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Dear Cher-Rae, Viljami,

Revised Minded-to Decision and Further Consultation on Pathway to 2030

Thank you for further opportunity to respond to the Ofgem's minded-to decision on the Pathway to 2030 (PT2030). **It is our view that the only way to deliver the Holistic Network Design (HND) in a timely and cost-effective manner is with a Transmission Operation (TO) led delivery model for all non-radial offshore infrastructure.**

At SSEN Transmission¹ we are committed to delivering a network for net zero. We are therefore fully aligned with the objectives of the PT2030 workstream and will do our part to support the connection 50GW by the early 2030s, a crucial step in delivering a decarbonised energy system by 2035. It is to achieve these outcomes that we have continued to review the proposed delivery model (DM).

We now have additional detail behind the HND designs, revealing much more of the complexity in the necessary design, the development process, and the requirement for robust industry regulations and codes. The successful delivery and operation of these systems will require world-first in terms of their technical complexity; a mix of HVAC and HVDC as well as being offshore with large offshore windfarm connections.

Delivery model consultations to date have assumed that developers can provide design and development solutions. While developers and new entrants are able to design and deliver point to point radial connections, there is no evidence that they also have the capability to design and develop integrated offshore HVDC and HVAC systems.

Since publication of the asset classification decision in October 2022, we have been working hard to scrutinise the HND and undertake initial detailed network design (DND) activities for those assets that have been designated for TO delivery. As far as we are aware, we are the only industry group advancing the detailed network design and preparing for early 2030 delivery.

Our work has identified that the timely and cost-effective delivery of the HND is only achievable through effective coordination between non-radial transmission infrastructure. This has led us to conclude that HND is at risk with the current delivery model proposals, and that TO delivery model is the only way to realise a timely and cost-effective HND. We set our thinking in the accompanying Annexes and summarised below.

¹ We are SSEN Transmission, the trading name for Scottish Hydro Electric Transmission. Following a minority stake sale which completed in November 2022, we are now owned 75% by SSE plc and 25% by Ontario Teachers' Pension Plan Board.

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- **A TO delivery model ensures maximum coordination throughout project execution.** Current delivery proposals for non-radial offshore transmission assets will create significant logistical challenges for the coordinated delivery of the HND. They create uncertainty as to delivery partners at each stage of project execution, stifling our ability to jointly make progress. They also risk fragmenting the offshore network amongst multiple delivery partners, for which cooperation frameworks will need to be established and which adds complexity. The impact is further delay and the risk of inefficient outcomes.
- **A TO delivery model is the only way to resolve complex technical challenges.** The HND is a complex network of interacting AC and DC network elements. This leads to complex technical challenges throughout execution and operation. Fragmented network ownerships may lead to multi-vendor solutions for different network elements, which means that multi-vendor multi-terminal HVDC interoperability technology solutions where those elements interact at offshore hubs. This technology is not currently proven meaning that this solution is not feasible within HND timeframes. A TO delivery model mitigates these issues by enabling a single-client and the option of single-vendor solution.
- **The TOs have demonstrated competencies and experience to design, deliver and operate the offshore grid.** Fundamentally the HND is part of an integrated transmission network, not dissimilar in function or design to that onshore. Planning, developing, maintaining, and operating a network is what the TOs already do successfully onshore. In comparison current proposals risk bringing in untested and un-experiences new entrants into the market, with cost and timing implications throughout project execution and operation.
- **There is already a fit for-purpose regulatory model onshore, that could work offshore.** Current proposals require further regulatory policy, licence, codes and process development, which will take time and maintains an element of uncertainty which could add delay to project progression. In comparison, the rules, frameworks, and codes that guide how the TOs operate, and how we interact with other parts of the network, are already in place. A TO delivery model offshore therefore limits the need for time and resource intensive regulatory intervention.

Therefore, a single owner and operator represents the best chance to deliver a technically challenging and time-sensitive design, avoid significant risks introduced by multiple parties attempting to collaborate and unlocks opportunity to rationalise the system design and, therefore, cost.

Please find our answers to the individual consultation questions in Annex 1 below, our delivery model analysis that has led us towards our position in Annexe 2, and a case study bring to life the implications of different delivery models in Annexe 3. We consider this an important decision, with direct implications on the deliverability of the HND. We would therefore welcome the opportunity to meet with you to further discuss our thinking and work done to date.

Yours sincerely,

Andrew Ferrimore & Josh Henderson
SSEN Transmission

Annexe 1 – Consultation questions

Question 1: Do you support the introduction of a late competition OFTO build model for non-radial offshore transmission assets?

We do not support the introduction of a late competition OFTO build model (DM7) for non-radial offshore transmission. Similarly, we do not support any model which relies on developers to create a detailed network design which will integrate with the Onshore grid, or relies on competition at any point within the project execution. As a TO we have significant experience of planning, designing, and developing networks – and that is what the HND is, an offshore network. Each element of the network interacts and influences other elements; no element of that network can therefore be defined and developed in isolation of the others. This means fragmenting the offshore grid amongst different delivery partners, creates significant uncertainty as to how that process will progress, and a material risk to HND delivery.

Furthermore, DM7 introduces a competitive process into the delivery of some elements of the integrated offshore grid. As per our previous engagement with Ofgem through the ASTI process, introducing a competitive element ahead of delivery is fundamentally inconsistent with delivery at pace. As part of our ASTI delivery plan submission in September 2022 we set out the state of the supply chain, and what we are being told directly by vendors is that we need to get in the queue now with an attractive proposition to compete in a globally competitive market. The current delivery models' proposals are not consistent with that feedback.

