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A security standard for offshore transmission networks - an initial joint DTI / Ofgem consultation

Document type: Consultation

Ref: 211/06 (Ofgem) & 06/2186 (DTI)

Date of publication: 13 December 2006

Deadline for response: 22 January 2007

Target audience: Potential offshore transmission licensees, the GB System Operator, onshore electricity network businesses, offshore renewable generators, other interested

Overview:

The Great Britain Security and Quality of Supply Standard defines the minimum security requirements for the onshore electricity transmission network. An industry subgroup was asked to consider if the security requirements offshore would need to be different and, if so, to consider the justifiable levels of security for offshore electricity transmission networks.

This document summarises the results of this review work and invites views on the subgroup's recommendation for minimum security requirements for offshore electricity transmission networks.

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Context

This document is an Ofgem and DTI consultation which forms part of the joint work of the two organisations on developing the regulation of offshore electricity networks. It follows on from the Government's decision in March 2006 to regulate offshore transmission activities through licensed price controls and Ofgem's document in April 2006 outlining the scope of work. More detailed proposals on the offshore electricity regulatory framework were published in November 2006, the first a joint document consulting on two possible options for licensing electricity transmission owner activities offshore, the second a DTI consultation on the regulation of offshore electricity distribution activities offshore.

This document should be read as the joint views of Ofgem and DTI. Where the organisations have separate views, duties or actions, these are made clear.

This document is an initial consultation on a proposal for minimum requirements for security of offshore electricity transmission networks. It reproduces the recommendations of the GB SQSS subgroup.

We are consulting on:

(i) whether it is appropriate for the minimum security requirements for offshore electricity transmission networks to be different to those currently applicable to onshore electricity transmission networks; and

(ii) if so, whether the minimum security requirements for offshore electricity transmission networks recommended by the GB SQSS subgroup are appropriate.

Associated Documents

Licensing offshore electricity transmission

http://www.ofgem.gov.uk/temp/ofgem/cache/cmsattach/17689_199_06.pdf

DTI open letter and consultation on draft order for distribution class exemption

Will be available at www.dti.gov.uk

http://www.dti.gov.uk/files/file35598.pdf

http://www.dti.gov.uk/files/file35593.pdf

Offshore electricity transmission - scoping document

http://www.ofgem.gov.uk/ofgem/work/index.jsp?section=/areasofwork/offshore

Table of Contents

Summary **1**
1. Introduction and update **3**
Aims of this consultation 3
Current situation 3
What happens next 4
Previous consultation 4
Consultation timescales 5
2. Summary of GB SQSS subgroup's work **6**
Background 6
Approach to offshore regulation 7
GBSQSS subgroup 8
Summary of GB SQSS subgroup's recommendation 9
Main conclusions 9
Detailed recommendations 10
Implementation of GB SQSS Subgroup's recommendation 12
Our initial view 12
3. Further issues **15**
Further work 15
Appendices **16**
Appendix 1 - Consultation Response and Questions **17**
Appendix 2 – GB SQSS subgroup recommendation **19**
Recommendations for the coverage of offshore transmission networks in the Great Britain Security and Quality of Supply Standard 19
Summary 19
Background 21
Analysis work undertaken 21
Approach to the analysis 21
Scope 23
Assumptions made 24
Uncertainties / Risks 25
Offshore transmission voltage requirements 25
Analysis results 26
Sensitivity assessment 27
GB SQSS Subgroup Recommendation for criteria for the new Standard 27
Issues and further work for OTEG consideration 30
Appendix 3 – Appendix to the GB SQSS subgroup recommendation **33**
Terms of reference for the GB SQSS sub group of OTEG 33
Background 33
Composition of the sub group 33
Purpose 34
Participation 34
Deliverables 34
Objectives 35
Accountability 36
GBSQSS sub-group members 36
The present GBSQSS standard 36

Cost benefit analysis dataset 38
Offshore windfarm 38
Size and distance of offshore wind farm 38
Generator 38
Wind resource 38
AC transmission (transformers and compensation) 38
Transformers 38
Cables 40
DC transmission - VSC 40
Converters with associated equipment (circuit breakers, transformers filters etc) 40
DC Cables – capacity and resistance (ABB) 41
AC and DC cable parameters 42
Costs of Voltage source based HVDC (BEAMA) 42
Single wind farm connections 42
Offshore platform 42
Offshore network capacity (AC and DC cables) 44
Multiple wind farm connections 45
Offshore network capacity (AC and DC cables) 47
Existing standards definitions 47
Existing standards definitions 48
Sub-group assumptions 49
Appendix 4 - The Authority's Powers and Duties 50
Appendix 5 - Glossary 52
Appendix 6 - Feedback Questionnaire 55
Appendix 7 - Government consultation code of practice criteria 56
Comments or complaints 56

Summary

Offshore networks are important as they will transfer electricity from offshore generating stations (such as wind farms and potentially other technologies that harness wave and tidal resources) to the onshore network. However, they are also potentially expensive, so we are seeking to ensure that these networks are developed as efficiently as possible to ensure all users of the system do not have to pay excessive charges.

The Great Britain Security and Quality of Supply Standard (GB SQSS) provides a coordinated set of criteria and methodologies that electricity transmission licensees are required to apply when planning and developing (and in the case of the system operator, operating) the onshore transmission systems. The criteria in the current GB SQSS are underpinned by cost benefit analysis. Compliance with the GB SQSS is a requirement of the current electricity transmission licence.

Available evidence shows that installation of transmission assets offshore is substantially more expensive than onshore. In the April 2006 document, Ofgem set out its view that there was a need for additional cost benefit analysis to assess the levels of security that are justifiable for offshore electricity transmission networks. Analysis work has been carried out by an expert industry group - the GB SQSS subgroup that was established to consider whether the existing GB SQSS requirements are appropriate to apply to offshore electricity transmission networks.

This joint Ofgem/DTI document summarises the recommendations of a subgroup of the Offshore Transmission Expert Group (OTEG) tasked with reviewing the minimum security requirements for offshore electricity transmission networks. This document is one of several consultations affecting offshore electricity transmission currently being undertaken by DTI and Ofgem. The minimum security requirements consulted on in this document if adopted, will be an essential part of the offshore regulatory framework. Using its powers from the 2004 Energy Act the Government is seeking to establish this framework by 2008 in order to enable offshore electricity generators to connect to the onshore transmission system and onshore distribution systems.

Ofgem and DTI want to ensure that similar principles apply to any offshore transmission network and that the offshore regulatory regime is consistent with onshore arrangements.

Firstly, the document consults on whether or not it is appropriate to introduce offshore security standards that are different to current onshore arrangements.

Secondly, the consultation summarises the results of the subgroup's review work. Views are sought on whether or not these are appropriate.

Thirdly, the OTEG subgroup recommended some future work streams including access to onshore distribution networks, Grid Codes, access rights, and larger capacity networks. We invite respondents to give views on these suggestions.

Responses to this consultation must be submitted by 22 January 2007.

The Government will then make a decision and publish the proposed legal text for an offshore security standard in mid-2007. The entire offshore electricity transmission regime is intended to come into force in 2008.

1. Introduction and update

Question box

There are no questions in this chapter.

Aims of this consultation

1.1. This consultation sets out the GB SQSS subgroup's recommendation for the minimum levels of security for offshore electricity transmission networks. This recommendation is based on results of cost benefit analysis work.

1.2. We are seeking views on the GB SQSS subgroup's recommendation. In particular, we invite views:

i. whether it is appropriate for the minimum security requirements for offshore electricity transmission networks to be different to those currently applicable to onshore electricity transmission networks; and

ii. if so, whether the minimum security requirements for offshore electricity transmission networks recommended by the GB SQSS subgroup are appropriate.

Current situation

1.3. Under the Crown Estate's Rounds 1 and 2 (R1 and R2) of offshore development, 29 generating stations have been granted options for site leases. There are four offshore wind farms currently built and operating. Three of the projects currently built and operating (North Hoyle, Scroby Sands and Kentish Flats) are connected to the onshore distribution system via 33kV cables. These offshore connections are low voltage and along with any future projects connecting at low voltage, will not fall under the offshore transmission regime. A separate DTI consultation was published on the proposed regulation of offshore distribution on 22 November 2006[1].

1.4. However, the fourth project constructed to date (Barrow) has a 132kV connection to shore. Post-commencement of the relevant sections of the Energy Act 2004 all 132kV offshore connections will be high voltage (defined as 132kV or more). Barrow, and any other projects with connections at 132kV or more, whatever their Round, will be high voltage connections and will fall under the offshore transmission regime.

[1] http://www.dti.gov.uk/consultations/open-consultations/index.html

1.5. Further information about the R1 and R2 projects is set out in Chapter 1 of the November 2006 joint consultation on options for licensing electricity transmission owner activities offshore.

1.6. The transmission licence obliges transmission licensees to comply with the GB SQSS when planning and developing the transmission network and in the case of the System Operator, when operating the network. The onshore distribution arrangements do not include generation connection requirements that are similar to those in the transmission sector.

What happens next

1.7. Following this consultation, the Government will make a decision on:

iii. whether it is appropriate for the minimum security requirements for offshore electricity transmission networks to be different to those currently applicable to onshore electricity transmission networks; and

iv. if so, whether the minimum security requirements for offshore electricity transmission networks recommended by the GB SQSS subgroup are appropriate.

1.8. If we decide that a different security standard for offshore electricity transmission networks is appropriate, we would expect to introduce this by virtue of the powers in the Energy Act 2004. Subject to responses to this and any subsequent consultation, we would expect to publish proposed legal text in mid-2007. We would also expect to consider any consequential impacts on standard conditions C17 and D3 of the electricity transmission licence.

1.9. It is intended that the offshore electricity transmission regime will come into force in mid-2008, subject to the commencement of the necessary Energy Act 2004 provisions. If we decide to develop a different security standard for offshore electricity transmission networks, we would expect any changes to the GB SQSS to be designated by the Secretary of State under powers provided to him by the Energy Act 2004.

Previous consultation

1.10. A description of the relevant previous consultations and the work carried out by the expert group established to assist us in developing regulatory arrangements for offshore electricity transmission networks is included in Ofgem/DTI's joint document in November 2006 outlining two possible options for licensing electricity transmission owner activities offshore.

Consultation timescales

1.11. This consultation opened on 13 December 2006. Your views are invited by 22 January 2007.

2. Summary of GB SQSS subgroup's work

Questions

Question 1: Do you consider that the GB SQSS subgroup's recommendation is a suitable basis for developing a security standard for offshore electricity transmission networks?
Question 2: Do you consider that the default offshore grid entry point (i.e. boundary between generator and offshore transmission network) assumed by the GB SQSS subgroup is appropriate?
Question 3: Do you consider that the scope of the cost benefit analysis work undertaken by the GB SQSS subgroup was adequate?
Question 4: Do you consider that the conclusions drawn by the GB SQSS subgroup from the results of the cost benefit analysis work are valid?
Question 5: Do you consider that the sensitivity analysis carried out by the GB SQSS subgroup to validate the recommendations made given the uncertainties relating to the information used for the cost benefit analysis work was adequate to test the robustness of the conclusions drawn?
Question 6: Do you consider that the recommended minimum levels of security for offshore substations and for offshore cable connections are appropriate?
Question 7: How should the minimum security requirements for offshore electricity transmission networks that connect a single wind farm to an onshore network be defined?
Question 8: Would extension of the GB SQSS to reflect the GB SQSS subgroup's recommendation have a significant impact on existing users of the GB transmission system?
Question 9: Would any aspect of the GB SQSS subgroup's recommendation result in practices that can be considered discriminatory?

Background

2.1. Compliance with the GB SQSS is a requirement of the current electricity transmission licence. Standard condition C17 of the transmission licence obliges National Grid Electricity Transmission plc (NGET) to plan and develop its transmission system and to operate the GB transmission system in accordance with the GB SQSS. Standard condition D3 of the transmission licence obliges SP Transmission Limited (SPT) and Scottish-Hydro Electric Transmission Limited (SHETL) to plan and develop their transmission systems in accordance with the GB SQSS. The GB SQSS provides a coordinated set of criteria and methodologies that the GB electricity transmission licensees are required to apply when assessing new connections and other transmission network developments. The GB SQSS also includes a set of criteria that NGET is required to apply when operating the GB transmission system and define the security requirements for abnormal system conditions such as transmission system or generation plant outages.

2.2. The Energy Act 2004 provides broad powers for the Secretary of State to develop a regulatory regime for offshore electricity transmission. Section 89 amends section 4 of the Electricity Act 1989 so that the prohibitions (and licensing and

exemption regime) also apply in the Renewable Energy Zone and confirms that the regime applies in the territorial sea adjacent to Great Britain.

2.3. In March 2006 the Government announced that offshore electricity transmission would be regulated through a licensed price control regime. The Ofgem scoping document (April 2006) identified five broad work streams required in the introduction of regulatory arrangements for offshore electricity transmission networks.

2.4. One area where further work was considered necessary was a review of the existing technical rules governing onshore electricity networks to see whether they are applicable for offshore developments or whether offshore specific requirements might be appropriate.

2.5. We recognise the significant impact that compliance with the GB SQSS has on the design of onshore transmission networks. We also appreciated the value of early clarity on the minimum security requirements that should apply to offshore electricity transmission networks.

2.6. In May 2006 Ofgem and DTI set up OTEG to provide further technical advice and information necessary to developing the detailed regime. Further details of OTEG are included in the November 2006 joint consultation. OTEG decided to establish the GB SQSS subgroup to undertake review work to assist our decisions relating to security requirements for offshore transmission networks.

Approach to offshore regulation

2.7. Onshore, Ofgem has sought to ensure that the GB transmission system is developed and operated in an economic and efficient manner, while maintaining high standards of safety, security and reliability. We consider that similar principles should apply to any offshore electricity transmission regulation arrangements that are developed.

2.8. It is Ofgem's intention therefore that the onshore and offshore electricity transmission regulatory regimes should be consistent and be based, as far as possible, on the same broad principles of promoting competition, non discrimination and cost reflectivity.

