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GSR011: Review of Offshore Networks



NETS SQSS Review Panel

6 August 2014, John West

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GSR011 – Issues Identified in Review

- Capacity of Offshore HVDC Links:
  - Do the conclusions relating to short duration losses of a DC link carrying more than 1800MW adequately take account of short term effects such as RoCoF protections?

- Overhead Line Single Circuit Fault Rates:
  - Is the underlying assumption that overhead line fault rates are evenly distributed during the year valid and would an uneven distribution affect the GSR011 report conclusions with respect to N-1-1 faults?

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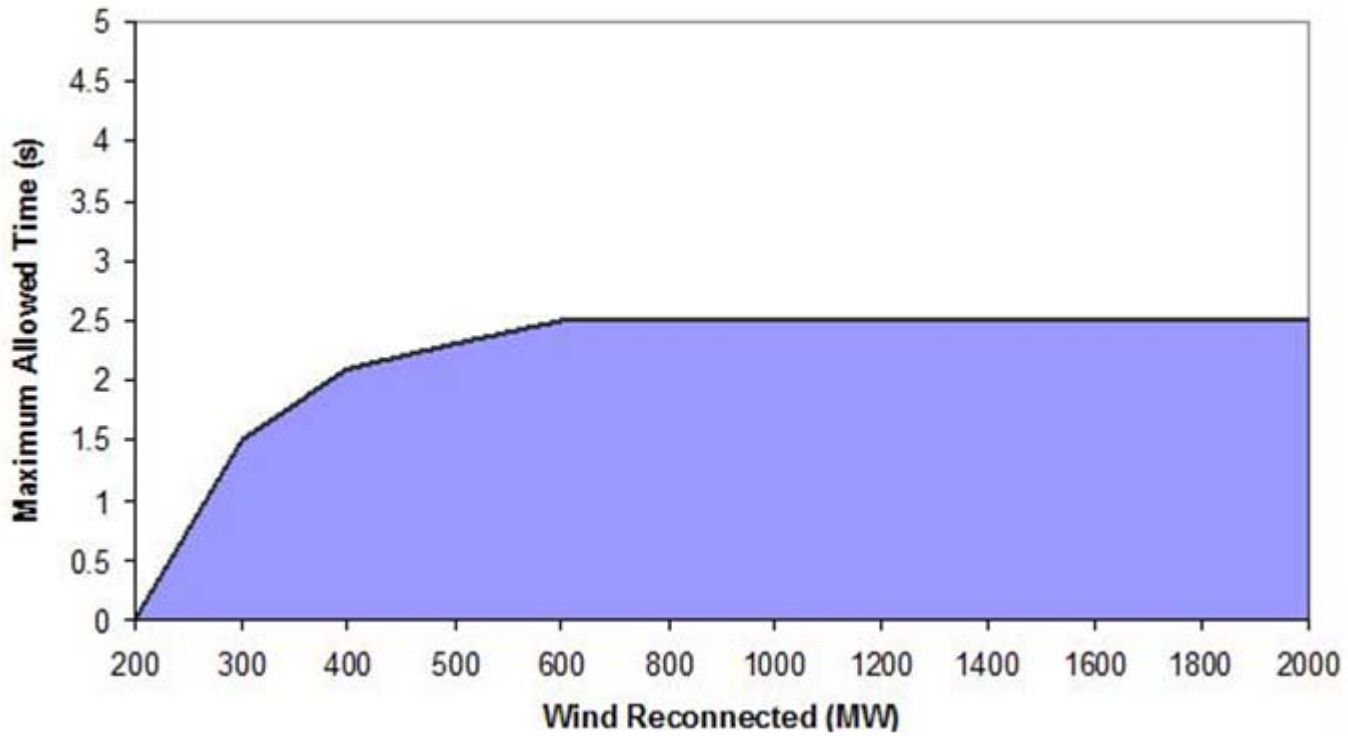
GSR011 – Capacity of Offshore HVDC Links

For HVDC link capacities greater than the infrequent infeed loss limit, the GSR011 analysis (Section 4.3 & Appendix F) indicates that it may be acceptable to loose more than the infrequent infeed loss limit if some generation is reconnected after a few seconds. For example:



Page 24 – Figure 1: 2GW loss allowed time

GSR011 – Capacity of Offshore HVDC Links

Over the first two seconds, the Rate of Change of Frequency (RoCoF) is 0.3 to 0.4Hz / second, higher than some settings for RoCoF protections.

This issue was recognised by the working-group and the recommendation on short duration losses (Section 5) is clear that very fast restorations are likely to be required.