We have been proactively undertaking detailed network design activities on those HND assets classified as onshore transmission. Our work to date has highlighted the importance of coordination throughout the DND and asset delivery, and technical challenges associated with the delivery of the HND. We have reviewed the implications of the proposed delivery models in light of that analysis and set out our detailed thoughts in Annexe 2 of this submission, alongside a case study bringing that thinking alive at the R4_1 offshore hub.

Our previous PT2030 consultation responses

Since the start of this workstream we have encouraged the application of a principle-based approach to finding the best solution for the delivery of the HND. These were set out in our response of 22 September 2021 to assess whether the proposed delivery model:

- 1) accelerates delivery of 2030 and Net Zero targets.
- 2) enables coordination and collaboration; and,
- 3) provides certainty to consumers, stakeholders (including offshore wind developers and onshore TOs) and the supply chain.

Informed by these principles, our response set out the benefit of using the existing competencies and experience of TOs. With the aspiration of achieving delivery by 2030, we highlighted the value of drawing upon the TO's experience of delivering networks through the onshore regime, in particular through the planning, developing, operating and maintaining of an efficient, coordinated and economic network. At a fundamental level the HND represents a part of an integrated transmission network, while it is located offshore it is similar in function and design to that onshore.

Following Ofgem's minded-to decision on delivery models for non-radial offshore transmission assets, our response of 15 July 2022 continued to note that TO-delivery (DM1) should remain under consideration, especially for any longer-term delivery of offshore infrastructure. While we explained that the benefits of DM1 were not properly represented, we accepted that the use of a very-late competition developer-build and OFTO-operate model (DM6) could be a pragmatic option from the perspective of drawing on a known and functional regime in order to minimise delay through further regulatory policy development.

Developments since the last consultation

The revised minded-to position to which we are now responding proposes a late-competition developer-design and OFTO-build model (DM7) for non-radial offshore transmission alongside DM6. We are concerned that it creates uncertainty in delivery parties, which is essential for the coordinated delivery of the HND which the delivery model was intended to achieve.

We accept that regulatory policy on the delivery of the HND through the PT2030 workstream is evolving. It is right, therefore that we revisit our positions as regulatory decisions emerge and we have more information at our disposal. Prior to the HND asset classification decision, our positions on delivery models were without the context of exactly where those delivery models would apply. Ofgem's asset classification decision in October provided some welcome certainty on regulatory and technical classifications of assets within the HND, but left remaining uncertainty on delivery models, roles, responsibilities, and specific delivery partners.

Since the asset classification decision, we have been proactively undertaking initial DND activities on those assets that were classified as onshore transmission for TO-delivery. To date this has included scrutiny of the ESO's design assumptions and outcomes, and early optioneering on infrastructure requirements at hub locations. This analysis has highlighted the complexity of infrastructure design required to deliver the HND, in particular at hub locations where different asset types, and therefore delivery bodies, interact. The revised minded-to proposals create significant interface risk at these hubs, stemming from logistical and technical implications of fragmenting the offshore grid amongst several delivery partners.

Our work to date has emphasised the importance of coordination in delivering a timely and cost-effective HND. We believe that this is best achieved with a TO-build delivery model for all offshore grid infrastructure.

In response to Ofgem's previous minded-to position and proposal for a very late competition generator-build model (DM6) for the PT2030 workstream, and based upon what we knew at that time, we noted this was a pragmatic choice for connecting offshore wind by 2030. On the face of it, the revised minded-to decision to also include the option of a late competition OFTO-build model (DM7) provides similar continuity with the OFTO framework, whilst also responding to feedback regarding the challenges of developer cooperation.

Based on our latest assessment, however, we are concerned that DM7 compromises effective coordination, and 2030 delivery, because of the reliance on the identification of a coordinating party, whether this is a developer or an OFTO. The DMs reliant on future identification of developers or OFTOs as expected coordinating parties will not deliver connections by, or near, 2030 since there is still the need to identify and select a lead developer through a process that does not yet exist. This is on top of our previous concerns about the same parties having the competencies for detailed design work. We therefore do not support the introduction of a late competition OFTO-build model for non-radial offshore transmission assets.

Since the asset classification decision, we have been proactively undertaking initial DND activities on those assets that were classified as onshore transmission for TO-delivery. As set out above, this activity has highlighted the complexity of infrastructure design required to deliver the HND. We have therefore begun initial engagement with the supply chain to gain specialist technical insight into our optioneering process from the feasibility and deliverability perspectives. The good news is there that our engagement suggests there are no show stoppers if the right approach is undertaken, but the task at hand is staggering in both scale and complexity, and is likely to require early engagement and commitment in face of high global demand. This has material impacts on delivery models and approaches, as we set out throughout the remainder of this question.

Given that complexity, it is our view that coordination is best achieved through a single delivery body for co-ordinated offshore grid infrastructure. Consistent with our previous consultation response, we believe the TOs have the relevant competence to plan, deliver, operate, and maintain an offshore network – including non-radial offshore transmission. Given that we are already undertaking DND on the onshore transmission assets, it is crucial that this decision is made soon.

Similar conclusions to our own were recently reached by ENTSO-E when assessing roles and responsibilities for future offshore systems². Our European neighbours face similar challenges to those in GB, with offshore wind energy expected to be a key contributor to the objectives of the EU Green Deal. The position paper highlights that the European Commission's RES strategy "*anticipates the integration of 300 GW offshore wind generation capacity into the energy system by 2050*". Looking at a range of delivery models ENTSO-E conclude that the onshore Transmission System Operator (TSO) model "*offers the greatest certainty, especially regarding efficient development and operation and the fit to the regulatory and legal framework*". Clearly, we recognise that there are differences between incumbent delivery models in different jurisdictions however we consider that the principles of a single delivery body and implementation of a known framework stand.