2.9. The Government's decision on the regulatory high-level regulatory regime in March 2006 stated that the onshore electricity transmission regulatory arrangements would be, as far as practicable, extended offshore. An explanation of the Government's approach to implementing offshore electricity transmission regulation, the Regulatory Impact Assessment and related documents are available on the DTI website: www.dti.gov.uk

2.10. The GB SQSS defines standard criteria that transmission licensees are required to apply. These standard criteria reduce the risk of unequal treatment of customers as well as defining the normal level of security for the GB transmission system. We

considered that a useful starting point for the review was to assess if the GB SQSS should be applied offshore and, if so, whether any changes were required to accommodate the different characteristics of offshore electricity transmissions links or other aspects associated with the offshore environment.

2.11. The fundamental question addressed by the GB SQSS subgroup was whether there is merit in extending the current GB SQSS to also apply within relevant offshore water areas, since this:

- builds on the harmonised arrangements delivered as part of BETTA in general;
- reflects NGET's extended role as offshore system operator and its overall responsibility for co-ordinating connection offers for both onshore and offshore elements of the transmission system; and
- ensures consistency between onshore and offshore electricity transmission arrangements.

GBSQSS subgroup

2.12. From a practical perspective, we recognise the technical complexity of the work required to identify the appropriate security standard that should be applied when developing offshore electricity transmission networks. In particular, we acknowledge the concerns that the characteristics of the marine environment, of individual offshore wind projects as well as generic differences between what is required onshore and offshore, may vary and that this may affect the level of security that is justifiable offshore.

2.13. These characteristics were taken into account when the terms of reference of the GB SQSS subgroup were drafted. The specific objectives were:

- Develop a framework of security rules that can be applied to offshore transmission networks and that is compatible and consistent with the current onshore transmission network and market structure;
- To achieve (i) it will be necessary to assess the relevance of the existing GB SQSS for offshore electricity transmission networks in the first instance and, if required, to outline any amendments that are needed to extend the GB SQSS offshore;
- Identify and develop a range of feasible alternative options for security standards relating to offshore transmission networks.

2.14. To inform the required analysis work the GB SQSS subgroup considered relevant matters to establish the technical background against which a cost benefit analysis could be applied. The relevant matters that the GB SQSS subgroup considered were the:

- proposed connection designs for offshore wind farm developments currently in the planning process;

- default scope of an offshore electricity transmission network in terms of the interface points with the offshore generator and the onshore network; and
- likely voltage performance of and the need to specify voltage limits for offshore electricity transmission networks.

2.15. The remainder of this chapter summarises the recommendation of the GB SQSS subgroup. The GB SQSS subgroup's full recommendation is included as Appendix 2 of this consultation. Appendix 3 includes a summary of the group's consideration of the technical background to the review work.

Summary of GB SQSS subgroup's recommendation

2.16. The GB SQSS subgroup used a cost benefit analysis approach to determine the optimum economic and technical security standard for offshore electricity transmission networks. Such an approach is consistent with that taken in developing other network security standards. The GB SQSS subgroup identified key parameters which impacted on the proposed solution from the results of the cost benefit analysis work. These key parameters were:

- transformer / cable Mean Time To Repair (MTTR);
- value of energy curtailed;
- offshore substation distance from shore; and
- cable failure rates / reliability.

2.17. A large number of permutations were considered as part of the cost benefit analysis. The results from this analysis work were used by the GB SQSS subgroup to demonstrate the robustness of the recommendations to variation of these key parameters.

2.18. As part of the analysis work, the GB SQSS subgroup considered the costs that may arise should offshore transmission assets not be available. Assessment was made based on expected energy curtailed for wind generation only. Also, the GB SQSS sub group did not consider how the costs of energy curtailed would be funded. It should be noted that the GB SQSS subgroup did not consider any consequential impacts on access rights, compensation arrangements and transmission charging for offshore generation.

2.19. Based on the results of this analysis, the GB SQSS subgroup considered that the criteria in the current GBSQSS is not appropriate for application to offshore electricity transmission network development. The GB SQSS subgroup then carried out further analysis work to identify levels of security that are justifiable for offshore electricity transmission networks.

Main conclusions

2.20. The GB SQSS subgroup reached the following conclusions from its assessment of the technical background and the results of the analysis work:

- the high cost of installing submarine cables, the large distances expected between each offshore substation and the shore and the geographical disposition of current offshore generation developments, are at present likely to result in offshore electricity transmission networks consisting of radial connections to the onshore transmission or distribution networks in the initial stages;
- the majority of R2 projects are considering connecting to the shore using 132kV submarine cables;
- there is no justification for redundancy to be installed in offshore electricity transmission network capacity;
- the cumulative effect of a significant number of offshore generating stations connected to an onshore transmission or distribution network via a single offshore transmission cable circuit may have an adverse impact on overall system security;
- large volumes of generation connected via single offshore transmission cable circuits may increase the volume of reserve that NGET requires for the safe and secure operation of the GB transmission system and appropriate mechanisms for funding will need to be considered; and
- there would be value in allowing customer requested connection design variation as part of the offshore security standard where the variation can be demonstrated to be economically justifiable and there is no adverse impact on other users of the transmission system.

Detailed recommendations

2.21. The GB SQSS subgroup has said it considers that its recommendation provides a robust basis for a security standard for offshore electricity transmission networks which would not be considered to form part of the main interconnected transmission system. The GB SQSS subgroup recommends that security requirements for offshore electricity transmission networks should:

- be included as an extension to the GB SQSS;
- allow for account to be taken of diversity when assessing the transmission capacity required for an offshore electricity transmission network that connects more than one offshore wind farm to an onshore network;
- define minimum security requirements for an offshore substation (assets installed on an offshore platform that are required for the connection of an offshore generator to the offshore cable connection);
- define minimum security requirements for an offshore cable connection (cable(s) linking the offshore substation to an onshore network); and
- allow for the offshore developer to request variation from the minimum security criteria.

2.22. The GB SQSS subgroup recommends the following minimum levels of security for offshore electricity transmission networks that connect a single offshore wind farm to an onshore network:

- offshore platform capacity of at least the export capacity requested by the generator; and
- offshore cable connection capacity of at least the export capacity[2] requested by the generator.

2.23. The GB SQSS subgroup recommends the following minimum levels of security for offshore electricity transmission networks that connect more than one offshore wind farm to an onshore network:

- offshore platform capacity of at least 90% of the total installed capacity for all associated offshore wind farms; and
- offshore cable connection capacity of at least 90% of the total installed capacity for all associated offshore wind farms.

2.24. The GB SQSS subgroup recommends the following minimum levels of security for offshore substations that are used to connect one or more offshore wind farms to an onshore network:

- for wind farms with a capacity of 120MW or greater, following an outage (planned or unplanned) of any offshore platform transformer, there should be sufficient capacity, at a minimum, to export 50% of the installed platform transformer capacity; and
- for wind farms connected using HVDC technology, following an outage (planned or unplanned) of any single offshore platform DC converter module, the loss of power infeed shall not exceed 1000MW.

2.25. Noting that modules of 1000MW or larger are not available with current HVDC technology, the GB SQSS subgroup was not able to conclude on an offshore specific loss of power infeed requirement. The GB SQSS subgroup recommends a limit based on the Normal Infeed Loss Risk defined in the GB SQSS until sufficient information is available to inform a subsequent review.

2.26. The GB SQSS subgroup recommends the following minimum levels of security for offshore cable connections that are used to connect one or more offshore wind farms to an onshore network:

- for outages (planned or unplanned) of offshore transmission circuits (i.e. offshore transmission AC and DC cables) the loss of infeed should not exceed 1500MW.

2.27. As part of its cost benefit analysis work, the GB SQSS subgroup considered wind farms up to a capacity of 1500MW (reflecting the sizes of all current developments). The GB SQSS subgroup recommends a limit of 1500MW based on

[2] The maximum export capacity of the generator is equal to the system access provided.

the information available at this stage and notes that this limit may benefit from subsequent review should larger offshore developments be considered.

2.28. The GB SQSS subgroup recommends that guidance should be provided within any standard developed for offshore electricity transmission network to explain the cost benefit methodology that underpins the recommended minimum security requirements.

2.29. The GB SQSS subgroup has said it considers that there is a need to define voltage limits at the offshore grid entry point and the connection point with an onshore network for offshore electricity transmission networks. The GB SQSS subgroup recommends that the appropriateness of the onshore voltage limits for offshore electricity transmission networks should be considered as part of a review of the Grid Code.

Implementation of GB SQSS Subgroup's recommendation

2.30. In considering practical implementation issues, DTI commissioned a study by the Centre for Distributed Generation and Sustainable Electrical Energy (CDGSEE). As part of this study, viable connection options for current offshore generation projects were developed applying the proposed minimum security requirements that have been recommended by the GB SQSS subgroup. A summary report for the CDGSEE study work will be published separately on the DTI website.

2.31. In summary, the conclusions of the CDGSEE study are that:

- the optimum economic and technical connection options for most of the current offshore generation projects are radial connections to an onshore system (majority at 132kV and above); and
- there is limited opportunity for adjacent offshore generation developments to share connections to the onshore system.

Our initial view

2.32. We consider that the work carried out by the GB SQSS subgroup has met the objectives set out in the terms of reference. We commend the GB SQSS subgroup for the quality of work completed in a very short timeframe. We are also satisfied that the analysis on which the GB SQSS subgroup's recommendation is based has adequately taken account of the need:

- for existing transmission licensees to meet their existing GB SQSS compliance requirements in respect of the onshore transmission network;
- to minimise the overall level of transmission costs;
- to ensure the safe operation of all transmission circuits;
- to clearly and robustly define all aspects of the security rules framework to minimise the risk of misinterpretation when applying rules relevant to the planning and operating of transmission networks;
- for no undue discrimination on a geographic basis;

- to ensure consistency and compatibility with onshore markets and industry structure; and
- to promote equality of treatment in respect of system access for transmission users across GB.

2.33. We are seeking views on whether the recommendation made by the GB SQSS subgroup is a suitable basis for the development of a security standard for offshore electricity transmission networks. In particular, we invite views on the:

- default offshore grid entry point (i.e. boundary between generator and offshore transmission network) assumed by the GB SQSS subgroup;
- scope of the cost benefit analysis work undertaken by the GB SQSS subgroup;
- conclusions drawn by the GB SQSS subgroup from the results of the cost benefit analysis work;
- sensitivity analysis carried out by the GB SQSS subgroup to validate the recommendations made given the uncertainties relating to the information used for the cost benefit analysis work; and
- recommended minimum levels of security for offshore substations and for offshore cable connections.

2.34. We note that the GB SQSS subgroup's recommendation reflects the view that the transmission capacity requirement should, as a minimum, be equal to the capacity requested by the generator. We acknowledge that the rationale for this view is that the generator will take account of diversity[3] when assessing the export required for the installed wind farm capacity.

2.35. We also note the alternative view considered by the GB SQSS subgroup that the transmission capacity requirement should be assessed by the transmission licensee and be at least 90% of the installed capacity of the offshore wind farm for connections to single wind farms. We acknowledge that this view is based on results from the cost benefit analysis carried out by the GB SQSS subgroup that demonstrated that it would be economic for transmission capacity to be provided for 90% of installed wind farm capacity.

2.36. We invite views on both these options for defining the minimum security requirements for offshore electricity transmission networks that connect a single wind farm to an onshore network.

2.37. It is not anticipated that development of the GB SQSS to include security standards for offshore electricity transmission networks based on the GB SQSS subgroup's recommendation would significantly change the security and quality of supply delivered and costs to onshore users of the GB transmission system. However, we invite views on possible impacts of implementing the GB SQSS subgroup's recommendation on the:

[3] Explained in paragraph 1.39 of the recommendation.

- security of supply delivered to existing customers of the GB transmission system; and
- costs of operating the GB transmission system.

2.38. We accept that for the level of security required for connection of an offshore generator would be substantially different under this recommendation from that required for the connection of an onshore generator. We intend that such matters should be taken into account as part of the commercial arrangements for generators connecting to offshore electricity transmission networks.

3. Further issues

Question 1: Do you agree that the work areas identified by the GB SQSS subgroup should be considered further as part of the work to develop regulatory arrangements for offshore electricity transmission networks?

Further work

3.1. The GB SQSS subgroup presented recommendations at the open OTEG meeting on 29th September 2006. The GB SQSS subgroup noted a number of areas of further work that it had identified when carrying out its review work.

3.2. The GB SQSS subgroup offered to further consider the:

- level of security required for demand connections offshore;
- appropriate level of security for generating plant with higher annual capacity factor (than assumed for wind) which are installed offshore; and
- requirements for voltage limits for offshore electricity transmission networks.

3.3. The GB SQSS subgroup also recommended that OTEG should consider the:

- scope of and timetable for Grid Code review work. In particular the GB SQSS subgroup recommends that the assumptions that it made as part of its review work should be considered as part of the Grid Code review work; and
- appropriate treatment of embedded transmission connections (offshore electricity transmission networks connecting to an onshore distribution network).

3.4. We invite views on the need for further consideration of the matters identified by the GB SQSS subgroup.

Appendices

Index

Appendix	Name of Appendix	Page Number
1	Consultation response and questions	17
2	The GB SQSS subgroup recommendation	19
3	Appendix to the GB SQSS subgroup recommendation	33
4	The Authority's powers and duties	50
5	Glossary	52
6	Feedback questionnaire	55
7	Government consultation code of practice criteria	56

Appendix 1 - Consultation Response and Questions

1.1. Ofgem and DTI would like to hear the views of interested parties in relation to any of the issues set out in this document.

1.2. We would especially welcome responses to the specific questions which we have set out at the beginning of each chapter heading and which are replicated below.

1.3. Responses should be received by 22 January 2007 and should be sent to:

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1.4. Unless marked confidential, all responses will be published by placing them in Ofgem's library and on Ofgem and DTI's websites www.ofgem.gov.uk and www.dti.gov.uk. Respondents may request that their response is kept confidential. Ofgem and DTI shall respect this request, subject to any obligations to disclose information, for example, under the Freedom of Information Act 2000 or the Environmental Information Regulations 2004.

1.5. Respondents who wish to have their responses remain confidential should clearly mark the document/s to that effect and include the reasons for confidentiality. It would be helpful if responses could be submitted both electronically and in writing. Respondents are asked to put any confidential material in the appendices to their responses.

