

SQSS Review Panel – Modification Proposal

TREATMENT OF SWITCH FAULTS

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Summary

Under the current version (V2.2) of the NETS SQSS, switch faults (including faults on busbar couplers and busbar sections) are explicitly secured for new local generation groups only within chapter 2 and 7 of the standard. This is done with respect to limiting the loss of power infeed to the infrequent infeed loss risk (currently 1320MW and due to increase to 1800MW as of April 2014) arising from any such event.

Switch faults, depending on the location of the substation in which they occur and the generation/demand background, can potentially cause wider system issues such as instability, cascade tripping and voltage collapse. As greater concentrations of generation in particular areas of the system occur, and the dynamic characteristics of the network change as a result of the progression towards environmental targets (as described in Future Energy Scenarios), it becomes increasingly more critical to ensure the impact from these events is understood and managed appropriately.

The current NETS SQSS, whilst considering such situations within chapter 2 in a planning / design context, makes use of background condition assumptions concerning the network position and generation pattern “foreseen over the course of a years operation” and as such the current consideration of switch fault risk at the design stage is very much dependent upon the context in which the risk arises, and not all risks will be removed ahead of the operational time phase.

There is however, within the operational requirements of chapter 5 of the NETS SQSS, no clarity in how a switch fault scenario should be considered relative to other risks that arise in real time. There is further no explicit reference within chapter 5 of the NETS SQSS that the operator should indeed consider switch fault scenarios in its analysis of the system in real time, although equally such analysis is not precluded either by the requirements of the standard.

It is hence proposed that the current NETS SQSS is modified to provide both an explicit reference to switch fault scenarios and to how these should be considered in the operational timeframe. The proposed modifications to the NETS SQSS are identified further below.

Users Impacted

Low

System Operator and Transmission Owners

Description & Background

Previous examination of the topic

A previous SQSS review (GSR004) modification based on available fault statistics at the time on the frequency of switch fault scenarios on the GB transmission system, requested in October 2007 the introduction of switch fault consideration to the design of the wider

system under chapter 4 of the SQSS. A Working Group was set up to investigate the proposal further and came to the conclusion in 2010 that it would not be economic and efficient to secure against switch faults as part of chapter 4 of the SQSS deterministically as this would involve having to implement additional busbar sectioning facilities retrospectively on all existing substations where such risks existed. It was highlighted that a number of measures both operational and design related could be taken to address the risk more economically and efficiently in a planned network context, ranging from:-

- The installation of modern / higher reliability equipment within the switch protection zones at most risk,
- Nesting particular transmission reconfigurations / outages behind generation outage, to;
- Reconfiguring to eliminate the potential exposure to specific switch risks (i.e. isolating their protection from the associated live substation by opening and disconnecting that breaker).

Each of the above actions are consistent with the approach to switch fault design in relation to chapters 2 and 7 of the SQSS which require the normal background patterns of network and generation availability be considered ahead of deterministic application of the switch fault requirements of the standard.

Current provisions within the SQSS and Gap analysis

a) Switch fault consideration

Under the current version of the SQSS, switch faults are only secured as part of chapters 2 and 7 with respect to limiting the loss of infeed for new generator connections. Section 2 requirements below are also replicated in the offshore (section 7.8) and onshore (section 7.13) *Busbars* and *Switchgear* requirements for offshore network design.

2.6.4 Following the concurrent *fault outage* of any two *transmission circuits*, or any two *generation circuits* on the same *double circuit overhead line*, or the *fault outage* of any single *busbar coupler circuit breaker* or *busbar section circuit breaker* or mesh circuit breaker, the *loss of power infeed* shall not exceed the *infrequent infeed loss risk*;

2.6.6 Following the *fault outage* of any single *busbar coupler circuit breaker* or *busbar section circuit breaker* or mesh circuit breaker, during the *planned outage* of any single section of *busbar* or mesh corner, the *loss of power infeed* shall not exceed the *infrequent infeed loss risk*.

(analogous offshore references are to be found in paragraphs 7.8.3.3, 7.8.3.5, 7.13.3.3, and 7.13.3.6)

Such analysis is required to be considered against the conditions as described in paragraph 2.8, including 2.8.5; “conditions on the *national electricity transmission system* shall be set to those which ought reasonably to be expected to arise in the course of a year of operation...” Chapter 7 also references network and generation background conditions in exactly the same way in section 7.13 ensuring the switch fault risk is considered with reference to expected year round conditions.

Within the Operational criterion there is no analogous discussion or treatment of switch-fault conditions and whilst switch-fault condition assessment is not precluded here, nor is it explicit across those conditions normally studied as referenced in paragraphs 5.1-5.4 that a switch-fault is to be normally considered. Current ability for switch-fault consideration can only therefore be made within chapter 5 in reference to (5.6) periods of “major system risk” which in its definition enables circumstances beyond those in 5.1-5.4 to be considered where they are significantly more likely or have a significantly greater impact than those normally considered. However across the measures section 5.6

provides for there is no clarity in where consideration of switch-fault risk would sit against other risks of this categorisation