Delivery of HND depends on coordination between all non-radial transmission infrastructure

One of Ofgem's stated objectives of the OTNR Pathway to 2030 workstream is:

*"to ensure that all network infrastructure (both onshore and offshore) which is necessary to connect projects in scope of this workstream is designed in a coordinated manner with an optimum engineering solution that at the same time considers the economic, environmental and community impacts."*³

We continue to support this objective and are of the view that it can only be realised by TO delivery model for all non-radial transmission assets. Our initial DND activities to date include scrutiny of the ESO's design assumptions and outcomes, and early optioneering on infrastructure requirements at hub locations. The results of our analysis further highlight the criticality of coordination in delivering the HND in a timely and cost-effective manner.

We do not think that the use of DM6 and DM7 are consistent with this objective. In the Annexe to this response, we set out in detail the implications of current proposals for non-radial offshore transmission delivery models from the perspectives of HND deliverability. We look at this from the perspective of the logistical, delivery, technical, and regulatory considerations. We conclude that a TO delivery model is the only way of delivering the HND in timeframes that are close to those expected of the HND.

Question 2: Do you support the extension of AI policy to the projects in scope of the PT2030 workstream?

Subject to our response to Q1, we agree with extending the existing use of Anticipatory Investment from the Early Opportunities workstream. The same advantage appears to be pursued in that later users would benefit by avoiding any delay or delivery risks as well as assisting with the financial risk for developers too.

Our concern with the previous minded-to position was that it only went so far as to refer to anecdotal suggestions that developers were willing to undertake the desired coordinated approach. It's unclear whether further introducing Anticipatory Investment is in direct response to an appeal being made by developers that it will sufficiently incentivise undertaking a coordinated approach. If not, there remains the concern about developers not yet demonstrating the needed experience with complex and shared use infrastructure. Without this, developments could deviate from the current, and needed, design principles that are intended to promote coordination.

We still have our previous concern of why competing developers would choose to coordinate even with the use of Anticipatory Investment and what incentives could be given to realise this. Ofgem have reserved the ability to give more detail, and this will be important to providing a fully informed view. Until then, it still remains to be seen whether the use of AI is sufficient without the framework of rules and guidance to provide support. With the review of delivery models intending to provide certainty, it remains an unfortunate and significant outstanding concern that

² [ENTSO-E Position Paper on Offshore Development: Assessment of Roles and Responsibilities for Future Offshore Systems \(windows.net\)](#)

³ [Minded-to Decision and further consultation on Pathway to 2030 | Ofgem](#)

developers will pursue this option. Until this is realised, it can only be expected to then result in delays that a single delivery body would avoid.

On the basis of one of the later competition models being pursued, SSEN Transmission also welcomes introducing a Tender Entry Condition (TEC) to ensure alignment with OTNR objectives as a similar assessment introduced through the Early Opportunities workstream. However, this view is given only as far as the current expectation of Ofgem providing more detail of what will be included in these assessments used for the TEC.

Question 3: Do you agree with the proposed mechanics of charging to take account of coordinated infrastructure?

Subject to our response to Q1, overall, we don't have any immediate objections to the workings of charging proposals for coordinated infrastructure. However, some of this is reliant on contractual arrangements being facilitated between asset users and NGENSO. While we don't object to this intended approach if choosing to pursue DM6 and DM7, it would be useful to understand that relevant parties for such an approach share the appetite required for it to be achieved. The expected CUSC modifications are known but it is worthwhile noting that these still exist with some level of risk towards achieving the charging arrangements hoped for in the minded-to consultation. With this being acknowledged, these charging arrangements would otherwise be addressed with a TO own and operate model which, if then being considered as onshore would then allow for extended use of TNUoS arrangements.

As with the comments returned as part of reviewing the use of Anticipatory Investment within the Early Opportunities workstream, we expect that there will need to be an understanding on whether securities provided by the later connecting developer would cover a development that will be built anyway. It would also need to be avoided that the required securities do not become prohibitive and run counter to the efforts to remove barriers to investment. Again, as noted above, the use of a TO own and operate model through DM1 would remove the need for these arrangements to be rolled out with the aim of facilitating coordinated development.

We agree with the expected use of the Transmission Demand Residual (TDR) providing support to the initial user and that a later user might agree a change to the Bilateral Connection Agreement (BCA). However, on the expectation of the BCA, there appears to be an absence of any guidance if the requested variation does not come an agreement. As with the wider expectations on charging mechanics, any aspiration should be fully informed by expectations of how any changes are achieved.

Annexe 2 – Delivery model considerations and implications of DM6 and DM7

In this annexe we set out the implications of DM6 and DM7 on the delivery of the offshore grid from logistical, delivery, technical, and regulatory perspectives. This assessment has been informed by the detailed network design activities that we have undertaken to date in response to Ofgem's asset classification decision.

Logistical considerations

The HND is an ambitious undertaking that will define the future offshore network and set precedent for future iterations. It is unprecedented in scale and complexity. Coordinating the delivery of the HND will undoubtedly therefore be a logistical challenge. Approaching such complexity requires simplification as and where possible in order to minimise interface risk and optimise coordination. It is our view that the use of DM6 and DM7 for non-radial offshore transmission assets does the opposite by harbouring uncertainty and fragmenting the network.

- **Delivery partner certainty**

Coordination is contingent on knowing who the coordinating parties are. Without knowing who the parties are, coordinated activities cannot take place. It is therefore essential that there is delivery party certainty at the earliest opportunity. A decision on final delivery models is expected from Ofgem in Spring 2023. If the current proposals stand, at this point developers will need to decide on delivery approach for the non-radial offshore transmission assets. Questions they need to answer include whether they opt for generator- or OFTO-build delivery models, who the leading partner will be, and what agreements need to be in place to implement those arrangements. Again, doing so will take time.