> ***Short duration losses of a DC link carrying more than the Infrequent Infeed Loss can be tolerated where parallel routes can increase their flows.*** *Analysis of system frequency performance following a loss of more than 1800MW shows that the frequency fall can be maintained within existing limits provided the loss can be quickly reduced to a level less than 1800MW – the amount of power restoration required will depend on the delay in restoring it. Whilst the frequency analysis suggests restoration times up to 2 or 3 seconds would be acceptable, it is likely that much faster restorations will be required to prevent generation instability and tripping.*

The working-group has proposed a change of definition for Loss of Power Infeed such that redistribution via other HVDC links can be taken into account in assessing the Loss of Power Infeed. It is additionally proposed that this revision should emphasise the need to consider consequential losses of infeed that might occur in the redistribution timescales.

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GSR011 – Capacity of Offshore HVDC Links

Proposed NETS SQSS Change:

Loss of Power Infeed	The output of a generating unit or a group of generating units or the import from external systems disconnected from the system by a secured event, less the demand disconnected from the system by the same secured event. For the avoidance of doubt if, following such a secured event, demand associated with the normal operation of the affected generating unit or generating units is automatically transferred to a supply point which is not disconnected from the system, e.g. the station board, then this shall not be deducted from the total loss of power infeed to the system. For the purpose of the operational criteria, the loss of power infeed includes the output of a single generating unit, CCGT Module, boiler, nuclear reactor or DC Link bi-pole lost as a result of an event. In the case of an offshore generating unit or group of offshore generating units, the loss of power infeed is measured at the interface point, or user system interface point, as appropriate. ***In the case of an offshore generating unit or group of offshore generating units for which infeed will be automatically re-distributed to one or more interface points or user system interface points through one or more HVDC links, the re-distribution should be taken into account in determining the total generation capacity that is disconnected. However, in assessing this re-distribution, consequential losses of infeed that might occur in the re-distribution timescales due to wider generation instability or tripping should be taken into account.***

GSR011 – Overhead Line Single Circuit Fault Rates

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The N-1-1 analysis in the consideration of offshore contingencies (Section 4.1) assumes an overhead line single circuit fault rate of 0.62 faults per year. It also assumes that faults are equally likely in winter and summer.

For the boundary considered, this resulted in a N-1-1 fault rate for two onshore circuits of 0.006 (1 fault in every 167 winters). This fault rate is below the level of 1 in 100 winters, therefore reinforcing the GSR008 position that this type of fault should not be a credible contingency.

Similarly, the N-1-1 fault rate for a prior outage of an offshore DC circuit and the fault outage of onshore overhead line circuit was assessed as 0.06 (1 fault in every 17 winters). As this fault rate was above the level of 1 in 100 winters, it is proposed to include this type of fault as a credible contingency.

GSR011 – Overhead Line Single Circuit Fault Rates

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In practice, the distribution of overhead line faults between the summer and winter period will largely be influenced by the distribution of weather related faults.

National Grid statistics for weather related faults in England and Wales for the period 2006 to 2012 are summarised below.

Number of Weather Related OHL Single Circuit Faults

Year:	Winter (Nov-Apr):	Summer (May-Oct):	Total:
2006	15	56	71
2007	18	32	50
2008	17	15	32
2009	14	36	50
2010	14	7	21
2011	11	21	32
2012	12	12	24
2013	Awaiting Data	Awaiting Data	Awaiting Data
Average:	14	26	40

For the seven years included in the table, the distribution of faults is not quite even with the winter fault rate being around 50% of the summer fault rate.

GSR011 – Overhead Line Single Circuit Fault Rates

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As a sensitivity, if the boundary analysis testing N-1-1 is repeated using a fault rate of 0.62 faults per year modified by the distribution seen up to 2012, this would decrease the likelihood of faults on the boundary.

N-1-1 (2 x Overhead Line Faults)

OHL Fault Rate Per 100km Cct	Unplanned Outage Rate	Prior Outage Hours in Winter	N-1-1 Boundary Fault Rate	Equivalent to 1 in ??? Yrs
0.62	0.2%	7	0.0059	168
0.45	0.2%	7	0.0043	233

N-1-1 (Prior Offshore Fault and an Onshore OHL Fault)

OHL Fault Rate Per 100km Cct	Unplanned Outage Rate	Prior Outage Hours in Winter	N-1-1 Boundary Fault Rate	Equivalent to 1 in ??? Yrs
0.62	6.0%	210	0.0595	17
0.45	6.0%	210	0.0429	23

This sensitivity, based on the distribution of weather related fault rates up to 2012 does not change the conclusions of GSR011.