to engage with NGET, SPT and SSENT regarding Eastern HVDC on early construction funding, Project Delay Charges and the Project Assessment.

6. Appendices

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Appendix 1 – The TOs' justification of the Eastern HVDC links' needs cases

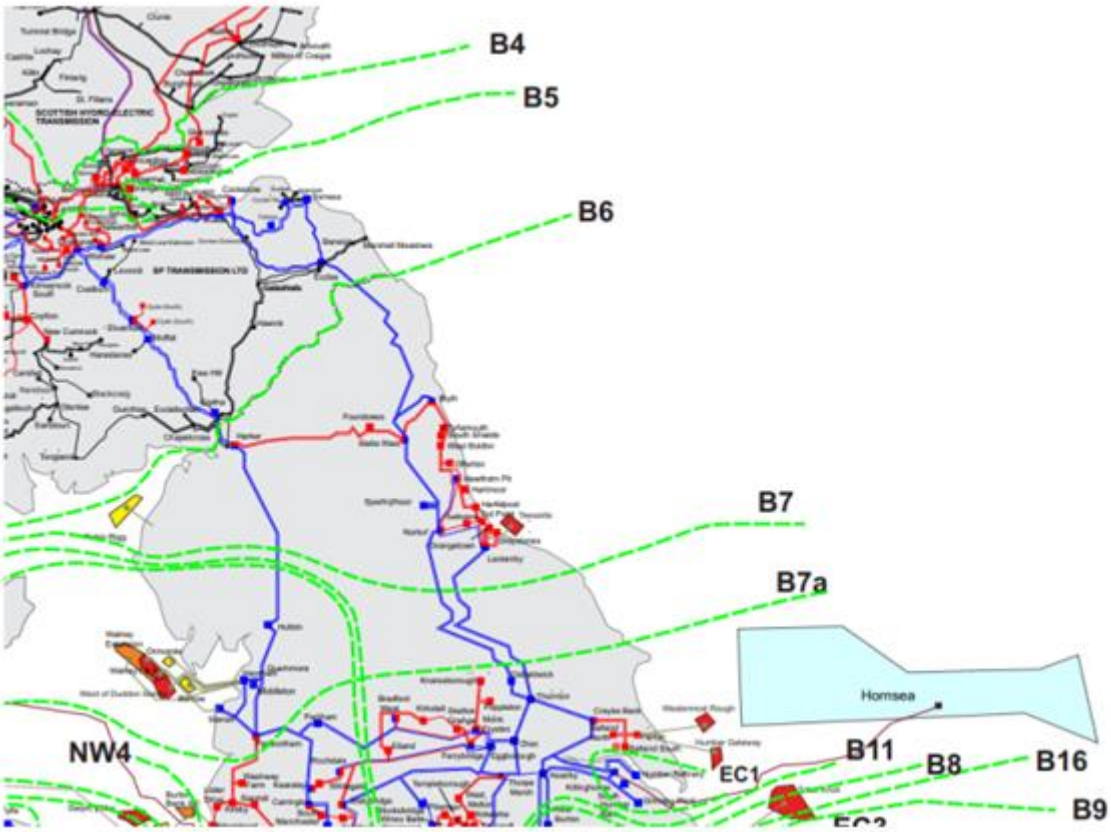
Why the projects have been brought forward

6.1. As identified in our Initial Needs Case Decision, a significant growth in renewable and low carbon electricity is expected in Scotland and along the North-East coast of England, including an expansion in offshore wind in line with net zero targets. Analysis from the ESO forecasts that unless the electricity transmission network is upgraded, we should expect significant constraints across the network, and in particular across the Scottish-English border throughout the next decade. Constraints on the network would lead to the ESO making constraint payments to generators that need to be switched off. The cost of this would ultimately feed into consumer bills[16].

6.2. The ESO's annual NOA process, has consistently shown the need for investment across multiple northern transmission boundaries of the GB network. Specifically, this analysis shows that the current capability of network boundaries B6, B7, B7a and B8 are unlikely to be sufficient to accommodate the future network requirements as forecasted by the ESO. As can be seen in Figure 3 below, Boundary B6 runs along the England Scotland border which delineates the NGET area from the SPT area to the north of it. Boundary B4 delineates the SPT areas from the SSENT area.