Ofgem note that DM7 might be an appropriate alternative to DM6 in circumstances where there is no natural leading party between developers. This does not resolve the issue of providing certainty during the DND and development stages, which at present are time critical. The implications of lack of certainty at these stages have a direct impact on the deliverability of the HND, both from a timing but also a feasibility perspective when thinking about technical design and the supply chain that we discuss later.

Further delivery partner uncertainty is introduced later on through DM7, with an OFTO tender process ahead of construction. This introduces yet another delivery party into the mix, and for whom it would be entirely reasonable to want to revisit aspects of project development ahead of committing to construction. For example, if the coordinated DND were to conclude that a single vendor HVDC solution is the right approach to delivery, procurement cannot begin until all parties to that procurement exercise are known and commercial agreements are in place.

The implication of DM6 and DM7 is therefore a lack of certainty on this is a delay as coordinated activities cannot even begin until all delivery partners are known, and may stall if conflicts or disagreements arise at any stage of project execution. In comparison a TO-delivery is simple; a single delivery partner is confirmed from the outset and is not subject to ongoing internal conflict. This means that the execution of the HND can begin without delay and potential interruption.

- **Number of delivery partners**

Fundamentally the more partners involved in a project, the greater the coordination challenge is. More partners mean more agreements, more contractual arrangements, greater diversity of views, potentially conflicting ideas, and competing priorities. Under proposed delivery models DM6 and DM7 coordination will be required between TOs, OFTOs, and developers – potentially multiple of each, and with different partners at different stages. This raises a material challenge to coordination, as joint venture frameworks and contractual agreements will need to be put in place before coordinated activities, such as the sharing of information, can take place.

We understand it is those outstanding issues around developers working together that, at least in part, led to the revised minded-to decision to include DM7 as an option for non-radial offshore transmission. Whilst we accept it is helpful to have another option on the table for certain circumstances, in our view DM7 maintains the same issues as DM6, in so far as relevant developers will still need to align on proposed approach to delivery and to coordinate throughout the planning and development stage.

The implication of DM6 and DM7 is therefore a significant increase in complexity of logistical arrangements required for HND delivery, which significantly increases risk of delay and introduction of inefficiency into the execution process. A single TO-delivery party simplifies those logistical arrangements, with decision making subject only to pre-existing internal governance frameworks.

Delivery considerations

Given the scale and complexity of the HND as a whole it is important to assess the impact of delivery models on each stage of project execution. This includes detailed network design (DND), project development, procurement, and construction. It is our view that the use of DM6 and DM7 for non-radial offshore transmission will introduce inefficiencies into each stage of execution through uncertainty, complexity, and inhibiting the ability of delivery partners to coordinate and realise economies of scale.

- **Delivery partner capability**

The use of DM6 and DM7 relies on offshore wind developers working together to design, develop, and under DM6 to construct non-radial offshore wind connections, with an OFTO either constructing and operating (DM7) or just operating (DM6) the asset longer term.

We agree that some offshore wind developers have the experience and capability to undertake those roles. Their experience, however, is generally from delivering radial offshore transmission that serve only their own generation – the attraction of such an approach being control over connection dates. Furthermore, that experience is also in a customer client environment whereby the TOs undertake connection works to existing network infrastructure, with the ESO playing a role as coordinator. In the HND environment the non-radial offshore transmission assets will be an integrated part of the network, rather than a connection. Furthermore, the experience of developers does not extend to undertaking those roles in a coordinated manner with other developers and TOs, as may be required under DM6 and DM7. The role that offshores wind developers will need to undertake is therefore greater than that in which they have direct experience.

Furthermore, the scale of growth of offshore wind ambition has introduced new offshore wind developers into the UK sector, not all of which have direct GB development experience. The use of competitive process for the construction and / or operation of non-radial assets may also bring new OFTO entrants into the market that are potentially untested and lack GB experience. We disagree therefore with assertions that future OFTOs will have direct relevant experience to construct and / or operate non-radial offshore transmission.

In comparison planning, developing, maintaining, and operating a network is what the TOs already do successfully onshore. We already therefore have the relevant competencies to do so in the offshore domain, a fact that we have highlighted in our previous consultation responses. These are not limited to technical aspects, but include experience in stakeholder and community engagement, and a consistently high-quality standard for environmental management. This may be lost with a more fragmented approach to network delivery by untested network delivery parties.

- **Detailed network design and project development**

A coordinated offshore network requires coordination at the DND and development stages. No single part of the offshore grid should be designed in isolation, to do so introduces significant risk and inefficiency, that will result in delays and cost escalation. It may also have implications on longer-term system operability due to the challenges

associated with delivering and operating DC networks, which we discuss later in this response. In order to overcome these challenges the DND stage requires technical data sharing and modelling, which is not immediately possible where there are a multitude of potentially competing parties. The only way to deliver a truly coordinated DND is therefore with a TO delivery model.

We accept the point raised by Ofgem that there are fewer non-radial links than anticipated during its previous minded-to decision but disagree that this means there is less delay risk associated with DM7. As already discussed, coordination and timely delivery requires certainty from the outset, something that DM7 does not provide. Even though there are fewer non-radial links, those links are still an important element of the offshore grid that need to be delivered alongside onshore transmission and radial offshore transmission at offshore hubs, not in isolation.

