Recommendation for the Treatment of Offshore Power Station Demand

Introduction

Work on the re-drafting of the GB Security and Quality of Supply Standard (SQSS) to include offshore transmission systems is moving into the final stages. A further suite of security recommendations, based on cost benefit analyses performed by the SEDG centre, has been submitted to Ofgem and is currently under review. Once approved, these recommendations will form a basis for the final drafting of the offshore SQSS, which is currently scheduled for completion early in the New Year.

The function of offshore transmission systems is recognised as being primarily for the connection of offshore power stations to onshore transmission or distribution systems. Hence, it is not considered appropriate that the supply of offshore non-power station demand be included in the offshore SQSS. However, the requirement to include a new section on the design of offshore power station related demand connections is the subject of this paper.

Three options for the treatment of offshore power station demand within the offshore SQSS are considered:

i) Base offshore power station demand criteria on the existing onshore criteria including the 'Variation to Connection Design' clause, which will provide developers with some flexibility to reduce security and costs where appropriate;

ii) Include a new set of relatively relaxed criteria tailored towards offshore power station demand connections; and

iii) Exclude consideration of power station demand, as well as non-power station offshore demand, from the offshore SQSS altogether.

The paper concludes by recommending that Option (i) is likely to be the most appropriate method for addressing offshore power station demand.

Background

Several key assumptions have been made to direct the drafting work to date, based on input from the GB SQSS Sub-Group and policy decisions from Ofgem. The relevant assumptions currently agreed include:

- Offshore transmission networks will be considered as radial networks connected to a single onshore interface point. Should the offshore network parallel the onshore network in any way it would become part of the *Main Interconnected Transmission System* (MITS) and therefore subject to the onshore security standards;
- The offshore network is defined as the network up to the first substation which the circuit(s) reach onshore;
- The SQSS structure will include stand alone sections for offshore; and
- Offshore transmission arrangements are for generation and not non-power station demand.

In re-drafting the GB SQSS to include the offshore security standards, some existing sections, common to both onshore and offshore (e.g. Introduction, Terms and Definitions and Appendix A), have been modified to accommodate offshore and some additional sections have been created which mirror their onshore counterparts. The new sections include:

- Design of Offshore Generation Connections;
- Operation of the Offshore Transmission System; and
- Voltage Limits in Planning and Operating the Offshore Transmission System

Given the nature of an offshore transmission system and its primary purpose of connecting offshore renewable generators to onshore systems, the need for a further new section to cover the 'Design of Offshore Demand Connections' has, until recently, been considered unnecessary. Indeed, all work streams developing the offshore regime (Grid Code, STC, etc.) have been progressing work on the assumption that there will be no demand connected offshore. However, while the general consensus is now that there will not be any non-power station demand connected either at the offshore platform or to any onshore section of an offshore transmission system, the need to consider the potential requirement for offshore power station demand connections on the offshore platform remains.

Two types of offshore power station have been considered as part of this review, namely: offshore wind farms; and offshore gas turbines. In the case of the latter it is assumed that the capacity of offshore gas turbines is limited to a maximum of 200MW (i.e. two 100MW units) per offshore platform. In the case of the former, the cumulative capacity from wind farms at the offshore grid entry point is assumed to be limited to a maximum of 1500MW. The cost benefit analyses, which underlie the recommendations relating to the offshore generation connection criteria, are based, inter alia, on these assumed limits.

Treatment of Power Station Demand

Onshore

In the current (onshore) GB SQSS, the generation connection criteria extend from the generation points of connection (i.e. the point at which the generation circuits connect to the GB transmission system) and reach into the MITS. The demand connection criteria extend from the lower voltage side of the GSP transformers and again reach into the MITS. The current GB SQSS recognises that there may be parts of the GB transmission system where more than one set of criteria apply and explains (e.g. in paragraph 1.11) that in such places the requirements of all relevant criteria must be met. An example of such a situation is where a power station feeds into the GB transmission system at a point local to where the power station demand is also supplied from the GB transmission system. In such cases, both the generation connection criteria (of Section 2) and the demand connection criteria (of Section 3) must be met. This is reinforced by paragraphs 2.2 (generation connection), 3.2 (demand connection) and 4.2 (MITS) of the GB SQSS.

Where there is overlap of generation and demand criteria, given the high levels of power station generation relative to power station demand, it is the generation connection criteria rather than the demand connection criteria which are more likely to drive the need for investment in assets.

Offshore

Offshore, overlaps of the offshore generation connection criteria and offshore power station demand connection criteria would also occur. Again, in such cases, the requirements of all relevant criteria would have to be met.

The offshore generation connection criteria are based on cost benefit analyses, which recognise the relatively high costs of offshore assets and the intermittency of the majority of generation that will connect. Accordingly, relative to onshore, the level of security for generation connections provided by the application of the offshore generation connection criteria will be lower.

If existing onshore demand criteria were to be applied offshore the reduction in offshore generation connection security is sufficient such that, where there is an overlap of criteria for

the offshore transmission system, it is the demand connection criteria rather than the generation connection criteria which would be more likely to drive the need for investment in assets. However, in order to allow for the most economic and efficient design, the 'Variation to Connection Design' clause of the offshore demand connection criteria could be utilised (at the customer's request) to avoid over investment in assets.

As an alternative to taking power station demand from the offshore transmission system, the customer may prefer to provide his own power station 'back up' supplies but his ability to do this may be a function of the level of offshore power station demand required.