[16] More information can be found in ESOs modelled constraint costs: download (nationalgrideso.com)

Figure 3: GB Transmission System Boundaries B4 - B9 (from ETYS 2020)



6.3. NGET, SPT and SSENT put forward possible solutions to relieve constraints on the effected boundaries and reduce consequential constraint costs; to be compared within the ESO's NOA process (the NOA being designed to give an indicative view of necessary investments across the network). The NOA compares investment options through a CBA and makes recommendations on options to progress further, to pause, or to stop based on assessment against estimates of future supply and demand across a range of Future Energy Scenarios. In the case of those proposed investments that we have deemed to be eligible as a LOTI project, these projects are subject to further comparative CBA by the ESO in support of NGET, SPT and SSENT's LOTI submission to us. The CBA conducted by the ESO is able to consider options in a greater level of detail, including in terms of route location and timing, and local wider supply and demand forecasts and trends.

6.4. Boundary capability changes over time as the network, generation and demand change. Expected further reinforcement needs can be identified by comparing required power transfers with boundary capability. In the case of Eastern HVDC projects, the requirement for increased boundary capability is consistent across B2, B4, B5, B6, B7a and B8. The required transfers across all four Future Energy Scenarios (both Future Energy

Scenarios 2020 and Future Energy Scenarios 2021)[17] significantly exceed current capability, continuing to indicate a strong need for transmission reinforcement.

6.5. NGET, SPT and SSENT highlight through the FNC submissions that they consider the need for increased north to south transfer capability across key network boundaries in Scotland and the north of England is further sustained by the continued customer connection activity since the Initial Needs Case submission and the uptrend in Future Energy Scenarios 2021 when compared to Future Energy Scenarios 2017 (used in the Initial Needs Case submission).

6.6. NGET, SPT and SSENT note there are a number of onshore network reinforcement options being progressed that increase boundary capability in the short term. However, NGET, SPT and SSENT are clear that it is only major system reinforcements (i.e. the Eastern HVDC projects) that can provide the magnitude of uplift being indicated by the required transfers.

Reinforcement options considered

6.7. NGET, SPT and SSENT have considered a range of options to address the system requirements set out above. An initial list of 210 conceptual options were identified which intended to provide opportunities to provide an increase in boundary transfer capabilities over B6, B7, B7a and B8, before narrowing down a shortlist of 32 options for further scoping and progression to assessment via a CBA. Further detail on the options assessed at the Initial Needs Case can be found in our Initial Needs Case Consultation.[18]

6.8. Following the Initial Needs Case assessment, the onshore alternative to E2DC crossing B6, the Torness to Lackenby 400KV overhead line (NOA code, TLNO) is no longer considered an alternative standalone option to the offshore links. The NOA process, and ESO's CBA for the Eastern HVDC projects at Initial Needs Case stage established that a larger reinforcement[19] is required d earlier than can be achieved through an onshore

[17] The FES scenarios are updated annually each summer. This allows the most up to date FES to be used for the following NOA, which is published each January. Further information on the NOA and FES can be found here: Network Options Assessment (NOA) | National Grid ESO
[18] Paragraphs 3.7-3.12 Eastern HVDC - Consultation on the project's Initial Needs Case and initial thinking on its suitability for competition | Ofgem
[19] The onshore reinforcement from south east Scotland to north west England identified with the NOA code CMNC was recommended to proceed in NOA2020/21 over the TLNO alternative. CMNC has been included in the post-link package, within the LOTI CBA. Further detail on the LOTI CBA is set out in Chapter 4 of the consultation.

overhead line option. TLNO is therefore no longer included in the options taken forward to the ESO's CBA for the Eastern HVDC projects at FNC shown in Table

Table 1: Options considered within the FNC CBA

NOA Code	Option	Onshore/Offshore	EISD	Cost (19/20 prices)
E2DC	Torness to Hawthorn Pit	Offshore	2027	£1,294m
E2D2	Torness to Cottam	Offshore	2030	£2,300m
E2D3	Torness to Drax	Offshore	2029	£1,979m
E4DC	Peterhead to Hawthorn Pit	Offshore	2029	£1,687m
E4D2	Peterhead to Cottam	Offshore	2031	£2,528m
E4D3	Peterhead to Drax	Offshore	2029	£2,105m