As already set out, the DM6 and DM7 for non-radial offshore transmission introduces delivery partner uncertainty and a potentially large number of delivery partners. The DND process, which we have already begun for those HND assets classified as onshore transmission, and offshore hubs, cannot be concluded without input and agreement from all relevant parties. This means that DND is essentially on pause until the process of establishing delivery partners under DM6 and DM7 is concluded, which as discussed, relies on new frameworks and contractual arrangements being put in place. This will take time, and also impairs our ability to produce a robust delivery plan which is required to determine whether those assets classified as onshore transmission will be within scope of the ASTI framework.

We have already begun early DND activities on those assets classified as onshore transmission, including implications at offshore hubs. We expect to have allowance provision to undertake pre-construction activities on those assets through the Accelerating Strategic Transmissions Investment (ASTI) regime and are working towards submitting a delivery plan to Ofgem in Winter this year. A TO delivery model therefore enables continuity of ongoing work and DND by a single competent party. This has the potential to accelerate delivery by avoiding delays in both kicking off the DND and during it.

- **Procurement approach**

The global supply is constrained as countries across Europe, and beyond, strive to reach domestic and international decarbonisation targets. The demand on transmission design expertise, fabrication capabilities, and delivery experience are therefore unprecedented. Essentially this means the supply chain can pick and choose who they work with. Ahead of our September ASTI delivery plan submission we undertook an extensive programme of supply chain engagement in order to inform procurement strategies for our ASTI projects. The results of that engagement was stark; to compete in a globally competitive market we need to engage with the supply chain now, at scale, and with regulatory certainty underpinning our projects. The supply chain constraint is a fact now recognised by Ofgem in the December 2022 ASTI decision⁴.

Fragmenting the offshore network amongst different participants means that GB may lag behind other jurisdictions that offer certainty earlier, and a more coordinated and long-term proposal to the supply chain. This is because the delivery of individual onshore transmission or non-radial offshore transmission assets is not as appealing to a potential vendor as a long term and certain pipeline of works. This is also essential to giving the supply chain the signal they need to grow and upskill in response to demand. Furthermore, delays resulting from delivery party uncertainty and regulatory development mean we may miss the already dwindling window of opportunity to get the supply chain on board to ensure delivery as near as possible to 2030.

To demonstrate who we are competing against, last year TenneT launched a large scale HVDC cable tender for at least 10 connections in Netherlands and Germany to help achieve their 2030 offshore expansion targets⁵. This is part of their 2GW programme, a new 2GW standard for offshore connections which they hope will provide planning

⁴ [Decision on accelerating onshore electricity transmission investment | Ofgem](#)

⁵ [TenneT announces large scale HVDC cable tender for offshore grid connections in the North Sea](#)

security for supply chains, a blueprint for future connections, and faster deployment. If major vendors buy into this a significant amount of supply chain capacity will be booked up ahead of 2030.

Recent engagement with HVDC vendors to progress offshore grid optioneering, has reiterated these challenges and that they are becoming starker at staggering pace; one vendor suggested that we need to be engaging seriously now in order to deliver pre-2035. Other implications they highlighted are the benefits of standardisation of offshore infrastructure, and the importance of this in attracting the key suppliers. To realise the benefits of standardisation and economies of scale, requires portfolio approach to supply chain engagement which is not possible with fragmented ownership and development under DM6 and DM7.

In comparison, TO-delivery of non-radial offshore transmission assets alongside those assets classified as onshore transmission enables us to compete in that market with a portfolio approach to procurement, which we are already implementing for our ASTI projects. This approach also benefits in being to engage early with the supply chain before greater market and supply chain constraints develop. A single delivery body enables a standard set of procurement requirements to be developed, which further reduces risk and enables us to compete in a constrained market.

Technical considerations

The reality is that the offshore grid presents a significant technical challenge, both engineering and system design, throughout delivery and operation. It is essential that the offshore grid is developed under a common set of specifications, otherwise there is a risk of diverging technical solutions across different parts of the network, developed by different vendors with intellectual property (IP) constraints limiting how those different parts interact. The risk is therefore the development of an uncoordinated and inefficient offshore grid.

- **Technical governance frameworks**

The offshore grid will be an integrated network of interconnecting AC and DC assets. There are currently no established or agreed Regulations, grid codes, or technical specifications that guide the development, design, and/or operation of a HVDC grid. This includes voltage levels, control and protection systems, main circuit design, and performance characteristics. This differs significantly from established AC systems where these terms are defined and agreed. There are multiple industry working groups actively developing specifications and standards, but these are not yet complete. As a result, fundamental characteristics of the offshore grid will remain open to interpretation by different parties. A central coordinating party overarching across multi-vendor DC systems is therefore critical.

A potential implication of DM6 and DM7 where different parts of the offshore grid are developed and operated by different parties, is development of different parts of the network to different standard and by different vendors. The implication of this is a network that is not efficiently designed, and additional work will be required to integrate those systems (studies, testing, commissioning), which results in additional time, cost and ultimately a risk that integration is not possible.

A TO-delivery model means that there will be a single coordinating party and single vendor delivering all non-radial transmission infrastructure. This means all of the assets can be designed to the same technical specification with no IP issues, and therefore mitigating the need for lengthy integration processes.

- **HVDC interoperability**

Whilst AC system interoperability is a well proven and widely used technology, DC system interoperability is in its relative infancy – from both a technological and regulatory perspective. This is particularly prevalent where there is a requirement for interoperability between multi-vendor DC systems; put simply different HVDC converter providers have different control and protection systems. These systems utilise proprietary protocols and control algorithms which vendors are unable to share with competitors; the result is delay and cost. This becomes most relevant at offshore hubs where different HVDC assets interact, including at the SW_E1a and R4_1 hubs for which we present case studies later in this document.