Expected Level of Offshore Power Station Demand

The potential for a net export of power from the onshore system to the offshore transmission system is highest when the power station is off-load (i.e. not generating). At other times, station auxiliaries are more likely to be supplied directly by the generator itself.

In the case of ***wind farms***, all critical turbine systems such as braking and control cabinets will be fitted with battery backup systems. Developers have indicated that a single 500kW diesel generator installed on the offshore platform would be sufficient to energise a single string of turbines. These, in turn, could then be used to energise the remaining strings attached to the offshore platform. From this information one could conclude that, if a level of demand would be required to be supplied from the onshore system that this would generally not exceed 500kW. In any case, this demand requirement would only rarely exceed 1 MW.

In the case of ***gas turbines***, station demand information has been taken from an offshore gas turbine project currently in development. The relevant turbine data submitted through this application was for a Brush LM2500, 32.7MW turbine. This unit was reported as having a maximum demand of 310kW, reduced to 120kW under minimum generation conditions. Again, one turbine unit could easily be started using a single diesel generator installed on the platform with further units then taking supply from the first. As in the case of wind turbines, the demand requirement would only rarely exceed 1 MW.

Options for Treatment of Demand in the SQSS

Three options have been developed out of the information presented above. These are outlined below as potential ways forward in resolving this issue.

i) Base offshore power station demand criteria on the existing onshore criteria including the 'Variation to Connection Design' clause to facilitate reduced security and costs where appropriate

Group Demand	Initial system conditions	
	Intact system	With single *planned outage*
over 1 MW to 12 MW	**Within 3 hours** *Group Demand* minus 1 MW **In repair time** *Group Demand*	Nil
up to 1 MW	**In repair time** *Group Demand*	Nil

The transfer of existing onshore demand connection capacity requirements to offshore was originally recommended by the SQSS sub-group in their final recommendations report. The potential increase in the level of system security required for those developments with an off-load demand of greater than 1MW is covered by the 'Variation to Connection Design' clause which gives customers the opportunity to opt for a 'less

secure' connection to the transmission system under terms specified in their Bilateral Connection Agreement (BCA).

Benefits of this approach

- Consistency with onshore demand criteria
- Covers all levels of demand likely to arise at offshore installations
- Ease of drafting

Negatives of this approach

- Offshore demand has not been considered by any other work streams.
- With the inclusion of power station demand on the offshore platform, there is potential that it may be argued that the connection of non-power station consumer demand should also be included (either at the offshore platform or elsewhere from the offshore transmission system).
- The 'Variation to Connection Design' clause is invoked by the customer's request and therefore may rely on the Offshore Transmission System Owner (OFTO) / developer making the customer aware of the clause. This could result in a perverse incentive to over invest for the OFTO.

ii) Include a new set of relatively relaxed criteria tailored more for offshore demand connections

Group Demand	Initial system conditions	
	Intact system	With single *planned outage*
up to 12 MW	**In repair time** *Group Demand*	Nil

Benefits of this approach

- Addresses offshore station demand whilst giving some recognition to finding an overall optimum and economic solution
- Covers all levels of demand likely to arise at offshore installations

Negatives of this approach

- Not supported by any cost benefit analyses
- Not consistent with onshore demand criteria
- Offshore demand has not been considered by any other work streams
- With the inclusion of station demand on the offshore platform, there is potential that it may be argued that the connection of non-station demand should also be included (either at the offshore platform or elsewhere from the offshore transmission system).

iii) Exclude consideration of power station demand, as well as non-power station demand, from the offshore SQSS

Benefits of this approach

- No knock on effects to other work streams that were instructed from an early stage that offshore demand was outside the scope of their current work
- No perceived risk that others may misinterpret the inclusion of a consideration for station demand as a route to connecting non-station demand.

Negatives of this approach

- It is acknowledged that power station demand does fall within the scope of the GB SQSS. Accordingly, appropriate offshore demand connection criteria should be included in the offshore SQSS.

Preferred Option

It is the recommendation of this paper that Option (i) is the best way to treat offshore power station demand. While in a small number of circumstances, application of the onshore demand connection criteria to offshore transmission systems may indicate a potential need for additional assets relative to the offshore generation connection criteria, the 'Variation to Connection Design' clause, will provide developers with the flexibility to reduce demand security and costs where appropriate and thereby achieve an overall optimum and economic solution. In drafting the criteria for this option, it would have to be clear that the offshore demand connection criteria relate only to offshore power station demand.

Since the 'Variation to Connection design' clause is invoked at the customer's request, reasonable efforts should be made by the OFTO / developer to ensure that the customer is made aware of the potential relaxation it provides. To this end, it may be appropriate to formalise this requirement on the OFTO / developer.

Adoption of Option (i) would not preclude the customer (generator) providing his own back-up supplies as an alternative; for example through the installation of a diesel generator.

Option (ii) is not favoured on the grounds that there are no analyses to support an arbitrary reduction in the standard. It is, however, acceptable for the standard to be reduced through implementation of the 'Variation to Connection Design' clause on the request of the customer as in option (i).

Option (iii) is discounted as it ignores, rather than addresses, the issue. As a working document the GB SQSS would not be fit for purpose if appropriate criteria were not included.

In view of the above, Option (i) is recommended for adoption both for offshore wind farm and for offshore gas turbine power station demand.