6.9. Following the Initial Needs Case assessment, the NOA 2020/21 included and recommended a 'proceed' signal for a third and fourth 2GW HVDC link from Scotland to south of the Humber in the NGET licence area, both with an Earliest In Service Date of 2031 (these are identified with the NOA code E4L5 and TGDC). NOA 2020/21 also recommended that several network investment options across the B6, B7a and B8 boundaries also proceed for delivery in the early 2030s. These options have been considered in the ESO's CBA for Eastern HVDC projects,

Delivery programme

6.10. The delivery programmes for each of the reinforcement options have been coordinated across NGET, SPT and SSENT to produce the Earliest In Service Dates set out in Table 1, above. These are based on the scope of the reinforcement, procurement methods, consent requirements and delivery timescales based on NGET, SPT and SSENT's experience and construction and commissioning timelines.

6.11. As set out at the Initial Needs Case assessment, a key consideration for the Eastern HVDC projects is the trade-off between the benefits of links landing further south on the network, versus the consumer detriment of delays.[20]

[20] Further information is set out in Chapter 3 of our INC consultation: Eastern HVDC - Consultation on the project's Initial Needs Case and initial thinking on its suitability for competition | Ofgem

6.12. The FNC submission for E2DC highlights that the approach to Risk Management has continued to develop following the Initial Needs Case assessment and development of the project. The FNC submission includes a high level overview of the processes, methodology and approach for management of risks.

6.13. NGET and SPT have carried out a risk assessment exercise on the high-level programme for E2DC. The purpose of this is to give an indicative view of the likelihood of achieving the Earliest In Service Date (2027).

6.14. Although indicative at this stage, the outcome of this analysis suggests the probability of achieving the Earliest In Service Date of 2027 is approximately 40%, rising to 50% in February 2028 and 80% in July 2028.

6.15. NGET, SPT and SSENT have confirmed that based on an Earliest In Service Date for E2DC of December 2027 and delay analysis carried out by the ESO (further detail on which is set out in Chapter 3) a delay to February 2028 (2 months) would lead to additional constraint costs of between £17.2m and £37.5m, and a delay to July 2028 (7 months) would lead to additional constraint costs of between £60.1m and £131.3m.

Technical Design

6.16. We have reviewed the technical design of E4D3 and E2DC.

6.17. NGET, SPT and SSENT have confirmed they have engaged with a range of suppliers and reviewed a number of HVDC technologies that are expected to enable capacity of 2GW on each of the links. They assessed options for cables, converters, and optimal configurations. Following engagement with suppliers, technical, operational and economic review, as well as risk assessment of readiness of technology and review of experience so far, NGET, SPT and SSENT's recommended design included:

- Cross-linked polyethylene (XLPE) cables – with a fall back option of Mass Impregnated (MI) cables in case +525kv XLPE cables will not be available at the stage of procurement. Other cables that were considered included Paper Polypropylene Laminated (PPL) and High Performance Thermoplastic Elastomer (HPTE)

- Voltage Source converter (VSC) technology instead of Line Commutated Converter (LCC),

- Rigid bi-pole configuration without metal return and overall outage of +-525kV. Alternative configurations were not recommended due to higher cost and/or more operational risk.

Costs

6.18. As set out in Table 1, NGET, SPT and SSENT's currently estimated capital costs for E4D3 and for E2DC are £2,105m and £1,294m, respectively. The costs for each of the options set out in Table 1 are unchanged from those included in the Initial Needs Case assessment.

6.19. The cost estimates for the options considered in the ESO's CBA for the Eastern HVDC projects are based on development and capital expenditure only. Operation and maintenance costs are excluded within National Grid's CBA for the Eastern HVDC projects. NGET, SPT and SSENT have highlighted they do not consider operation and maintenance costs are likely to be significantly different between competing options and these costs are therefore not considered for the options listed in Table 1.

6.20. Any estimates for non-tendered elements were developed based on historic project data. The spend profile for all of the options considered is based on those of similar projects such as Western HVDC, Shetland HVDC and Caithness-Moray HVDC.