Furthermore, multiple HVDC projects are each the most significant influence on the design of each other, so the technical integration of multiple HVDC systems must be coordinated. The specific control and protection systems need to be designed, tested, and implemented across the multiple projects; the sequencing of the activities is critical as is their co-ordination and cross-optimisation. Where there are multiple HVDC parties, each with their own intellectual property, this will result in delays to programme and significant increase in cost during both development and construction.

There are no relevant examples currently in operation that demonstrate multiple-owner and multiple-vendor interoperability. Where there are examples, these are either under single owners or in jurisdictions where there are different regulatory/compliance standards. This is an area we have a particular interest in, via Project Aquila in partnership with the National HVDC centre, have been seeking to progress further to offer new options for HVDC project delivery and configuration across timeframes beyond the HND. Project Aquila was awarded Pathfinder status by BEIS in 2022 and will be the first multi-vendor; multi-terminal project developed outside of China. This will provide insight in how to specify across multiple owners and the processes for managing such multiple parties, but the technology will not be proven until the early 2030s.

This is important to consider as different delivery models across different assets may result in a multi-vendor HVDC approach to the offshore grid, which requires a multi-vendor HVDC technology that simply does not yet exist. The delivery of the offshore grid via DM6 and DM7 for non-radial offshore transmission is therefore not feasible in near-term timeframes. The only way to deliver a HVDC network within timeframes close to that expected of the HND is therefore via a single vendor solution. This can only be achieved in realistic timeframes with a single TO delivery partner. We demonstrate this through our case study on the R4_1 offshore hub.

- **Standardisation**

Our initial engagement with potential HVDC vendors has highlighted the technical challenges associated with the HND. Feedback suggests that most technical challenges can be overcome through engineering solutions, but this will take time and come at significant cost. In comparison, the use of standardised technology – such as offshore platform designs – has the potential to simplify infrastructure requirements. The impact of this could be cost savings, accelerated delivery, and attractiveness to the supply chain.

We risk losing out in the ability to deploy standardisation across the offshore grid with the use of DM6 and DM7 for non-radial offshore transmission, as a result of themes already discussed - including coordination at DND stage, portfolio level procurement, and inability to engage with the supply chain early. In comparison, a TO-delivery model for non-radial offshore transmission assets centralises the DND, development and delivery ensuring a consistent approach to technology across the offshore grid.

- **Operational activities**

Non-radial offshore transmission assets will form part of an integrated offshore grid. Their function will not only be limited to the transmission of power generated offshore, despite Ofgem and the ESO determining this to be their likely primary function. Over the course of operation offshore transmission assets will be expected to fulfil a variety of purposes, both in power transmission across a range of outages, but also in supporting voltage regulation and system stability (dynamic management of transmission system)

These voltage regulation and system stability activities will need to be delivered by all the off the offshore network (including non-radial). By fragmenting the offshore grid amongst different owners it will be difficult to subdivide the additional dynamic system stability requirements without both limiting the capabilities of the solution and introducing new interoperability challenges, such as control systems integration or voltages and frequency regulation management at different points of offshore interface. It is therefore important to consider the longer-term operational implications of fragmenting the offshore grid amongst different owners.

Our work has highlighted that there are aspects of design which will be technically challenging - for example the co-ordinating of control systems between the assets and the interfaces across them - which must be specified, delivered, tested, and maintained together throughout asset life. Coordination is essential to the resolution of such technical complexity.

Regulatory considerations

We have already highlighted the material logistical, delivery, and technical challenges of the HND and that impact that DM6 and DM7 for non-radial offshore transmission will have on those challenges. Arguably encompassing them all is regulation – the right framework has the potential to create the right environment and incentivise the right behaviours in order to meet those challenges head on.

- **Regulatory policy and process development**

Where there is an existing framework that works, we agree with the principle that there is no need to re-invent the wheel. From that perspective we understand the proposal to use DM6 for non-radial offshore transmission – albeit there are numerous additional challenges presented by DM6 beyond the regulatory, as already discussed in this response.

It is important to note that DM7 does not draw on regulatory precedent like DM6 as an OFTO-build model has not yet been implemented for any radial connections. This means, as acknowledged by Ofgem, there will need to be a period of regulatory policy and process development – from tender procedure to cost assessment – before this model can be implemented. This will take time.

The implication of this, if developers were to agree with a DM7 approach for the non-radial offshore transmission assets, that approach cannot be implemented until policy and process is developed. This is an issue because delivery of the HND is time-critical and requires certainty, so regulatory development only serves the purpose of adding delay and uncertainty into the timeline.

There is already regulatory policy and process in place for the planning, development, and operation of networks through the onshore regime, including the frameworks and codes that guide how we do so and how we interact with other parts of the network. Fundamentally the HND is an offshore network, not dissimilar in function or design to that onshore. The onshore regime is fit for purpose for the offshore grid with limited regulatory development requirement. A TO-delivery model offshore therefore limits the need for regulatory intervention through the development of new regulatory policy and process.

- **Regulatory treatment**

Non-radial offshore transmission assets will form part of an integrated offshore grid. Once part of an offshore grid, each asset will therefore play an equal part in its safe, efficient, and compliant ongoing operation. Those parts of the grid should therefore be treated equally from a regulatory perspective, including licence conditions and incentives. By fragmenting the offshore grid amongst different regime under DM6 and DM7, there is the risk of an unlevel playing field and inefficient operation as different parties are incentivised in different ways.