Next steps: Having considered the responses to this consultation, the Government will then make a decision and publish the proposed legal text for an offshore security standard in mid-2007. The entire offshore electricity transmission regime is intended to come into force in 2008.

1.6. Any questions on this document should, in the first instance, be directed to:

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CHAPTER: One

There are no questions in this chapter.

CHAPTER: Two

Question 1: Do you consider that the GB SQSS subgroup's recommendation is a suitable basis for developing a security standard for offshore electricity transmission networks?
Question 2: Do you consider that the default offshore grid entry point (i.e. boundary between generator and offshore transmission network) assumed by the GB SQSS subgroup is appropriate?
Question 3: Do you consider that the scope of the cost benefit analysis work undertaken by the GB SQSS subgroup was adequate?
Question 4: Do you consider that the conclusions drawn by the GB SQSS subgroup from the results of the cost benefit analysis work are valid?
Question 5: Do you consider that the sensitivity analysis carried out by the GB SQSS subgroup to validate the recommendations made given the uncertainties relating to the information used for the cost benefit analysis work was adequate to test the robustness of the conclusions drawn?
Question 6: Do you consider that the recommended minimum levels of security for offshore substations and for offshore cable connections are appropriate?
Question 7: How should the minimum security requirements for offshore electricity transmission networks that connect a single wind farm to an onshore network be defined?
Question 8: Would extension of the GB SQSS to reflect the GB SQSS subgroup's recommendation have a significant impact on onshore users of the GB transmission system?
Question 9: Would any aspect of the GB SQSS subgroup's recommendation result in practices that can be considered discriminatory?

CHAPTER: Three

Question 1: Do you agree that the work areas identified by the GB SQSS subgroup should be considered further as part of the work to develop regulatory arrangements for offshore electricity transmission networks?

Appendix 2 – GB SQSS subgroup recommendation

Recommendations for the coverage of offshore transmission networks in the Great Britain Security and Quality of Supply Standard

Summary

1.1. This paper sets out the recommendations of the GB SQSS subgroup for the coverage of offshore transmission networks in the GB SQSS (a copy of the terms of reference for the subgroup along with a list of members can be seen in Appendix3). The paper also describes the methodology used, the results of its assessment and provides a description of the sensitivity analysis carried out to validate the recommendations made.

1.2. Consistent with other security standards, a cost benefit analysis approach was used to determine the optimum economic and technical security standard for offshore transmission networks. The analysis identified key parameters which impacted on the proposed solution and considered a large number of permutations to demonstrate the robustness of the recommendations against varying input data.

1.3. Based on the results of this analysis, it is considered that the onshore GB SQSS planning and operational standards:

- are not appropriate for application to offshore transmission network development; and
- require amendment to facilitate the inclusion of offshore transmission networks.

1.4. These recommendations have taken account of a number of working assumptions which have been developed to determine the optimum economic solution for offshore transmission networks.

1.5. The recommendations made by the subgroup are:

a. The security standard for the offshore transmission network can be separated into two main sections:
- the offshore platform (i.e. the AC transformer circuits, platform LV interconnection circuits and HVDC converters on the offshore platform); and
- the offshore cable network (i.e. the transmission cable circuits linking the onshore network and the offshore platform).
- Each should be considered separately for single and multiple wind farm connections[4].

[4] The number of wind farms (single or multiple) can be determined by the number of users

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b. For single wind farm connections, both the offshore platform and cable network capacity should, at a minimum, be equal to the maximum export[5] capacity of the wind farm connected, with appropriate advice when less capacity can be installed.
c. For multiple wind farm connections, both the offshore platform and cable network capacity should, at a minimum, be equal to 90%[6] of the cumulative installed capacity of the wind farms connected.
d. For wind farms with a capacity of 120MW or greater, following an outage (planned or unplanned) of any offshore platform AC transmission circuit, there should be, at a minimum, be 50% of the installed platform export capacity remaining.
e. For wind farms connected using HVDC technology, following an outage (planned or unplanned) of any single offshore platform DC converter module, the loss of power infeed shall not exceed the existing onshore Normal Infeed Loss Risk. (1000MW)[7].
f. For outages (planned or unplanned) of offshore transmission circuits (i.e. offshore transmission AC and DC cables) the loss of infeed should not exceed 1500MW[8].

1.6. In line with the existing GB SQSS, it is recommended that the offshore transmission security standards allow the transmission licensee to meet a Generator's request for security above or below the minimum planning standard provided there is no adverse impact on any other user, the Main Interconnected Transmission System (MITS) or the GB transmission licensees.

1.7. In making this recommendation it is noted that there could be significant generation connected via a single offshore transmission cable circuit, resulting in a risk to the generator and/or offshore transmission System Operator (SO). The consequential impact of this recommendation on the access rights, compensation arrangements and transmission charging for offshore generation is outside the scope of work of the subgroup and has therefore not been considered.

connected to the offshore transmission network.

[5] The maximum export capacity of the generator is equal to the system access provided. The maximum export capacity is considered for single wind farm connections because the user is best placed to know the achievable output of their wind farm and apply for the most economic export capacity for their business. This would benefit from wider industry consultation as highlighted in paragraph 1.40.

[6] This value is due to the cost of offshore transmission asset installation to the full capacity of connected wind farms given the probability that the wind farm will generate at full output due to wind diversity. Should this de-rating cause installation of assets that are marginally required, this value should be reviewed. Subsequently, transmission capacity lower than this amount could be installed provided it could be justified to be economic and efficient.

[7] HVDC converter technology is not available for modules above 1000MW, therefore reliability and cost data was not available to assess this limit. Analysis has indicated that subject to the availability and reliability of larger converters it may be possible to increase this limit.

[8] The 1500MW limit is bound by the scope in the cost benefit analysis. Should there be a requirement for a wind farm connection of a size greater than this, the value should be reviewed.

Background

1.8. The Ofgem scoping document on 'Offshore electricity transmission' published in April 2006 identified issues that required further consideration in implementing an offshore electricity transmission regime. The scoping document noted that this work should be taken forward in conjunction with government and industry through a working group, to be called OTEG.

1.9. At the OTEG meeting on 4 May 2006 it was decided to establish a subgroup to undertake review work to assist Ofgem/DTI decisions relating to offshore transmission system security requirements. The GB SQSS subgroup report to OTEG who provide a single point of contact to address any issues that arise from the GB SQSS subgroup discussions.

1.10. The purpose of the GB SQSS subgroup is to assist OTEG by completing a review of the current GB SQSS and consequently considering:

- whether it is appropriate to apply to the present onshore standard to offshore transmission networks;
- if amendments are needed to extend the GB SQSS offshore; and
- the range of options that exist for alternative security standards for offshore transmission networks.

1.11. The GB SQSS subgroup has noted the above requirements in undertaking a review of the security requirements for offshore networks. The existing GB SQSS was used as a basis to determine requirements for offshore transmission networks.

1.12. A full review of the standard can be seen in Appendix 3, and has concluded that the areas that require detailed review for the inclusion of offshore transmission networks are:

- Chapter 2 – Design of Generation Connections ; and
- Chapter 6 – Voltage limits in planning and operating the GB transmission system.

Analysis work undertaken

Approach to the analysis

1.13. The existing GB SQSS is based upon a security standard that has taken account of the need to build a transmission system that is economic, efficient, and resilient to all secured events stated, whilst also stipulating the maximum loss of power infeed that can occur for outages of transmission system assets.

1.14. A cost benefit analysis approach has been used to determine the optimum security standard for offshore transmission networks. This analysis has identified key parameters which impact on the proposed solution and considered a range of possible values to demonstrate the robustness of proposals against variation of input data.

1.15. This analysis has considered all wind farm connections presently anticipated to connect to an offshore transmission network, along with the characteristics of the assets to be installed in the network that will have an impact on the outcome of the analysis. Generic offshore wind farms have been modelled to include the consideration of single and shared, AC and DC connections. The objective of this analysis was to determine the optimum economic and technical solution for an offshore network connecting to the onshore electricity grid system.

1.16. For this analysis it is assumed that offshore transmission networks will be cable circuits for the connection from the offshore high voltage platform to the first substation that the circuit reaches onshore. A review of the proposed connection designs for a number of Round 1 and 2 wind farms has been carried out to confirm this assumption and can be seen in Appendix 3.

1.17. Only three relatively small offshore wind farm substations have been built worldwide so far and only one offshore HVDC converter station, therefore reliable outturn cost data is not available. Cost estimates based on recent competitive tenders have been provided by contractors through their trade body BEAMA Power Ltd.

1.18. The subgroup has verified the cost benefit analysis dataset, based on several series of data and using existing reports where available. Due to the uncertainties and number of assumptions that have had to be made, a comprehensive sensitivity analysis to test the validity of the recommendations to variations in key items of data has been performed. A full list of the data used in the analysis can be seen in Appendix 3.

1.19. The following key input parameters were varied to determine their critical point:

- transformer / cable Mean Time To Repair (MTTR);
- value of energy curtailed;
- offshore substation distance from shore; and
- cable failure rates / reliability.

1.20. These parameters were then compared to the cost of installing additional offshore assets. The analysis has considered the costs associated with the expected energy curtailed, but has not considered the apportionment of these costs.

1.21. As part of the GB SQSS review, an assessment of all work of a similar nature was carried out to ensure the cost benefit analysis work was consistent with published reports. A comparison to the KEMA ‘Connect I’ and ’Connect II’ reports has been carried out, and it was concluded that the analysis carried out by the subgroup is consistent with that of the KEMA reports.

Scope

1.22. The GB SQSS subgroup reviewed the scope of offshore transmission to ensure that the review of the GB SQSS adequately covers the assets which are likely to be part of an offshore transmission system. As noted in Assumption 8 in Appendix 3, the offshore transmission system considered for this assessment is illustrated below. Consideration of designs for proposed offshore wind farm developments currently in the planning process have informed a working assumption that offshore transmission systems will be radial connections to an onshore system (transmission or distribution).

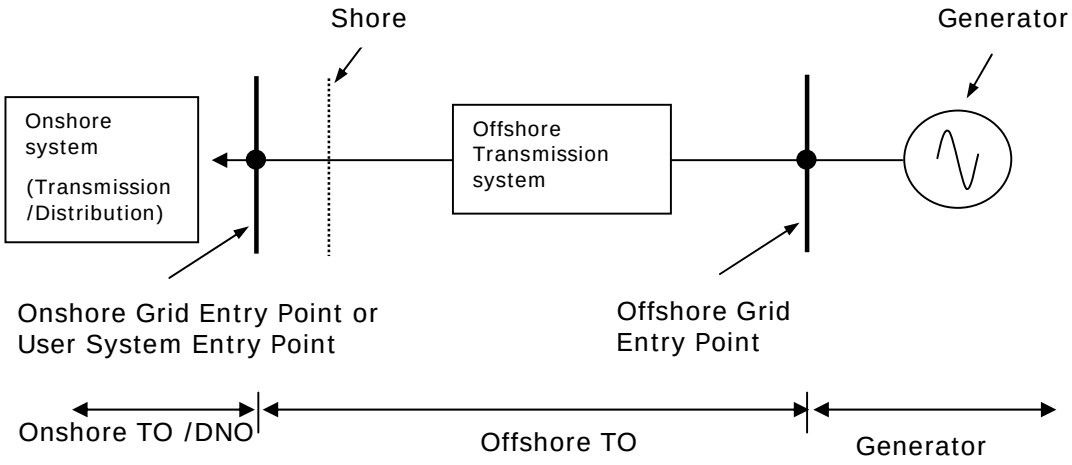

Figure 1: Designation of offshore transmission system

1.23. Figure 1 shows this type of radial connection and the two interface points for a radial offshore transmission system, the Onshore Grid Entry Point (or Onshore User System Entry Point) and Offshore Grid Entry Point.

1.24. Figure 2 shows an example of the expected connection arrangements at an offshore high voltage platform. Four options for the Offshore Grid Entry Point were considered. These options took account of both existing arrangements in Great Britain and current proposals for offshore generation projects that are being developed. A full assessment of the options has been carried out and can be seen in Appendix 3. The subgroup consider the preferred option shown in figure 2 to be the most appropriate default Offshore Grid Entry Point because this option:

- best facilitates competition in generation;
- simplifies ownership of offshore platform assets;
- allows the offshore TO to provide Users with a consistent level of security; and
- is deemed to be consistent (if more than one party is connected) with the default boundary arrangements defined in the CUSC and STC.

1.25. The GB SQSS subgroup has assumed that the default Offshore Grid Entry Point will be at the disconnector on the busbar side of the circuit breaker on the outgoing wind farm circuits on the offshore platform as part of its analysis work.

1.26. It has been noted that as offshore transmission will be 132kV and above in England and Wales, there will be a number of cases where the offshore transmission network will be connect to a DNO network. This issue has been highlighted by the GBSQSS subgroup which recommends that this be considered by OTEG outside the scope of the GBSQSS review.

