GBSQSS recommendations for offshore transmission networks

GBSQSS Sub Group
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Background

- Ofgem scoping document published in April 2006
- OTEG established
- GBSQSS sub-group of OTEG set up to review existing GBSQSS and test relevance to offshore transmission networks
- This presentation sets our GBSQSS sub-group assessment of the GBSQSS and its recommendations
- X meetings (man hours)
- X thousand studies
Methodology

- Consider GBSQSS and identify areas that require review
- Cost benefit analysis - in line with existing GBSQSS and ER P2/6
- Formulation of working assumptions
- Consideration of assets likely to have an impact on outcome of cost benefit analysis
- Creation of network models for assessment
- Population of network models with real data
- Carry out analysis and present back to sub-group at each meeting
- Test key input variables for the value at which the conclusion changes
Scope of offshore transmission

Onshore system (Transmission or Distribution)

Onshore Grid Entry Point or User System Entry Point

Offshore Transmission system

Offshore Grid Entry Point (offshore platform)

Onshore TO / DNO

Offshore TO

Generator
Scope of offshore transmission

- **Low voltage assets**
- **High voltage assets**
  - Preferred option
  - Windfarm
  - Offshore transmission network
  - Central high voltage offshore platform
  - Offshore platform transformer circuits
  - Low voltage assets
  - Preferred option
Cost benefit analysis

- Network models
  - Single / shared AC connections
  - Single / shared DC connections
- Windfarms considered
  - Up to 1500MW
  - Up to 100km from shoreline
- Sensitivity assessment of input parameters to test robustness of recommendation
Offshore transmission voltage requirements

- Assessment of existing arrangements
  - At onshore connection point of offshore transmission network to onshore electricity network
  - At offshore connection point of generator to offshore transmission network
- Outline possible options
  - Consideration of voltage limits at connection of offshore network to onshore network
  - Consideration of voltage limits at offshore platform
- Comparison of options and provide recommendations
Offshore transmission voltage requirements

Onshore TO or DNO

Onshore Grid or User System

Offshore transmission voltage requirements

Existing onshore GB SQSS voltage requirements apply.

Recommended that Grid Code, CC.6.3.2(b) CC.6.3.2(c) and CC.6.3.8(c) apply at onshore/offshore interface:
• Reactive power capability
• Voltage control

New voltage limits set for offshore platform

Offshore SQSS recommendations

Generator has to meet Grid Code requirements.

Offshore windfarm

Offshore TO

Offshore TO or DNO

Onshore TO or DNO

Onshore Grid or User System
Recommendation – Offshore platform

- For a single wind farm connection
  - Platform capacity should be planned to accept the full output of the windfarm with no equipment loadings exceeding their pre-fault rating.
  - For AC connections; for wind farms with an export capacity of 120MW or greater, following the outage (planned or unplanned) of a single offshore transmission transformer circuit, the reduction in transformer circuit capacity should not exceed 50% of the export capacity of the windfarm connected.
  - For DC connections; for outages (planned or unplanned) of a single offshore platform DC converter module, the loss of power infeed shall not exceed 1000MW.
Recommendation – Offshore platform

- For a multiple windfarm connections
  - Transformer capacity should be planned to accept 90% of the cumulative installed capacity of the windfarms connected, with no equipment loadings exceeding their pre-fault rating.
  - For AC connections; for wind farms with an export capacity of 120MW or greater, following the outage (planned or unplanned) of a single offshore transmission transformer circuit, the reduction in transformer circuit capacity should not exceed 50% of installed transformer capacity.
  - For DC connections; for outages (planned or unplanned) of a single offshore platform DC converter module, the loss of power infeed shall not exceed 1000MW.
**Recommendation – AC platform**

**Single windfarm connection**

For wind farms with an export capacity of 120MW or greater, following the outage (planned or unplanned) of a single offshore transmission transformer circuit, the reduction in transformer circuit capacity should not exceed 50% of the export capacity of the windfarm connected.

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.

Substation configurations for illustration only
Recommendation – AC platform

Single windfarm connection

For wind farms with an export capacity of 120MW or greater, following the outage (planned or unplanned) of a single offshore transmission transformer circuit, the reduction in transformer circuit capacity should not exceed 50% of the export capacity of the windfarm connected.

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.

Substation configurations for illustration only
Transmission transformer capacity should be planned to accept 90% of the cumulative installed capacity of the windfarms connected, with no equipment loadings exceeding their pre-fault rating. For windfarms with a cumulative installed capacity of above 120MW, following the outage (planned or unplanned) of a single offshore transmission transformer circuit, the reduction in transformer circuit capacity should not exceed 0.5 * X% of cumulative installed capacity of the windfarm/s connected.
Recommendation – AC platform

Multiple windfarm connection

Transmission transformer capacity should be planned to accept X% of the cumulative installed capacity of the windfarms connected, with no equipment loadings exceeding their pre-fault rating. For windfarms with a cumulative installed capacity of above 120MW, following the outage (planned or unplanned) of a single offshore transmission transformer circuit, the reduction in transformer circuit capacity should not exceed 0.5 * X% of cumulative installed capacity of the windfarm/s connected.

X=90% in this example

Substation configurations for illustration only
Recommendation – Network capacity

- For a single windfarm connection
  - Transmission cable circuit capacity should be planned to accept the full output of the windfarm with no equipment loadings exceeding the pre-fault rating.

- For multiple windfarm connections
  - Transmission cable circuit capacity should be planned to accept X% of the cumulative installed capacity of the windfarms 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.
**Recommendation – Network capacity**

**Single windfarm connection**

The transmission circuit capacity should be planned to accept the full output of the windfarm with no equipment loadings exceeding the pre-fault rating.

Following the outage of a single offshore transmission circuit, the reduction in circuit capacity should not exceed 1500MW i.e. can allow up to 1500MW to be connected to a single transmission circuit.
Recommendation – Network capacity

Multiple windfarm connection

The circuit capacity should be planned to accept 90% output of the windfarms connected to it, with no equipment loadings exceeding their pre-fault rating.

Following the outage of a single offshore transmission circuit, the reduction in circuit capacity should not exceed 1500MW i.e. can allow up to 1500MW to be connected to a single transmission circuit.
Issues for OTEG consideration

- DNO ‘sandwich’
- Assessment of demand connected to offshore transmission networks
- The consideration of generating plant with a higher annual capacity factor (e.g. offshore CCGT, tidal etc) should be considered
- Access rights, compensation arrangements and transmission charging require review