Whilst acknowledging that further regulatory policy development is required, there are potential implications of introducing an OFTO model into the offshore grid under DM6 and DM7. The OFTO regime incentivises the OFTO to maintain their asset for the duration of their 25-year TRS, whilst the non-radial transmission assets will form part of the transmission network and need to be treated as such, for the long-term. In comparison, TOs are incentivised to facilitate future co-ordination, on top of maintaining their networks for the long term, therefore OFTO operation potentially limits future ambitions and potential future uses of the infrastructure.

It is essential that all parts of the offshore grid are treated equally for performing the same functions, and this is only achieved through consistency in regulatory approach. Implementing existing onshore arrangements offshore via a single licenced transmission owner within a defined area is the only way to do this.

- **Wider policy development**

The net zero challenge has rightly led to a host of policy development within both Government and the regulator to ensure that the GB energy system can deliver those ambitions. Whilst we acknowledge that the PT2030 workstream is focussed on 2030 ambitions, and the enduring regime OTNR workstream will look at longer term arrangements, it is right to have one eye on the next step.

We welcome and support the recent direction of travel towards planning and designing a single integrated transmission network, with onshore / offshore geographical boundaries no longer relevant. This view appears to be consistent with the centralised strategic network plan (CSNP) that is expected to take a holistic view of the GB energy system, and major transmission infrastructure offshore being classified as onshore for regulatory purposes. It is also consistent with the wider European ambitions of energy integration and potentially a meshed offshore grid in the North Sea. In this regard we were pleased to see that the UK established a cooperation framework with the North Seas Energy Cooperation forum (NSEC)⁶ to further these ambitions following a Brexit hiatus in participation.

We have longstanding, unaddressed concerns around the perceived merits in fragmentation in the ownership of the GB transmission system. Our analysis of the HND is a real example of how such fragmentation introduces delay, inefficiency in design, additional costs and risk, and hence is a barrier to the achievement of net zero ambitions. There is no quick and simple 'hand over' of a developed project either at the design or construction stage. There is no quick and simple means to manage system interfaces or pursue joint procurement.

In previous minded-to decisions, we have asked that Ofgem does not use the delivery model decision for the PT2030 workstream to set any precedent for any other delivery models under the Enduring Regime. Should Ofgem disagree with our response to this revised minded-to decision, it is imperative that DM1 should remain on the table as a viable option for any enduring and post-2030 solution. We believe that its selection at this stage puts us on the right foot and allows for continuity in approach beyond the PT2030 workstream.

Closing remarks on delivery models

Our position can be summarised by linking back to the delivery model principles we proposed in the initial delivery model consultation:

1) accelerates delivery of 2030 targets and Net Zero targets – TO delivery gives the best option of achieving delivery as close as possible to the 2030 targets by avoiding unnecessary delay associated with uncertainty on approach to delivery, and therefore delivery partners, on non-radial offshore transmission links. It also mitigates the need for new regulatory policy and process development, and the time lost whilst a competitive process is undertaken. In some instances, it is the only way of delivering a feasible technical solution and of securing the support needed from the supply chain. We are already undertaking early DND activities for onshore transmission assets now, that same activity needs to begin on offshore transmission assets now in order to meet the HND objectives, which requires certainty.

2) enables coordination and collaboration – Success of the HND depends on coordination at all stages of execution and into operation. Fragmentation of network ownership leads to complexity in the logistics of coordination and raises material challenges when trying to resolve technical limitations of complex

⁶ [North Seas Energy Cooperation and UK establish cooperation framework to facilitate the development of offshore renewable energy \(europa.eu\)](https://europa.eu/nsec/)

interacting AC and DC networks, both during delivery and operation. A TO delivery models solves these issues with optimal coordination, resulting a timelier and more cost-effective HND outcome.

3) provides certainty to consumers, stakeholders, and the supply chain – Despite multiple decisions there remains outstanding uncertainty in the delivery of the HND. This uncertainty comes, in part, from a lack in involvement of the TOs in HND development and asset classification, and also a focus on the “lines” on the map instead of the “diamonds”. TO delivery closes the uncertainty loop, enabling us to progress at pace. It also sends the right signal to the supply chain and allows us to compete on a global procurement stage.

Annexe 3 - Case study on HVDC interoperability at the R4_1 offshore hub

To demonstrate the implication of delivery models on HND feasibility, this case study explores the impact of HVDC interoperability at the R4_1 offshore hub. Please note that the optioneering process is ongoing through the DND, so these designs should not be considered final.