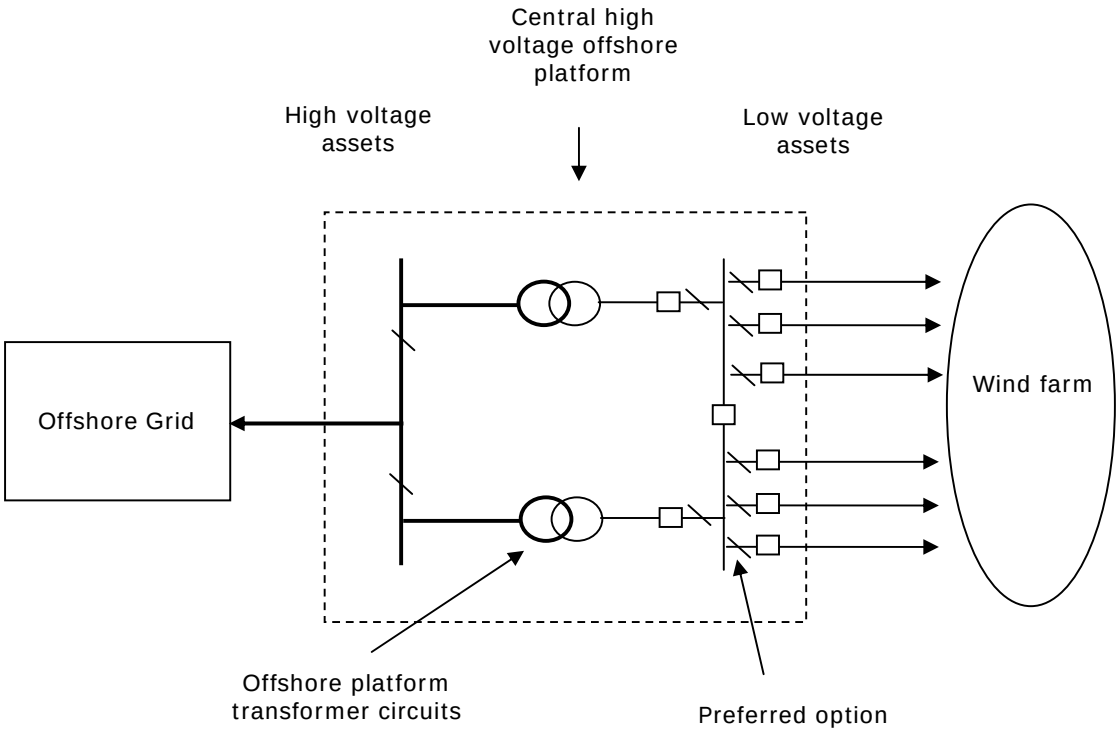

Figure 2: Options for Offshore Grid Entry Points

Assumptions made

1.27. The recommendations reached by the subgroup take into account a number of assumptions which can be seen in full in the assumptions register in Appendix 3. The key assumptions that have been made are:

- offshore transmission is classed as 132kV and above;
- offshore transmission networks will be radial connections to the onshore electricity network;
- the work carried out by the subgroup will consider the connection of wind generation only to offshore electricity transmission networks;
- values used for MTTR assume replacement transformers are available for a failed unit;

- Grid Code conditions will require review, however are outside of the scope of the GB SQSS review. This review of the Grid Code will need to take account of the recommendations and assumptions made by the GB SQSS subgroup;
- no consideration has been given to the financial compensation arrangements for loss of transmission system access or the relevant offshore transmission charging arrangements; and
- no consideration has been given to the security of connection on the distribution network should offshore transmission network connect to the DNO network.

Uncertainties / Risks

1.28. In the UK there is no future guaranteed value of Renewable Obligation Certificates ('ROCs'), therefore a range of values has been considered in the cost benefit analysis.

1.29. The technology currently available for offshore generation / transmission projects has generally been designed specifically for the individual project; therefore there is limited data available for use in the analysis. Given the expected technology advances along with possible reductions in costs as the scale of offshore investment increases, the output of this cost benefit analysis is subject to potential change should the cost of installing offshore transmission assets change substantially from those installed.

1.30. The cost benefit analysis has tested parameters that would have a significant impact on the outcome of the analysis. An illustration of this can be seen in Appendix 3, the cost benefit analysis summary report.

1.31. The analysis that has been carried out to date has assumed the connection of wind generation. The connection of other forms of generation would therefore require an additional review of the GB SQSS at a later date.

Offshore transmission voltage requirements

1.32. Consideration has been given to existing onshore arrangements along with other potential options for voltage requirements for offshore transmission networks, a full report can be seen in Appendix 3.

1.33. It is recommended that voltage limits will apply at the offshore platform and as a starting point these should be considered to be the same as those currently applied for onshore transmission. The subgroup however recommends these limits should be reviewed to ensure they are optimised for the application to offshore transmission networks. At the interface between the offshore TO and the onshore electricity network, Grid Code requirements currently placed on offshore generators should be duplicated in the GB SQSS for offshore networks to reflect the reactive power transfer and voltage control requirements placed upon an offshore TO.

Analysis results

1.34. It should be noted that the cost benefit analysis has been based upon finding the overall optimum technical and economic solution. This has taken account of the costs and benefits of an offshore transmission system.

1.35. The cost benefit analysis has assumed a dataset as agreed by the subgroup. The values within the data set have been tested to find the boundary level that they would have to reach, in order to change the output of the analysis.

1.36. The analysis has taken account of wind farms up to 1500MW capacity and ranging between 25km to 100km from the onshore electricity grid connection point. The appropriate HV and LV switching arrangements have not been considered.

1.37. On the basis of the results of the cost benefit analysis, the security for offshore transmission networks can be assessed in two sections; the offshore platform (including AC transformers and DC converters), and the cable network (between the offshore platform and the relevant onshore network). The main recommendations reached are shown in the recommendations section below.

1.38. The cost benefit analysis has concluded that for wind farms with an export capacity of 120MW or greater, it is more economical to install greater than the minimum number of AC platform circuits in order to meet required wind farm export capacity, e.g. two 60MW transformers / interconnecting circuits are more economical than one 120MW transformer / interconnecting circuit.

1.39. Due to the dispersed location of offshore wind generators, statistically there is a low probability that full output of all individual wind generators will be available at any given time. The cost benefit analysis has concluded that for the connection of multiple wind farms, the offshore network capacity should be planned to 90% of the cumulative installed capacity of the wind farms connected due to the cost of installing offshore transmission assets to the full capacity. In the case of multiple user connections, output diversity can be taken into account by the offshore TO when determining the level of system capacity required, without restricting users' export. In cases where marginal additional assets are required, consideration should be given to installation of network capacity below 90% if it can be justified to be economic and efficient. Guidance on this process should be provided in an appendix to the security standards.

1.40. In the case of single wind farm connections, the user is expected to apply for an export capacity to match their achievable output and it has been noted that the individual user would be in the best position to determine this output level. For single wind farm connections, restriction on user export could occur if the system capacity is lower than the requested export capacity. Therefore the transmission entry capacity requested by the user in the case of a single connection will need to be available. This approach is consistent with the on-shore GB SQSS, but it has been noted that this could lead to increase in investment and it would be beneficial to consult with the wider industry.

Sensitivity assessment

1.41. A number of key items of the input data to the cost benefit analysis have been tested to determine at what level they would change the outcome of the cost benefit analysis. A full list of the sensitivities considered can be seen within Appendix 3 – the cost benefit analysis data set. A summarised report detailing the output of the cost benefit analysis can be seen in Appendix 3, this document illustrates a number of the values that have been tested.

GB SQSS Subgroup Recommendation for criteria for the new Standard

1.42. In making these recommendations it should be noted that these apply to both the planning and operation of offshore transmission networks.

1.43. Based on the result of this analysis, it is considered that the onshore GB SQSS planning and operational standards are not appropriate for application to offshore transmission network development due to the relative cost and available ratings of offshore transmission assets that would be required to be installed for compliant network designs.

1.44. The cost benefit analysis was undertaken on the basis that the security standard should not be technology specific. The conclusion to the analysis is that, to ensure clarity, the standard could be written differently for the use of AC and DC technology at the offshore platform.

1.45. It should be noted that offshore wind farms proposing to connect using HVDC are likely to make use of voltage-source converter (VSC) technology. There is no reliability and cost data available for converters in excess of 1000MW, therefore it is not possible to assess the use of converters for single module connections above this value of 1000MW. It is therefore considered prudent to limit the largest connection to a single converter module at the existing onshore Normal Infeed Loss Risk (1000MW). Based on predicted estimates of failure rate provided by manufactures, analysis suggests that the loss of power infeed resulting from a single converter module could be above this value, however this should be assessed once the technology is available.

1.46. It is recommended that for multiple wind farm connections, the offshore network capacity is planned to accept 90% of the installed capacity of wind farms connected, due to the cost of installing offshore transmission assets to full capacity. In all cases where this value requires marginal additional assets to be installed, consideration should be given to installation of network capacity below 90% if it can be justified to be economic and efficient. Guidance on this process should be provided in an appendix to the security standards.

1.47. The recommendation for offshore GB SQSS is that the security assessment for offshore transmission networks can be considered in three sections.

Offshore platform (AC transformers, AC platform interconnection circuits and DC converters)

- AC platforms should be designed such that the High Voltage and Low Voltage terminals of the platform circuits are interconnected to allow for full flexibility of use of all assets housed upon it.
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- For single wind farm connections:
- Platform capacity should be planned to accept the export capacity of the wind farm with no equipment loadings exceeding their pre-fault rating.
- For AC platform designs; for wind farms with an export capacity of 120MW or greater, following the outage (planned or unplanned) of a single offshore platform AC transmission circuit, the reduction in platform export capacity should not exceed 50% of installed platform capacity. For the avoidance of doubt, this should not exceed 1000MW.
- For DC platform designs; platform capacity should be planned such that following the outage (planned or unplanned) of a single offshore platform DC converter module, the loss of power infeed shall not exceed existing onshore Normal Infeed Loss Risk (1000MW)[9].
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- For multiple wind farm connections:
- Platform capacity should be planned to accept 90% of the cumulative installed capacity of the wind farms connected, with no equipment loadings exceeding their pre-fault rating.
- For AC platform designs; for wind farms with a cumulative installed capacity of 120MW or above, following the outage (planned or unplanned) of a single offshore platform AC transmission circuit, the reduction in platform export capacity should not exceed 50% of the installed platform capacity. For the avoidance of doubt, this should not exceed 1000MW.
- For DC platform designs; platform capacity should be planned such that following the outage (planned or unplanned) of a single offshore platform DC converter module, the loss of power infeed shall not exceed existing onshore Normal Infeed Loss Risk (1000MW).
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- Following the unplanned outage of a single offshore transmission platform circuit during the planned outage of an offshore transmission platform circuit, the reduction in platform capacity should not exceed 1320MW.

[9] HVDC converter technology is not available for modules above 1000MW, therefore reliability and cost data was not available to assess this limit. Analysis has indicated that subject to the availability and reliability of larger converters it may be possible to increase this limit.

Offshore network capacity (AC / DC cables)

- For single wind farm connections the transmission cable circuit capacity should be planned to accept the export capacity of the wind farm with no equipment loadings exceeding the pre-fault rating.
- For multiple wind farm connections the transmission cable circuit capacity should be planned to accept 90% of the cumulative installed capacity of the wind farms connected to it, with no equipment loadings exceeding their pre-fault rating.
- Following the outage of a single offshore transmission cable circuit, the reduction in cable circuit capacity should not exceed 1500MW. This value is bounded by the limit in scope of the cost benefit analysis, i.e. can allow up to 1500MW to be connected to a single transmission cable circuit.
- Following the unplanned outage of a single offshore transmission cable circuit during the planned outage of an offshore transmission cable circuit, the reduction in circuit capacity should not exceed 1500MW. This value is bounded by the limit in scope of the cost benefit analysis.

Voltage requirements

- Voltage requirements for offshore networks should include the interface with the onshore network, particularly with respect to reactive power transfer. It is recommended that the existing Grid Code obligations CC.6.3.2(b), CC.6.3.2(c) and CC.6.3.8(c) on generators, at the point of connection, be adopted at the connection point of an offshore transmission network to an onshore system. Note that studies to inform this issue are ongoing.
- Steady-state operational and planning voltage limits based on the existing limits for onshore transmission networks should be adopted. However, the nominal voltages will have to be adapted to cover a wider range of voltages.
- Engineering Recommendation P28 compliance should not be required in an offshore network except at the point of connection with the onshore network. For secured events voltage fall should not exceed –6% (may be relaxed to -12% for certain major events) and voltage rise should not exceed +6%. For operational switching at intervals of less than 10 minutes, a maximum voltage fall of –6% is allowable. Note that, due to the possible impact on equipment, consultation with manufacturers on offshore voltage-step limits is ongoing.

1.48. It is recommended that the voltage requirements for offshore transmission networks at the connection to onshore networks should be contained within the security standards for offshore transmission networks. This recommendation is in line with existing arrangements. It is recommended that any future Grid Code subgroup of OTEG takes account of this recommendation in their assessment of Grid Code requirements for offshore wind farms connecting to offshore transmission networks[10].

[10] It has been assumed that Grid Code requirements on offshore wind farms will apply at the

1.49. In line with the existing GB SQSS, it is recommended that the offshore transmission security standards allow the transmission licensee to meet a Generator's request for security above or below the minimum planning standard provided there is no adverse impact on any other user.

1.50. It should be noted that due to the expected radial nature of connections to the onshore network, there could be large volumes of generation connected via a single offshore transmission circuit, resulting in a risk to the generator and / or offshore transmission SO. The consequential impact of this recommendation on the access rights, compensation arrangements and transmission charging for offshore generation is outside the scope of the subgroup work and has therefore not been considered.

1.51. It should be noted within the standard that for the connection of demand to the offshore transmission network, a review will be required of the security of connection to be provided. At the time of writing this recommendation, it is not envisaged that there will be any demand connections in the foreseeable future.

1.52. It should be noted that if the offshore transmission system is operated in parallel with the onshore transmission network then the MITS standards will apply to the relevant section of offshore transmission network.

1.53. A full review of the GB SQSS Terms and Definitions will be required as part of the drafting required implementing this recommendation in the GB SQSS.

1.54. Given the results of the cost benefit analysis have shown that in certain cases there would be a requirement to consider the use of alternative technologies further, it is recommended that the existing GB SQSS appendix dealing with cost benefit analysis be extended to include consideration of offshore networks.

1.55. It should be noted that the existing GB SQSS appendices should be reviewed at the same time as the drafting of the GB SQSS wording for the inclusion of offshore transmission networks to ensure consistency with existing standards.

Issues and further work for OTEG consideration

1.56. The GB SQSS subgroup identified the following issues for consideration by OTEG:

point of connection to the offshore network and no longer at the connection point to the onshore transmission network. This change to the point of application of the requirements may also necessitate a change to the detailed Grid Code requirements that would apply.

