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System Requirements

Annex covering the system requirements of the options assessment process.

NESO
National Energy System Operator

2.1. Identify future transmission capability.

This annex describes how boundary capabilities are determined in the options assessment process.

2.1.1. Boundary capability assessment for options

1. The TOs conduct boundary capability assessment studies with NESO conducting verification analysis on selected results to compare results using a challenge and review process.
2. NESO would then hold a series of meetings with TOs as part of the challenge and review process for future proof of study network and to determine level of whole system consideration (i.e., interaction of study network with neighbouring areas and DNO network). Following this, the TOs submit results with SRFs for their areas and coordinate with neighbouring areas.
3. NESO verifies selected boundaries and studies reinforcements based on previous TO submissions. TOs then provide updates to NESO on adjustments to their options. NESO may perform concurrent studies to cross-check capabilities and can request additional options from TOs if needed. These results are then input to the cost-benefit analysis.
4. An agreed set of offshore designs from the Offshore Coordination Project will be included in the background for the network studies. Some of the co-ordinated offshore circuit capacity will not be included in the boundary capability but directly modelled in the economic network assessment tools.
5. Thermal loading, voltage and stability boundary limitations are assessed to find the maximum power transfer capability across a boundary (Boundary capability). The boundary capability is the greatest power transfer that can be achieved without breaching any NETS SQSS planning limitations. Sensitivities in the background representing different network conditions, such as interconnector flows, generation patterns or time of the year that may cause critical changes in boundary capability, may be assessed separately.
6. Certain boundaries are classed as dynamic and have a capability that is dependent on the flow across associated interconnectors. The TO provides the boundary capability for each flow condition on relevant interconnectors, and the NESO undertake these studies alongside TOs when appropriate.
7. A winter peak network analysis is conducted using an agreed, challenging pathway, with the high electrical load and generation, to test the boundary capabilities. Additional sensitivity analysis considers different network conditions, pathways, and timeframes. Stability analysis considers year-round demand conditions and includes secured events (N-1-1, N-1, N-D) as per the NETS SQSS.
8. This analysis is done in accordance with the agreed ETYS, NOA and tCSNP study guidelines, which describes the constraint type, pathway, season, and the years for the network assessment. The ETYS, NOA and tCSNP study guidelines are governed by the STC.
9. To assess boundary capability, generation and demand conditions are adjusted to identify the maximum capability across the boundary. This entails scaling the generation and demand on both sides of the boundary until network limits are surpassed. The steady state

flows of each boundary circuit are then combined to determine the maximum boundary capability before the secured event.

10. The factors shown in Table 2.1 below are identified for each transmission solution to provide a basis on which to perform cost-benefit analysis at the next stage. The table includes the maturity levels for the pre-construction and construction stages and that are part of the design criteria.

Table 2.1 - **Transmission solution factors**

Factor	Definition		
Boundary capability	The calculated impact of the transmission solution on the boundary capabilities of all effected boundaries and in combination with other relevant transmission solutions.		
Earliest in-service date (EISD)	The earliest year an option can be delivered and be operational.		
Cost	The forecast total cost for delivering the project, split to reflect the pre-construction and construction phases.		
Stage	The progress of the transmission solution through the development and delivery process. The stages are as follows:		
	Project not started		
	Pre-construction with maturity level	*Level 1: Scoping*	Identification of broad needs case and consideration of number of design and reinforcement options to solve boundary constraint issues.
		Level 2: Strategic optioneering	The needs case is firm; a number of design options being developed so that a preferred design solution can be identified.
		Level 3: Design/ development and consenting	Designing the preferred solution into greater levels of detail and preparing for the planning process including public consultation and stakeholder engagement.
		Level 4: Planning / consenting	Continuing with public consultation and adjusting the design as required all the way through the planning application process.
		Level 5: Consents approved	Consents obtained but construction has not started.
	Level 6: Construction		Planning consent has been granted and the solution is under construction.

9. To assess the lead-time risk described in Table 2.1, NESO will consider, for a project with significant consents and deliverability risks, both 'best view' and 'worst case' lead-times submitted by the TOs to establish the least regret for each likely project lead-time.
10. If there are insufficient options to satisfy boundary requirements or insufficient optionality, NESO can request the TOs to initiate further work to identify further reinforcement options, aiming for at least three options per requirement. Long-term conceptual options are submitted to ensure an adequate number of options, but without detailed power system analysis.
11. For boundaries affecting multiple TOs, collaboration is encouraged to determine options for economic analysis and tCSNP outputs.
12. TOs submit their boundary capability results in the SRF Part D to NESO.
13. Where specific boundary capabilities are not provided for spring, summer, autumn, or outage conditions by the TOs the following winter adjustment factors, in Table 2.2, shall be used.

Table 2.2 - Seasonal boundary capability scaling.

Seasonal boundary capability scaling	
Spring and autumn thermal	85%
Summer thermal	80%
Summer outage thermal	70%
Summer outage voltage	90%

14. NESO collaborates with TOs to explore commercial options. The economic analysis tool requires the boundary capability in MW, which is provided by the analysis of commercial solutions. NESO is responsible for providing ongoing costs, including intertrip arming fees, and any capital expenses related to the design and installation of an intertrip service if recommended.