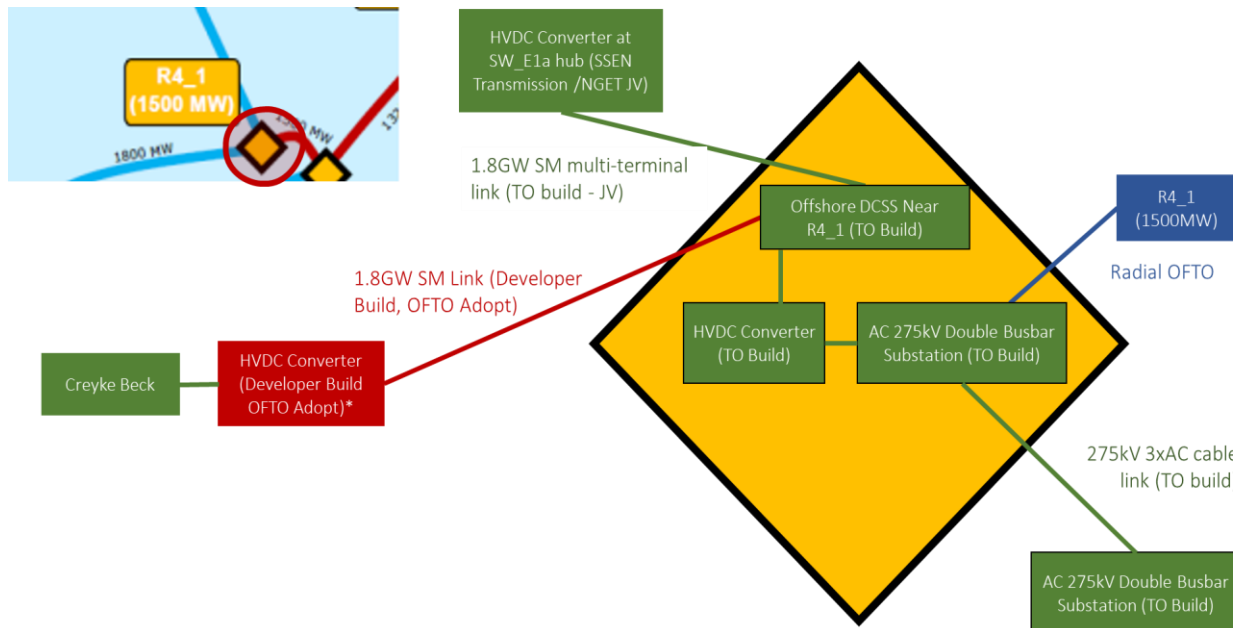


Figure 1: R4_1 hub arrangement under DM6/7

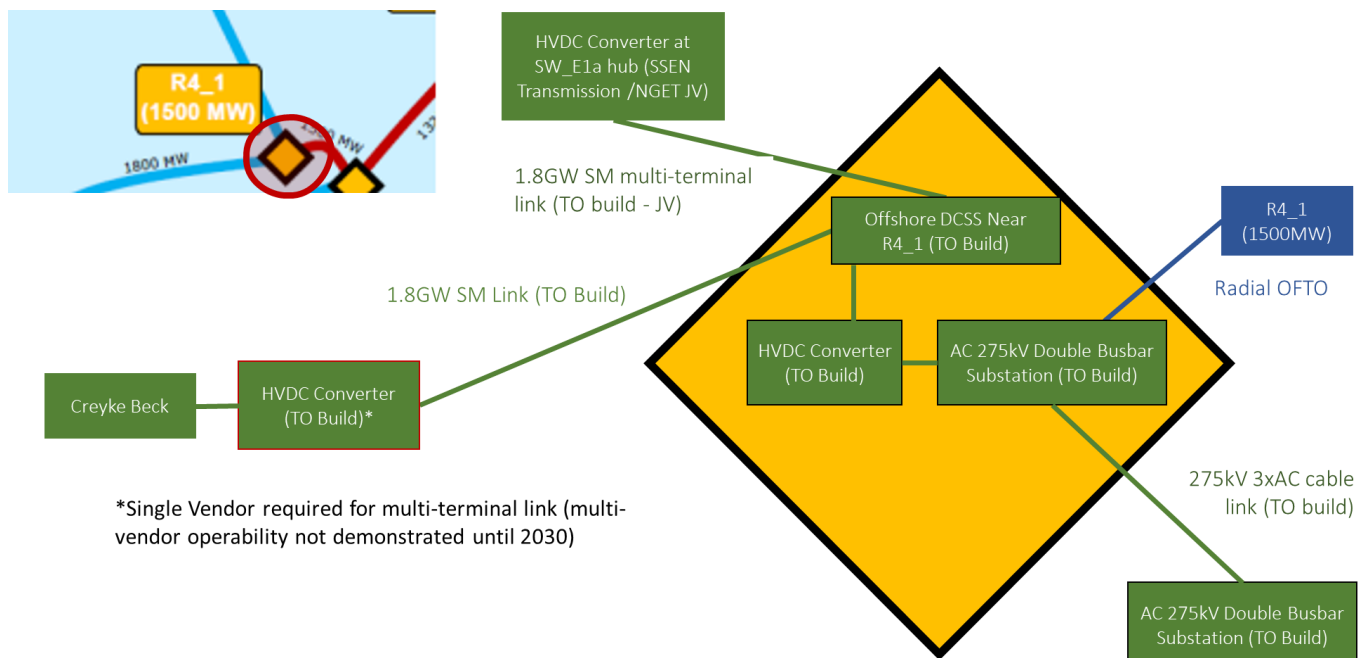


Figure 2: R4_1 hub arrangement under DM1

The first design, Figure 1, represents our best interpretation of infrastructure requirements based on the HND. Under this design the DM6 / DM7 non-radial offshore transmission link from Creyke Beck ties into a DC switching station (DCSS), along with the HVDC transmission link coming in from the SW_E1a offshore hub. Given that those two HVDC transmission lines are under different delivery models, it is plausible that they will employ different vendors. This means that the R4_1 DCSS will need to be multi-vendor. There is currently no relevant operational

control system that allows for communication between HVDC systems from different suppliers. Furthermore, there is currently no Regulations or grid codes/standards allowing integration and interoperability of multi-terminal HVDC link from multiple vendors. The firm indication from vendors is that they do anticipate multi-vendor multi-terminal HVDC technology to be deployable until potentially beyond 2034. The implication therefore is that the HND design is not deliverable within HND timeframes if non-radial offshore transmission links are delivered via DM6 or DM7.

Under the second design, Figure 2, the non-radial offshore transmission link from Creyke Beck is delivered by a TO. As TOs are responsible for all DC networks at that offshore hub, we are able to select a single HVDC vendor. This means that we know that the control protection systems at from each converter will be the same and therefore can be integrated, and that the design and testing of those systems can be coordinated efficiently, without intellectual property barriers. This therefore represents a significant saving in terms of cost and time relative to a multi-vendor outcome.