- In Great Britain there are no obligations on a DNO to provide secure access rights to embedded generation. In the case of an offshore transmission network connecting to a DNO network, the offshore transmission network will be designed to meet the minimum planning standards defined in the GB SQSS, however the DNO network it is connecting to will limit the access available to the offshore generator. This causes both contractual interface issues as well as technical issues, as the design of a transmission network offshore may be un-economic if the on-shore network is unable to deliver the power to the end consumer. Although not considered by the subgroup, DNO access rights are a major commercial consideration for users of the offshore transmission network. This issue has been highlighted by the GB SQSS subgroup, and recommend that this be considered by OTEG outside the scope of the GB SQSS review.
- Any Grid Code review will need to take account of recommendations and assumptions made by the GB SQSS subgroup.
- The consequential impact of this recommendation on the access rights, compensation arrangements and transmission charges for offshore generation should be considered.
- Note the unintended consequence of this recommendation whereby the contractual structures in the recommendation have the potential to be exploited when connecting single and multiple users.

1.57. The GB SQSS subgroup identified the following further work to be considered:

- The security requirements for demand connected to offshore transmission networks.
- The security requirements for offshore networks connecting generating plant with a higher annual capacity factor (e.g. offshore CCGT, tidal).
- The impact that this recommendation will have on the connection of generation where geographically proximate to any island off mainland England, Wales and Scotland. In line with the recommendation presented, in this case the connection of offshore generation could require different levels of capital investment where the offshore generation connects to the island or connects straight to the mainland, as illustrated in figure 3.

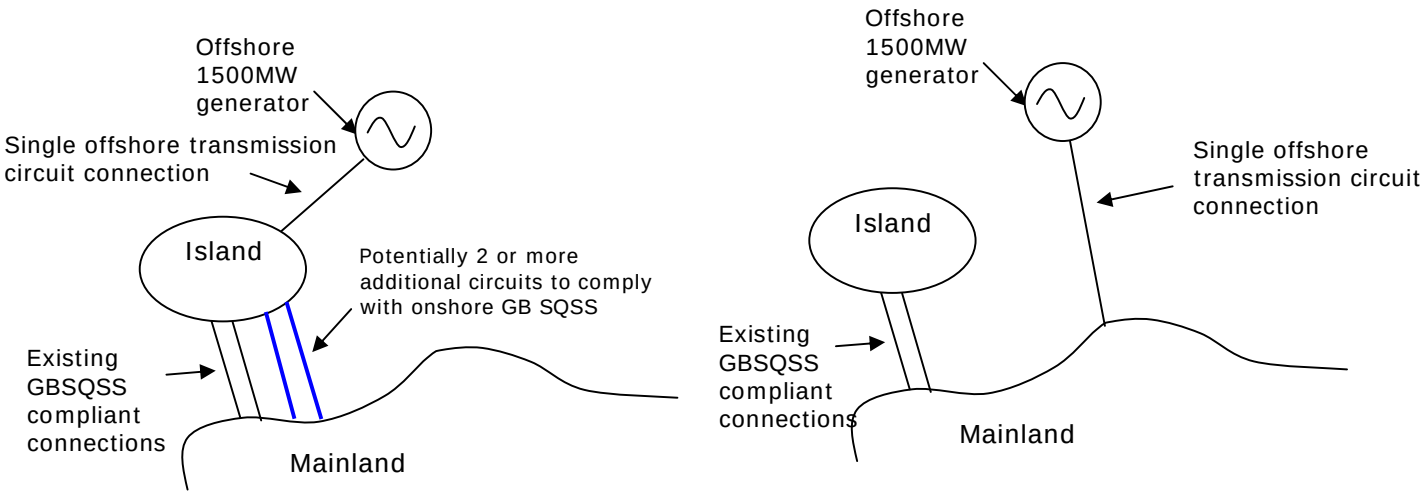


Figure 3: Connection of generation geographically proximate to an island off mainland England, Wales or Scotland

1.58. The GB SQSS subgroup identified the following further work to be considered with timescales to be advised by OTEG.

- The GB SQSS subgroup has provided a recommendation on the voltage requirements for offshore transmission, the specific voltage limits have not been considered. This will be required prior to the drafting of the standard to include offshore transmission.
- Feed into, if requested, discussions on Embedded Transmission.
- Feed into, if requested, discussions on access rights and compensation arrangements.
- In a limited number of cases it could be more economical to install Low Voltage (LV) interconnection between offshore transmission platforms to avoid installation of additional transformers. The ownership of these circuits at voltages below 132kV should be considered.

Appendix 3 – Appendix to the GB SQSS subgroup recommendation

Terms of reference for the GB SQSS sub group of OTEG

Background

1.1. The Ofgem scoping document published in April 2006 identified the issues that require further consideration in implementing an offshore electricity transmission regime. One of the identified work streams was the need to review the existing technical rules governing onshore networks to see how they could be made to work offshore.

1.2. At the first meeting of OTEG on 4 May 2006 it was decided to establish a sub group ('the GB SQSS sub group') to undertake review work to assist Ofgem/DTI decisions relating to offshore transmission system security requirements. The GB SQSS sub group will report to OTEG who will oversee the progress of this specialist sub group. OTEG will also provide a single point of contact to address any issues that arise from the GB SQSS sub group discussions.

Composition of the sub group

1.3. *OTEG is of the view that the GB SQSS sub group requires a focussed membership reflecting the complex technical nature of the issues that the sub group will be required to consider. Accordingly, membership of the GB SQSS* sub group will be limited to representatives from parties who had direct involvement in the development of the recent process under BETTA to harmonise onshore GB SQSS and parties who are, or will soon be, directly and significantly involved and experienced in the development of imminent offshore transmission networks.

1.4. The GB SQSS sub group is proposed to comprise of the three transmission licensees (NGET is expected to provide representation of its GBSO and its TO interests) and those offshore developers who at present have received offers for connection to onshore networks.

1.5. OTEG will have the right to invite other representatives (e.g. distribution licensees, offshore transmission equipment manufacturers) should the GB SQSS sub group consider that such expert knowledge is required.

1.6. The number of representatives from each party will be limited to one (other than NGET who will be limited to one representative of its GBSO activity and one representative of its TO activity). Each representative will be able to invite an additional technical advisor to sub group meetings as required. The chair of this sub group will be appointed by OTEG. The sub group at their first meeting will be required to appoint a secretary. It is recommended that these roles are filled by industry representatives.

1.7. Representatives from Ofgem and DTI will also be invited to the sub group meetings. The frequency, timing and location of the meetings will be agreed at the first meeting.

Purpose

1.8. The GB SQSS sub group is an advisory body, not a decision making body. The purpose of the group is to assist OTEG by completing a review of the current GB SQSS and consequently considering:

- whether it is appropriate to apply to the present onshore standard to offshore transmission networks;
- if amendments are needed to extend the GB SQSS offshore; and
- the range of options that exist for alternative security standards for offshore transmission networks.

Participation

1.9. Participants at any sub group acknowledge and agree that any draft text disclosed to them is confidential and must not be disclosed to any other person, business or undertaking other than the participants in the sub group meeting, their employees directly involved with this work and their advisors directly involved with this work or as the participants in the sub group may agree.

1.10. While the active participation of participants in any sub group is sought with the evaluation of technical rules, all participants acknowledge and agree that Ofgem/DTI are ultimately responsible for determining the form and content of the security standards relating to offshore transmission networks and any discussion in meetings and views expressed or implied in such discussion or document are entirely without prejudice to and shall not limit the discretion of Ofgem/DTI with regard to the final form and content of the document.

1.11. The participants also acknowledge and agree that the participation (including any discussion in meetings and views expressed or implied in such discussion or papers) in meetings, is entirely without prejudice and shall not limit the discretion of the licensees to comment during any future consultation of any Ofgem/DTI proposals published concerning the security standards relating to offshore transmission networks.

Deliverables

1.12. The GB SQSS sub group will be required to provide:

- a report to OTEG detailing the sub group's review of the current GB SQSS identifying any issues associated with its application offshore;
- recommendations to OTEG identifying feasible options for security standards relating to offshore transmission networks, the rationale supporting potential options and the views of the subgroup on each option; and

- responses to technical queries as referred by OTEG.

Objectives

1.13. Ofgem/DTI's initial stance is that there may be merit for a single set of standards to apply across the whole of GB and within relevant offshore areas, since this:

- builds on the harmonised arrangements delivered as part of BETTA; and
- ensures consistency between onshore and offshore transmission arrangements.

1.14. However the options presented by the subgroup will need to consider whether there are justifiable and workable alternatives to this.

1.15. The specific objectives of the GB SQSS sub group are as follows:

- Develop a framework of security rules that can be applied to offshore transmission networks that is compatible and consistent with the current onshore transmission network and market structure
- To achieve this it will be necessary to assess the relevance of the existing GB SQSS for offshore transmission networks in the first instance and, if required, to outline any amendments that are needed to extend the GB SQSS offshore
- Identify and develop a range of feasible alternative options for security standards relating to offshore transmission networks.

1.16. In achieving the above objectives the GB SQSS sub group will need to take account of the need (these are listed in no particular weighting or order):

- for existing transmission licensees to meet existing SQSS compliance requirements in respect of the onshore transmission network;
- to minimise the overall level of transmission costs;
- to ensure the safe operation of all transmission circuits;
- to clearly and robustly define all aspects of the security rules framework to minimise the risk of misinterpretation when applying rules relevant to planning and operating of transmission networks;
- for no undue discrimination on a geographic basis;
- to ensure consistency and compatibility with onshore market and industry structure; and
- to promote equality of treatment in respect of system access for transmission users across GB.

1.17. The review work requested of the GB SQSS sub group:

- does not constitute a fundamental review of the need for the existing criteria within the GB SQSS in respect of the onshore transmission network;
- should not result in any need for significant additional investment in the onshore transmission network;
- should not result in any unjustified costs for offshore transmission networks;

- should not lead to any significant change to the existing security and quality of supply delivered to onshore transmission customers;
- should not result in a significant increase in the system operation costs associated with the onshore transmission network; and
- should not have an impact on the current transmission pricing methodology.

Accountability

1.18. The sub group will report to OTEG. The chair of the sub group is required to provide regular reports to OTEG and ensure that work is progressed by the sub group in accordance with OTEG's instructions.

GBSQSS sub-group members

Edgar Goddard (Chair)	National Grid
Jonathan Davies (Secretary)	National Grid
Andy Hiorns	National Grid
Bridget Morgan	Ofgem
Anthony Mungall	Ofgem
Philip Baker	DTI
Cornel Brozio	SPT
Chandra Trikha	SSE
Robert Longden	Airtricity
Matthew Knight	BEAMA
Joe Duddy	RES
Goran Strbac	SEDG Centre
Paul Newton	E.ON (part)
Claire Maxim	E.ON (part)

The present GBSQSS standard

1.19. At present, all of the security criteria to be applied when planning and operating the transmission system are contained in one document. The following is a summary of the document contents and the chapters that the GBSQSS sub-group considers would need to be changed to accommodate offshore transmission systems within the GBSQSS:

Chapter 1 – Introduction
Chapter 2 – Design of Generation Connections
Chapter 3 – Design of Demand Connections
Chapter 4 – Design of the Main Interconnected Transmission System (MITS)
Chapter 5 – Operation of the GB transmission system
Chapter 6 – Voltage limits in planning and operating the GB transmission system
Chapter 7 – Terms and Definitions

Appendices A-E

1.20. Chapter1 presents the role, scope and structure of the GBSQSS. This chapter will require amendment to reflect the additional section/s added upon the inclusion of offshore transmission networks standards into the GBSQSS.

1.21. Chapter 2 presents the deterministic criteria by which all generation connections to the GB transmission system should be connected. Within this chapter, the main points to note are:

- For the loss of a single transmission circuit, no loss of power infeed shall occur
- For the loss of a single generation circuit or busbar, the loss of power infeed shall not exceed 1000MW
- For the loss of a single circuit while one is on arranged outage the loss of power infeed shall not exceed 1320MW

1.22. As noted in assumption A03, it is assumed that all offshore transmission networks will be radial connections, therefore chapter 2 will have greatest impact on the security level employed for offshore transmission.

1.23. Chapters 3 and 4 presents the deterministic rules for the security of connection of demand and design MITS respectively. It has been assumed that there will be no demand connected to the offshore transmission networks, along with the connections being radial, therefore these chapters not been reviewed.

1.24. It is recognised that should the offshore transmission network parallel the onshore transmission system then the onshore MITS standards should apply to the offshore transmission network.

1.25. Chapter 5 details the operational criteria that must be met during the operation of the GB transmission system. The recommendations seen in this paper apply to both the planning and operation of the GB transmission system.

1.26. Chapter 6 presents the voltage limits to be met during the planning and operation of the GB transmission system. A full review of these limits has been carried out and can be seen below.

1.27. Chapter 7 states the Terms and Definitions as used throughout the GBSQSS. It is noted that there are a number of items that may require review. Revised text will follow the GBSQSS consultation.

1.28. The appendices to the GBSQSS provide supporting information to the main chapters. With the introduction of an additional section for the planning and operation of Offshore transmission networks there will be a requirement to review these to ensure their relevance to offshore application, as well as the possibility of introducing an additional appendix to highlight the methodology undertaken during the cost benefit analysis work.

Cost benefit analysis dataset[11]

Offshore windfarm

Size and distance of offshore wind farm

- Up to 1500MW wind farm (agreed by the GBSQSS sub-group)
- Up to 100km distance from shore (agreed by the GBSQSS sub-group)

Generator

- Availability 95% (BEAMA and developers)
- Sensitivity studies: 90%-100%

Value of curtailed energy and losses

- Cost of energy for evaluation of costs of losses and cost of expected energy curtailed:
- 75£/MWh. Evaluation of capitalised costs of energy: discount rate 8%, period 25 years. (agreed by the GBSQSS sub-group)
- Sensitivity studies: low value 50£/MWh, high value 100£/MWh

Wind resource

- Load factor 40%. Two profiles: (i) diversified and (ii) non-diversified across the installed windfarm
- Alternative distribution - Weibull parameters c=10, k=2 (Airtricity)

AC transmission (transformers and compensation)

Transformers

- Reliability
- Failure rate: 0.03 failures per year (Developers)
- Repair time: 4.5 months (Developers)
- Sensitivity studies: low value 3 months, high value 6 months
-
- Electrical parameters
- Load losses 0.6% (Developers)
- No-load losses 0.03% (Developers)
- Reactance: 15% (Developers)
-
- Costs of transformers + associated equipment
- £25/kVA (for two transformers on a platform) (BEAMA)
- 20% additional cost for third and each successive transformer (BEAMA)

[11] Note: the source of the data is in brackets

- 20% decrease in cost for just one transformer on a platform (BEAMA)
-
- Cost of platform
- £5m per transformer plus (BEAMA)
- 20 £/KVA (for topside structures) (BEAMA)
- Assumes 2 transformers, add 20% structure cost for each additional transformer (BEAMA)
-
- Transformer repair costs
- £2.5m / repair (BEAMA)
-
- Cost of compensation
- Offshore £25/kVAr (BEAMA)
- Onshore £15/KVar (BEAMA)
-
- LV switchgear
- Unavailability: ignored (BEAMA)
- Full flexibility assumed
- Maintenance requirements: Visual inspection 2 yrs, grease mechanism 5 years, check gas 10 years. No significant invasive work required for the 25 year lifetime of a typical windfarm. i.e maintenance ignored for this analysis. (BEAMA)
- Mean time to repair: Best case 5 days, worst case 1 month. (BEAMA)
- Fault level constraints of switchgear: Standard breaker 31.5kA, 40kA available for little increase in capital cost. (BEAMA)
- Capital cost: incorporated in transformer cost
-
- HV switchgear
- Unavailability: ignored (BEAMA)
- Full flexibility assumed

Cables

Electrical Parameters of AC 132kV and 220kV offshore cables (ABB)

Cable ratings indicative only

Nominal Voltage		132 kV				220 kV			
		$500mm^2$	$630mm^2$	$800mm^2$	$1000mm^2$	$500mm^2$	$630mm^2$	$800mm^2$	$1000mm^2$
Max continuous load	**MVA**	**169**	**187**	**203**	**217**	**279**	**308**	**335**	**359**
Conductor a.c resistance at max. temperature, R_{ac}	Ω/km	0,0493	0,0395	0,0324	0,0275	0,0489	0,0391	0,0319	0,0270
Cable a.c resistance at max. temperature, R_{ac}	Ω/km	0,0631	0,0537	0,0471	0,0431	0,0660	0,0564	0,0494	0,0448
Conductor losses per phase at 100 % load	W/m	26,86	26,34	25,66	24,76	26,19	25,47	24,71	23,92
Screen/sheath losses per phase at 100 % load	W/m	5,17	6,58	8,40	9,98	6,26	7,74	9,56	11,37
Armour losses per phase at 100 % load	W/m	2,42	2,88	3,24	4,01	2,86	3,55	3,98	4,42
Dielectric losses per phase, W_d at nominal voltage	W/m	0,140	0,153	0,158	0,173	0,276	0,306	0,330	0,359
Total losses per phase at 100 % load & nom. Voltage	W/m	34,59	35,95	37,46	38,93	35,59	37,07	38,58	40,07
Conductor temperature at 75 % load	°C	52,1	53,9	54,6	55,2	53,6	54,1	54,8	55,3
Total losses p[illegible]	[illegible]	18,0	19,5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	22,5
Conductor ten[illegible]erature [illegible]	[illegible]	29,8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31,4
Total losses pe[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10,2
Conductor temperature at 25 % load	[illegible]	16,5	16,7	16,9	17,0	16,8	17,0	17,2	17,3
Total losses per phase at 25 % load	W/m	2,0	2,2	2,4	2,5	2,3	2,5	2,6	2,8
Capacitance, per phase	µF/km	0,192	0,209	0,217	0,238	0,136	0,151	0,163	0,177
Capacitive charging current, per phase at nominal voltage	A/km	4,589	5,005	5,196	5,689	5,434	6,024	6,504	7,066
Capacitive load at nominal voltage & 50 km of cable	MVAr	52,5	57,2	59,4	65,0	103,5	114,8	123,9	134,6
Inductance between conductors, per phase	mH/km	0,387	0,372	0,364	0,351	0,437	0,415	0,400	0,386
Inductive reactance, (star reactance)	Ω/km	0,122	0,117	0,114	0,110	0,137	0,130	0,126	0,121

Note that all calculations are based on:

Thermal resitance of soil / seabed	K.m/W	0,8
Temperature at burial depth	°C	12
Burial depth	m	2
Parallel heat sources		No
Soil moisture migration		No
FXBTV cable		According to design layout

"Hotspots" such as HDD at sea-defence crossings or J-tube installations should not be a sizing factor for the cable design.

"Hotspots" (at sea-defence crossings) can be avoided by using external cooling or transition joints.

"Hotspots" (at J-tube installations) can be avoided by using "open top" or fully ventilated J-tubes

Costs (BEAMA)

Voltage	X section	Supply	Supply	Lay and Bury	Circuit
kV	sqmm	Euro k/km	GBP k/km	GBP k/km	Total
3 core					
132	1000	550	390	200	590
132	800	440	310	190	500
132	500	330	240	180	420
220	800	470	440	220	660
220	500	400	390	200	590
Single core					
400	800	1200	860	540	1400

DC transmission - VSC

Converters with associated equipment (circuit breakers, transformers filters etc)

- Max size of converter 500 MW (BEAMA)
- Capital cost of converters £110/KVA (BEAMA)
- 20% additional costs for each additional converter (above 500 MVA)
- Mean time to repair 1 month (BEAMA)
- Failure rate 0.12 failures per year (BEAMA)
- Losses per converter station (BEAMA)

- 0.8% losses at no load
- 0.8% losses at full load
- Cost of platform £25m (BEAMA)
- Repair costs £500k/repair (BEAMA)
-

DC Cables – capacity and resistance (ABB)

Cable data

Power per bipole MW	Climate type	Submarine Cables			Land Cables		
		Conductor copper mm²	Cable diameter mm	Cable weight kg/m	Conductor aluminium mm²	Cable diameter mm	Cable weight kg/m
		+/- 150 kV Submarine Cables			+/- 150 kV Land Cables		
460	Moderate	1 800	109	40	Use Cu	90	21.0
MW	Tropic	2 000	112	42	Use Cu	93	22.6
320	Moderate	1 000	97	29	1 400	84	7.9
MW	Tropic	1 200	101	31	2 000	93	10.1
140	Moderate	240	69	13	400	60	3.5
MW	Tropic	300	71	14	500	63	4.0
		+/- 80 kV Submarine Cables			+/- 80 kV Land Cables		
70	Moderate	185	52	8	300	41	2.0
MW	Tropic	240	54	9	400	45	2.3

Indicative only

Resistance:

Table 21

IEC				
Cross section		Diameter approx.	Maximum d.c. resistance at 20°C, ohm/km	
mm²	kcmil	mm	aluminium	copper
25	49	5.8	1.20	0.727
35	69	7.0	0.868	0.524
50	99	8.0	0.641	0.387
70	138	9.6	0.443	0.268
95	187	11.2	0.320	0.193
120	237	12.8	0.253	0.153
150	296	14.2	0.206	0.124
185	365	15.9	0.164	0.0991
240	474	18.0	0.125	0.0754
300	592	20.5	0.100	0.0601
400	789	23.1	0.0778	0.0470
500	987	26.4	0.0605	0.0366
630	1243	30.2	0.0469	0.0283
800	1579	33.9	0.0367	0.0221
1000	1973	37.9	0.0291	0.0176
1200	2368	41.4	0.0247	0.0151
1600	3158	47.4	0.0186	0.0113
2000	3947	53.5	0.0149	0.0090
2500	4934	66	0.0120	0.0072
3000	5920	72	0.0100	0.0060

AC and DC cable parameters

- Reliability
- Failure rate: 0.08 failures/100km per year (BEAMA)
- Repair time: 3 months (BEAMA / DEVELOPERS)
- Sensitivity studies: failure rate +/- 50% failure rate
-
- Repair costs
- £500k / repair (BEAMA)
-

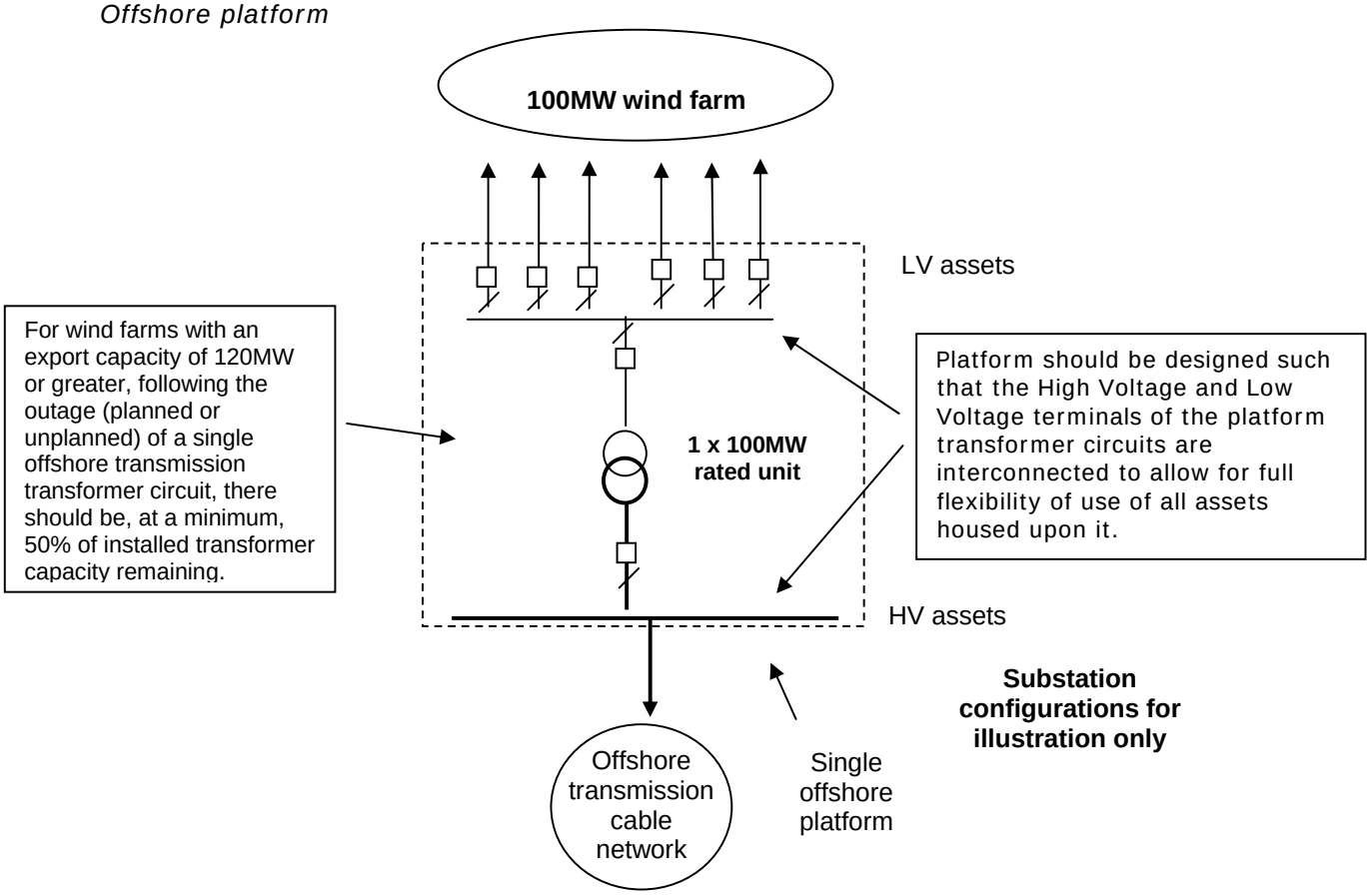
Costs of Voltage source based HVDC (BEAMA)

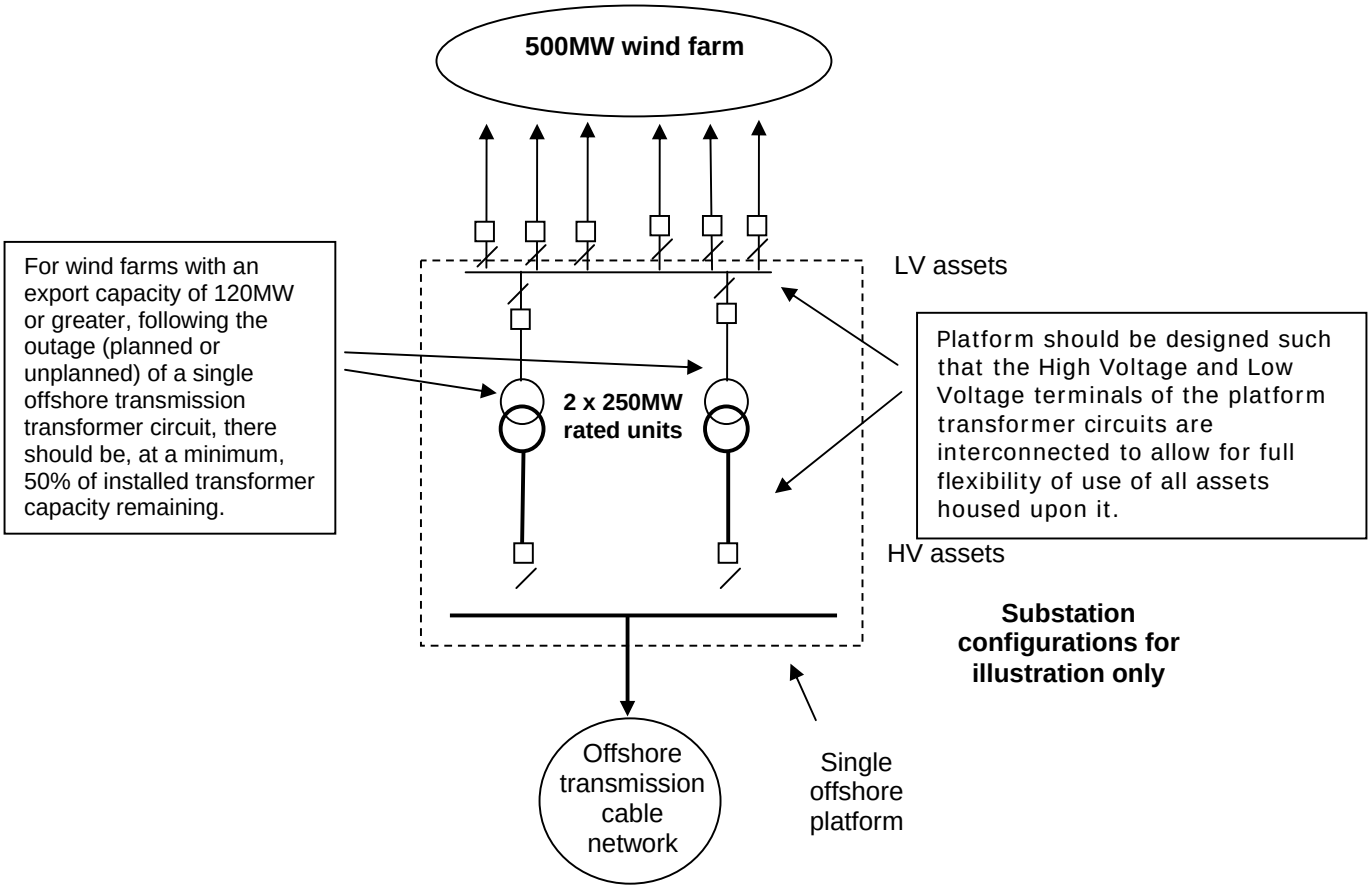
2 DC cables (VSC)

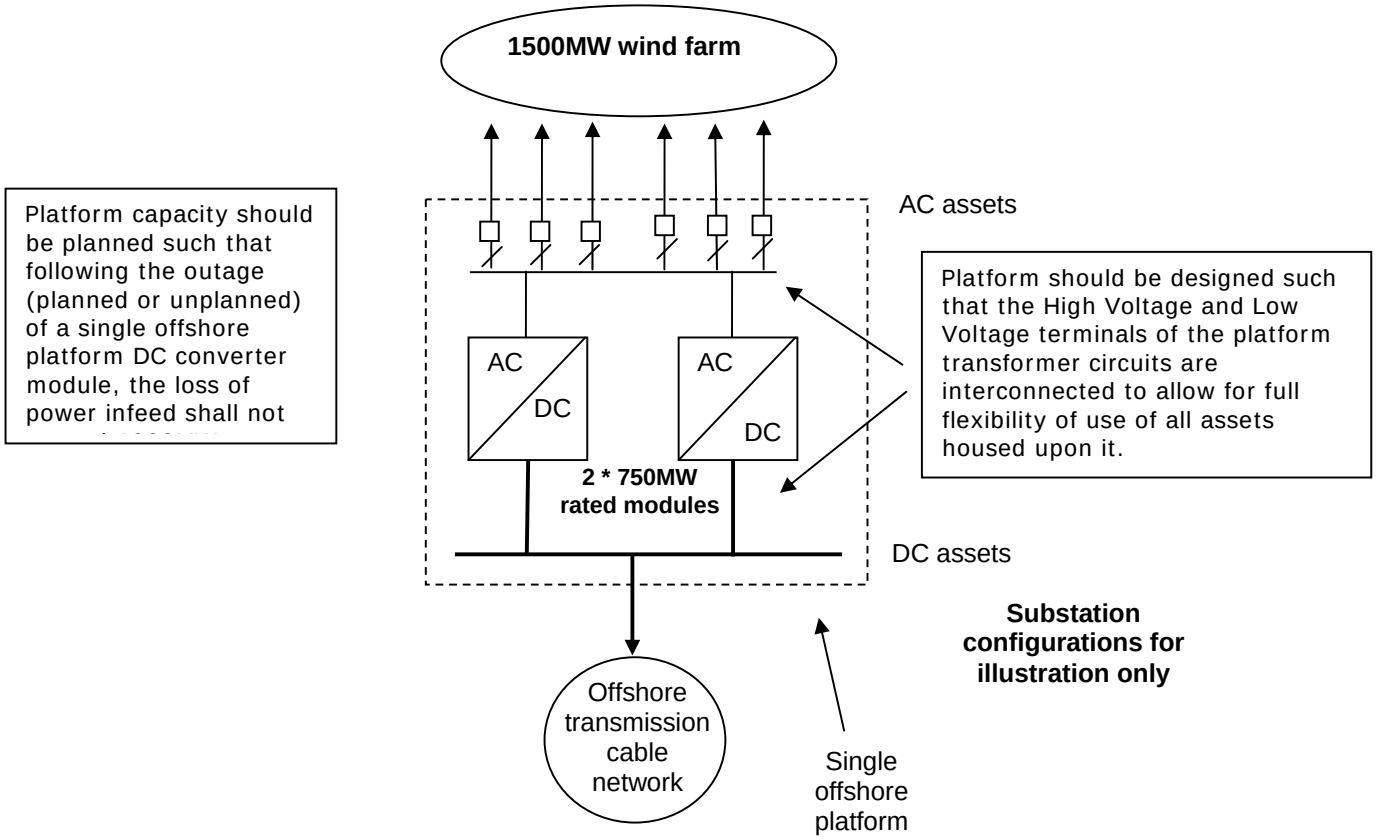
Voltage	X section	Supply	Supply	Lay and Bury	Circuit
kV	sqmm	Euro k/km	GBP k/km	GBP k/km	Total
150	2000		500	400	900

Single wind farm connections

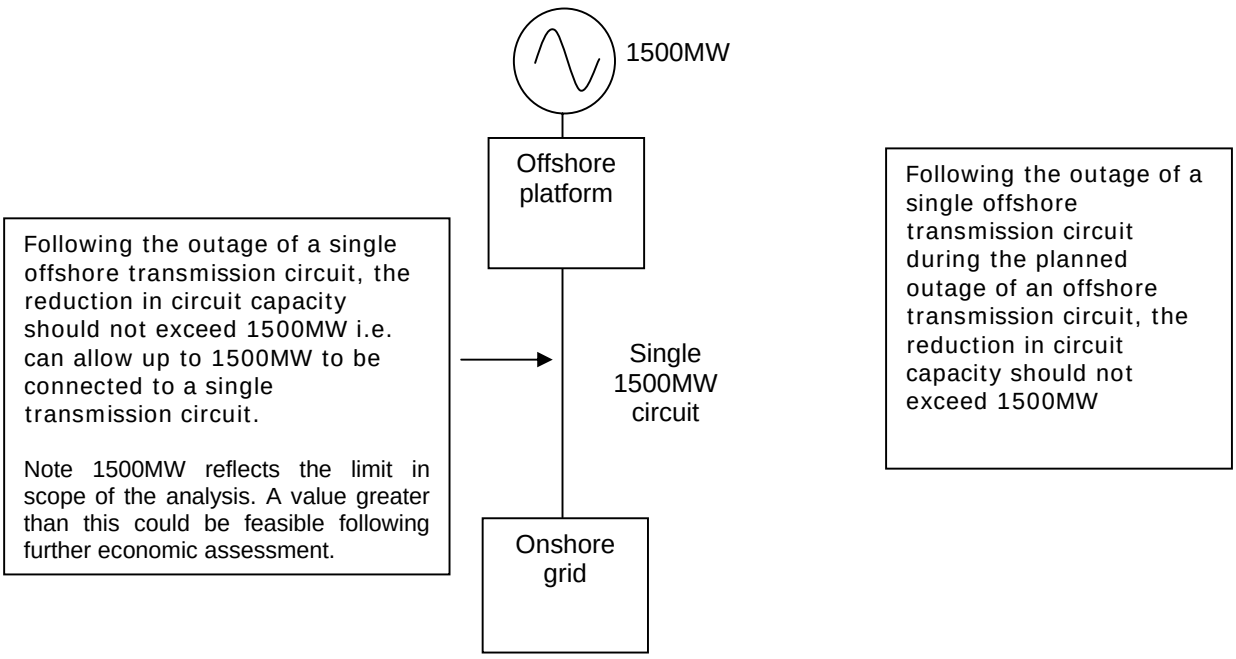
Offshore platform



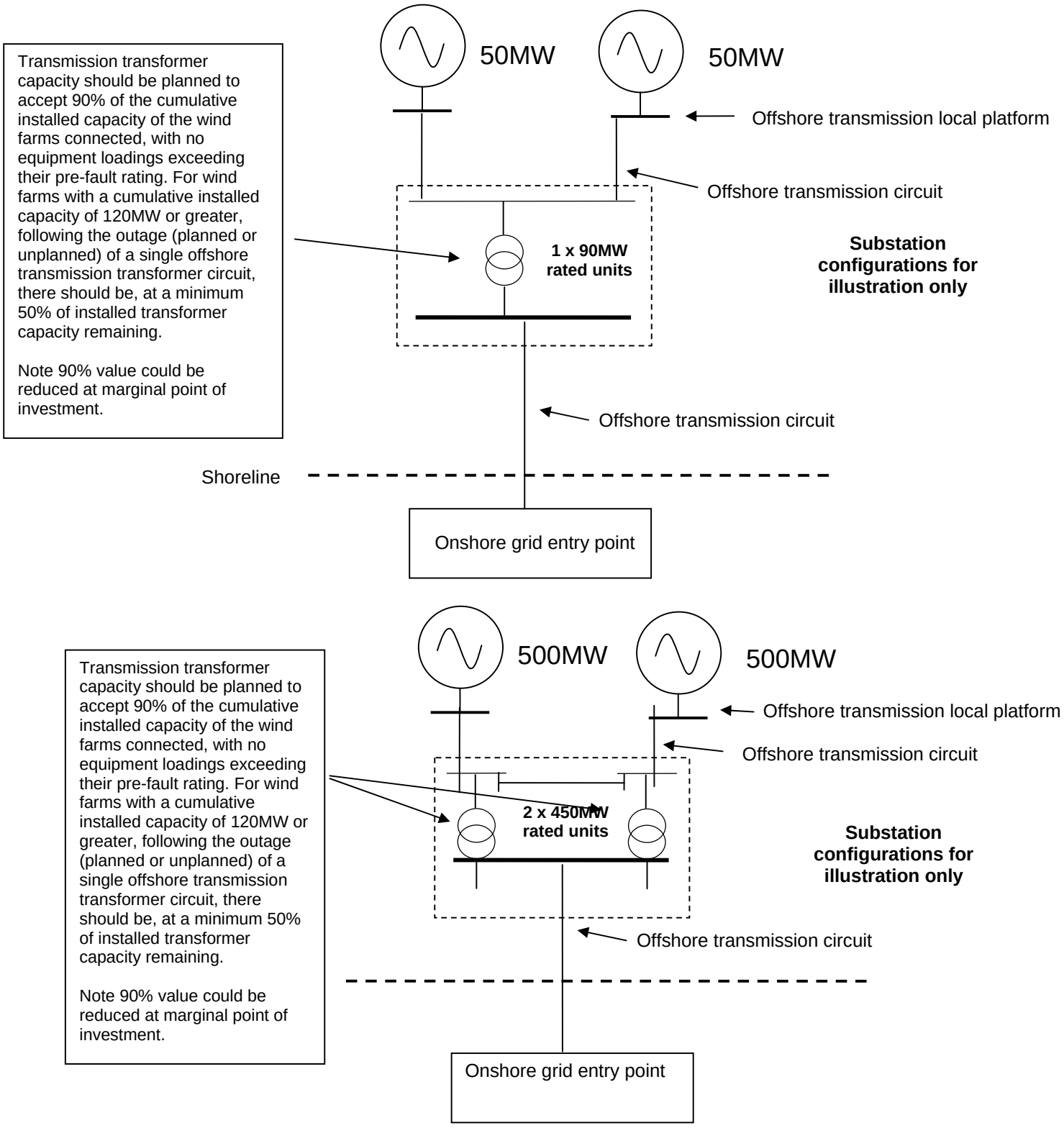

500MW wind farm
For wind farms with an export capacity of 120MW or greater, following the outage (planned or unplanned) of a single offshore transmission transformer circuit, there should be, at a minimum, 50% of installed transformer capacity remaining.
LV assets
Platform should be designed such that the High Voltage and Low Voltage terminals of the platform transformer circuits are interconnected to allow for full flexibility of use of all assets housed upon it.
2 x 250MW rated units
HV assets
Substation configurations for illustration only
Offshore transmission cable network
Single offshore platform



Offshore network capacity (AC and DC cables)

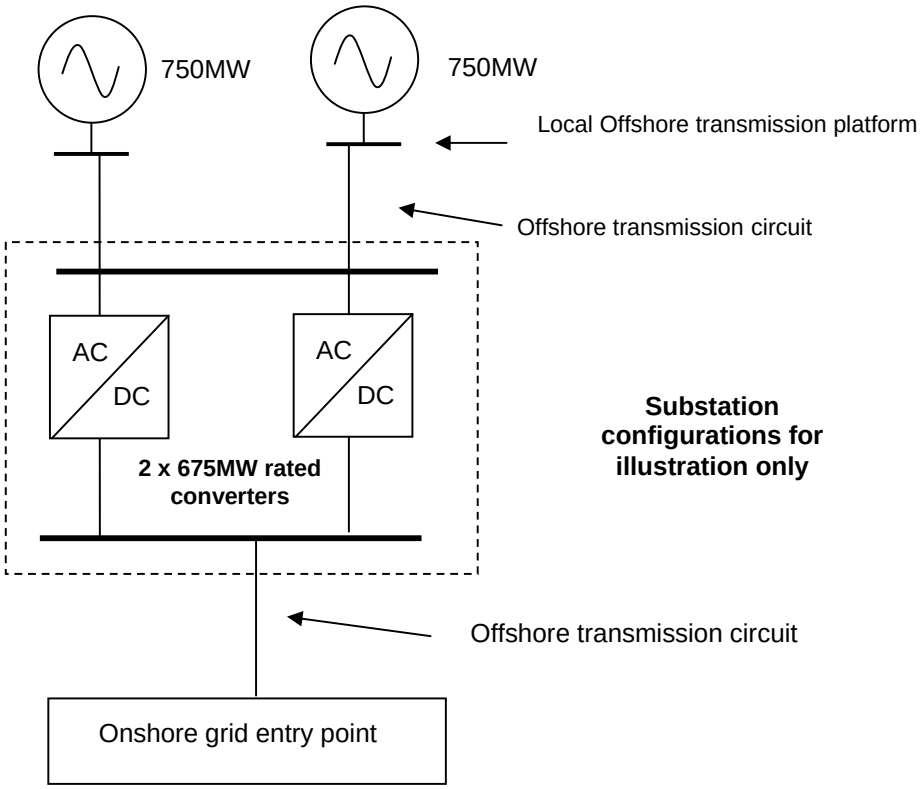


Multiple wind farm connections

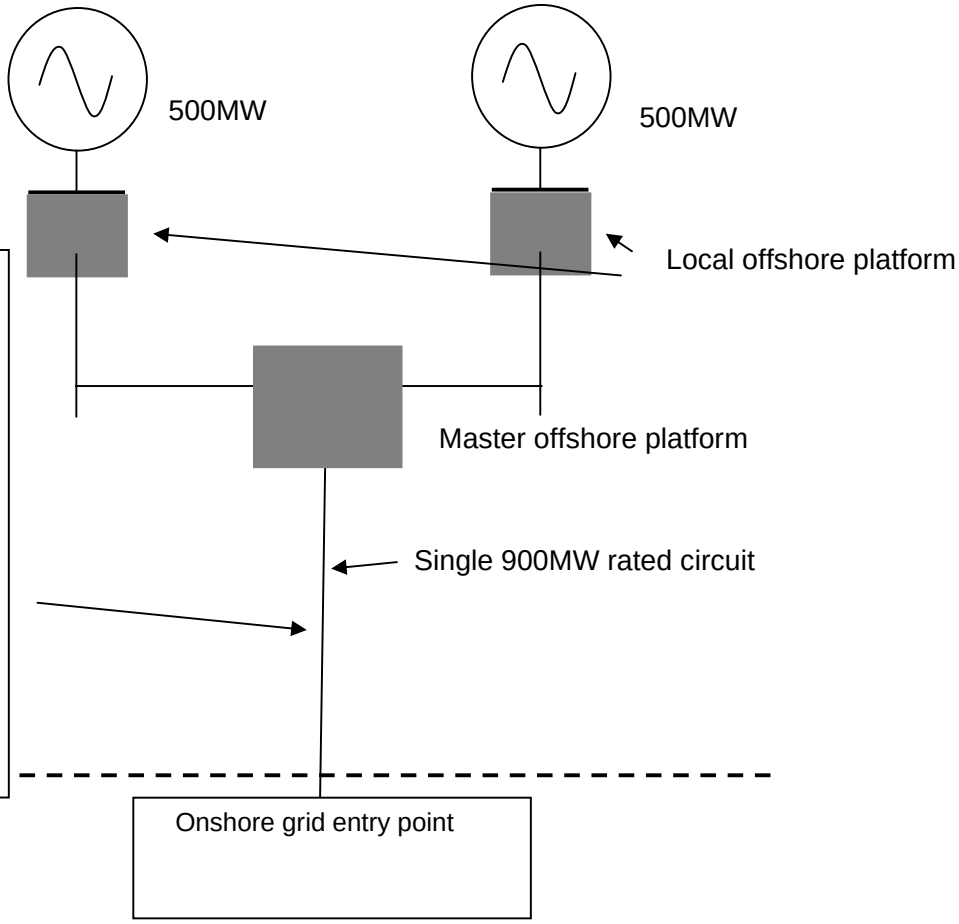


For multiple wind farm connections, the transmission capacity should be planned to accept 90% of the installed wind farm capacity. Platform capacity should be planned such that following the outage (planned or unplanned) of a single offshore platform DC converter module, the loss of power infeed shall not exceed 1000MW.

Note 90% value could be reduced at marginal point of investment.



Offshore network capacity (AC and DC cables)



The circuit capacity should be planned to accept 90% output of the wind farms connected to it, with no equipment loadings exceeding their pre-fault rating. Following the outage of a single offshore transmission cable circuit, the reduction in cable circuit capacity should not exceed 1500MW i.e. can allow up to 1500MW to be connected to a single transmission cable circuit.

Note 1500MW reflects the limit in scope of the analysis. A value greater than this could be feasible following further economic assessment.

Note 90% value could be reduced at marginal point of investment.

Existing standards definitions

1. N-1 = Capacity to export full generation under single circuit outage

GBSQSS wording:
Following the fault outage of a single offshore transmission circuit, no loss of power infeed shall occur.

2. N-2 = Capacity to not disconnect greater than 1320MW of generation under second circuit outage

GBSQSS wording:
Following the outage of a single offshore transmission circuit during the planned outage of an offshore transmission circuit, the reduction in circuit capacity should not exceed the infrequent infeed loss risk.

Definitions considered during the cost benefit analysis

3. N-0 = No capacity provided under single circuit outage

Suggested GBSQSS wording:
Following the fault outage of a single offshore transmission circuit, the loss of power infeed shall not exceed the normal infeed loss risk (1000MW).

4. “N-1” = Capacity to export X% of generation under single circuit outage

Suggested GBSQSS wording:
Following the fault outage of a single offshore transmission circuit, the loss of power infeed shall not exceed X% registered capacity of generation.

Sub-group assumptions

A001	Offshore transmission circuits are classified as 132kV and above.
A002	Integration of intermittent generation into onshore transmission networks is being considered separately. Integration of intermittent generation into offshore networks is outside the scope of this group.
A003	Offshore transmission networks will be considered as radial networks connected to a single onshore grid connection entry point. Should the nodes parallel the onshore network they would become part of the MITS and therefore subject to onshore security standards.
A004	This subgroup will consider only the connection of wind generation to offshore networks and not the connection of other technologies (Tidal generation / demand etc).
A005	Generation circuits are to be as defined in the introduction to paper number Offshore SQSS 1.
A006	Any recommendation for future development of the SQSS will be noted in the groups overall recommendation to OTEG. This could be a result of advances in technology for power transmission, generation technology changes etc.
A007	Any consideration of distribution network standards is outside the scope of this sub group. If it is believed to be an issue it will be raised in recommendation to OTEG.
A008	Offshore network defined as the network up to the first substation the circuit/s reach onshore.
A009	Technical code updates are outside the scope of this group. These works will be considered at a later date.
A010	Commercial frameworks will be developed as appropriate, and in accordance with the optimum design solution.
A011	Scope of offshore transmission system will be defined as; the connection from the onshore substation up to the disconnector on the busbar side of the outgoing windfarm feeder circuit (option 3 in the scope of offshore transmission system paper). The scope of the offshore transmission security standards will therefore include the offshore platform transformers and LV substation switchgear. Any changes to the default scope of an offshore transmission system will require a re-assessment of the offshore security standards.
A012	The Grid Code review work will need to take account of the default scope of offshore transmission systems assumed by the GB SQSS review sub group. (note assumption A011, but subject to change as development work progresses).
A013	The existing GB SQSS allows a transmission licensee to design a network to a higher level of security than required by the minimum, deterministic criteria defined in the standard provided the additional works can be economically justified. This facility should be included in the offshore security standards.
A014	Cost benefit analysis will consider only the use of currently available technology, the results of which will be used to form the sub-group recommendation. Sensitivity assessments will take account of technology thought reasonably to be available, along with technologies proposed to be available in the future.
A015	All data to be used in the cost benefit analysis will be as agreed at the sub-group teleconference, 18/08/06.

Appendix 4 - The Authority's Powers and Duties

1.1. Ofgem is the Office of Gas and Electricity Markets which supports the Gas and Electricity Markets Authority ("the Authority"), the regulator of the gas and electricity industries in Great Britain. This Appendix summarises the primary powers and duties of the Authority. It is not comprehensive and is not a substitute to reference to the relevant legal instruments (including, but not limited to, those referred to below).

1.2. The Authority's powers and duties are largely provided for in statute, principally the Gas Act 1986, the Electricity Act 1989, the Utilities Act 2000, the Competition Act 1998, the Enterprise Act 2002 and the Energy Act 2004, as well as arising from directly effective European Community legislation. References to the Gas Act and the Electricity Act in this Appendix are to Part 1 of each of those Acts.[12]

1.3. Duties and functions relating to gas are set out in the Gas Act and those relating to electricity are set out in the Electricity Act. This Appendix must be read accordingly[13].

1.4. The Authority's principal objective when carrying out certain of its functions under each of the Gas Act and the Electricity Act is to protect the interests of consumers, present and future, wherever appropriate by promoting effective competition between persons engaged in, or in commercial activities connected with, the shipping, transportation or supply of gas conveyed through pipes, and the generation, transmission, distribution or supply of electricity or the provision or use of electricity interconnectors.

1.5. The Authority must when carrying out those functions have regard to:

- The need to secure that, so far as it is economical to meet them, all reasonable demands in Great Britain for gas conveyed through pipes are met;
- The need to secure that all reasonable demands for electricity are met;
- The need to secure that licence holders are able to finance the activities which are the subject of obligations on them[14]; and
- The interests of individuals who are disabled or chronically sick, of pensionable age, with low incomes, or residing in rural areas.[15]

1.6. Subject to the above, the Authority is required to carry out the functions referred to in the manner which it considers is best calculated to:

[12] entitled "Gas Supply" and "Electricity Supply" respectively.
[13] However, in exercising a function under the Electricity Act the Authority may have regard to the interests of consumers in relation to gas conveyed through pipes and vice versa in the case of it exercising a function under the Gas Act.
[14] under the Gas Act and the Utilities Act, in the case of Gas Act functions, or the Electricity Act, the Utilities Act and certain parts of the Energy Act in the case of Electricity Act functions.
[15] The Authority may have regard to other descriptions of consumers.

- Promote efficiency and economy on the part of those licensed[16] under the relevant Act and the efficient use of gas conveyed through pipes and electricity conveyed by distribution systems or transmission systems;
- Protect the public from dangers arising from the conveyance of gas through pipes or the use of gas conveyed through pipes and from the generation, transmission, distribution or supply of electricity;
- Contribute to the achievement of sustainable development; and
- Secure a diverse and viable long-term energy supply.

1.7. In carrying out the functions referred to, the Authority must also have regard, to:

- The effect on the environment of activities connected with the conveyance of gas through pipes or with the generation, transmission, distribution or supply of electricity;
- The principles under which regulatory activities should be transparent, accountable, proportionate, consistent and targeted only at cases in which action is needed and any other principles that appear to it to represent the best regulatory practice; and
- Certain statutory guidance on social and environmental matters issued by the Secretary of State.

The Authority has powers under the Competition Act to investigate suspected anti-competitive activity and take action for breaches of the prohibitions in the legislation in respect of the gas and electricity sectors in Great Britain and is a designated National Competition Authority under the EC Modernisation Regulation17 and therefore part of the European Competition Network. The Authority also has concurrent powers with the Office of Fair Trading in respect of market investigation references to the Competition Commission.

[16] or persons authorised by exemptions to carry on any activity.
[17] Council Regulation (EC) 1/2003

Appendix 5 - Glossary

A

Authority

Gas and Electricity Markets Authority

B

BETTA

British Electricity Trading and Transmission Arrangements

BSC

Balancing and Settlement Code

C

CDGSEE

Centre for Distributed Generation and Sustainable Electrical Energy

CUSC

Connection and Use of System Code

D

DTI

Department of Trade and Industry

G

GBSO

Great Britain System Operator

GB SQSS

Great Britain Security and Quality of Supply Standard

GW

Gigawatt

I

IDNO

Independent Distribution Network Operator

IGT

Independent Gas Transporter

K

kV

Kilovolt

M

MW

Megawatt

N

NETA

New Electricity Trading Arrangements

NGET

National Grid Electricity Transmission plc

O

Ofgem

Office of Gas and Electricity Markets

OTEG

Offshore Transmission Expert Group

R

R1

Round 1

R2

Round 2

RAV

Regulatory Asset Value

RIA

Regulatory Impact Assessment

S

STC

System operator Transmission owner Code

T

TO

Transmission Owner

TOCO

Transmission Owner Connection Offer

Appendix 6 - Feedback Questionnaire

1.1. Ofgem considers that consultation is at the heart of good policy development. We are keen to consider any comments or complaints about the manner in which this consultation has been conducted. In any case we would be keen to get your answers to the following questions:

1. Do you have any comments about the overall process, which was adopted for this consultation?
2. Do you have any comments about the overall tone and content of the report?
3. Was the report easy to read and understand, could it have been better written?
4. To what extent did the report's conclusions provide a balanced view?
5. To what extent did the report make reasoned recommendations for improvement?
6. Please add any further comments.

1.2. Please send your comments to:

Andrew MacFaul
Consultation Co-ordinator
Ofgem
9 Millbank
London
SW1P 3GE
andrew.macfaul@ofgem.gov.uk

Appendix 7 - Government consultation code of practice criteria

NB: This consultation will run in a reduced timeframe of 6 weeks, rather than the 12 weeks set out in the consultation criteria below. This is an interim consultation on a set of narrow proposals of a technical nature. A limited number of companies are affected and have been involved in developing these proposals through an industry experts group and open workshops. A preliminary 12-week consultation was held in 2005 and a full 12-week consultation will take place on the final regulatory regime before it is introduced.

1. Consult widely throughout the process, allowing a minimum of 12 weeks for written consultation at least once during the development of the policy.
2. Be clear about what your proposals are, who may be affected, what questions are being asked and the timescale for responses.
3. Ensure that your consultation is clear, concise and widely accessible.
4. Give feedback regarding the responses received and how the consultation process influenced the policy.
5. Monitor your department's effectiveness at consultation, including through the use of a designated consultation co-ordinator.
6. Ensure your consultation follows better regulation best practice, including carrying out a Regulatory Impact Assessment if appropriate.

1.1. The complete code is available on the Cabinet Office's website (http://www.cabinetoffice.gov.uk/regulation/consultation/index.asp).

Comments or complaints

1.2. If you wish to comment on the conduct of this consultation or make a complaint about the way this consultation has been conducted, please write to:

Mary Smeeth
Better Regulation Team
Department of Trade and Industry
1 Victoria Street
London, SW1H 0ET
Telephone Mary on 020 7215 2146
or email to: mary.smeeth@dti.gsi.gov.uk