Section 5.9- 5.11 “Authorised variations from the operational criteria” provides for those exceptional circumstances under which operational approach can deviate from the norm. As discussed above, switch-fault risks will normally arise in the design of load generation connection and are accordingly covered in chapter 2 and 7 sufficiently to enable the TO to make with SO support appropriately balanced decisions regarding the local network design to remove switch fault risk for credible network and generation background conditions. As such it is not considered reasonable to require any residual switch-fault risk to always be avoided that must, by definition occur during an exceptional system condition, or unusual network configuration state- rather it is proposed to in such exceptional circumstances where such risks arise, only secure against this risk if it is economic to do so- as such any such consideration would factor into the optimisation of re-dispatch, outage placement and re-configuration options but not drive TO or operational constraint cost.

b) The impact of the switch fault- frequency containment

Chapter 5, unlike chapters 2 and 7 which limit power infeed lost, seeks to avoid “unacceptable frequency conditions” which is defined in terms of National Grid’s frequency regulation requirements against normal and infrequent events, rather than defining absolute levels of MW mismatch that could arise, as clearly in operational timeframes the impact of secured events would be expected to vary over the day.

It is recognised that switch faults, being often electrically close to a number of generators, have an impact that goes beyond the extent of generation that are disconnected following the fault. This issue can also impact busbar fault conditions also, although in practice due to substation design the impact of loss is not as widespread. There is value in subsequent work to update the SQSS definition of “unacceptable frequency conditions”, such that the impact of initial Rate Of Change Of Frequency is included in its consideration. However, given the design and setting of ROCOF relays is an active area of a Grid Code Working group at present, it is not proposed that further review of this is taken ahead of that work concluding.

The rationale for change and proposed nature of the change

Switch faults, depending on the location of the substation in which they occur and the generation/demand background, can potentially cause wider system issues such as instability, cascade tripping and voltage collapse. As greater concentrations of generation in particular areas of the system occur, and the dynamic characteristics of the network change as a result of the progression towards environmental targets (as described in Future Energy Scenarios), it becomes increasingly more critical to ensure the impact from these events is understood and managed appropriately;

- More generation concentration in particular areas of the network combined with;
- Changes in network dynamics (lower effective network inertia, wider impact of voltage dip upon a transmission network area of high generation connection density) leading to;
- Higher potential susceptibility to large instantaneous power loss conditions.

In GSR004, based on concerns over the increased potential for switch-fault, originally considered a more wide-ranging review of design and planning standards- and concluded that a prescriptive approach was not necessary given the economic considerations which already support the deterministic design requirements in chapters 2 and 7 that can and should logically flow into operation. GSR004 however did not address the current lack of clarity within the operational code as to how switch-faults may be considered and as such its core findings and the standard as currently written is potentially not consistent between design and operational time phases of its application in this area; the only

operational approach, recourse to “Major System Risk” consideration under paragraph 5.6 may be considered overly excessive & onerous.

The impacts discussed above reinforce the need for the operator to be clear on its consideration of switch fault risk in the context of the NETS SQSS, and in effects the operator is in practice now considering more frequently as a result of the levels of non-synchronous sources which have connected in recent years- and hence the need to resolve this issue as soon as possible ahead of the 2014 outage season.

It is therefore the conclusion of this proposal, that the existing SQSS requires clarity that provides the operator with a framework enabling the issues associated with switch faults to be explicitly factored into the securing of real time network operation. In this way these risks and the consequences of the management of these risks can be balanced with other factors explicitly identified today. These proposals do not seek to extend operator activity beyond current process nor generate additional operational cost as these modifications merely seek to clarify current operational process surrounding the economic management of these risks. As the proposed modifications concentrate on modification of chapter 5 and associated definitions the proposals do not impact current TO activities or investment approach and as such the impact from these proposals is limited to the System Operator in their application of economic assessment to the securing of the network to the SQSS.

Proposed Solution

The proposed Modification relates to chapter 5 alone. It would be intended to insert this paragraph into the “Authorised variations from the operational criteria” section of chapter 5 ahead of current paragraph 5.9.

Proposed words as follows:-

“In addition to the requirements of paragraphs 5.1 to 5.4 above, provided that there is no significant economic justification for failing to secure the *onshore transmission system* to this criterion and the probability of loss of supply capacity is not increased by following this condition and not decreased by not following this condition; the onshore transmission system shall be operated under *prevailing conditions* such that for the *secured event of*

-a fault outage of a single section busbar coupler breaker, busbar coupler circuit breaker or mesh circuit breaker.

The onshore transmission system should not be subject to:-

- *Unacceptable frequency conditions*
- *Unacceptable overloading of any primary transmission equipment*
- *Unacceptable voltage conditions: or*
- *System instability.”*

Assessment against SQSS Objectives

(i) *facilitate the planning, development and maintenance of an efficient, coordinated and economical system of electricity transmission, and the operation of that system in an efficient, economic and coordinated manner;*

This objective is explicit in the modification- switch-faults and their consequences are proposed to be considered by the operator by exception and on a purely economic basis. The consistency and clarity of approach driven by this amendment improves efficiency and co-ordination in the application of chapter 5 of the NETS SQSS.

(ii) ensure an appropriate level of security and quality of supply and safe operation of the National Electricity Transmission System;

This objective will be met as the aim of the SQSS change is to ensure operators consistently consider the security of the system in the event of switch faults to the approach defined in chapters 2 and 7 of the code thereby increasing clarity on the management of this issue.

(iii) facilitate effective competition in the generation and supply of electricity, and (so far as consistent therewith) facilitating such competition in the distribution of electricity; and

N/A

(iv) facilitate electricity Transmission Licensees to comply with their obligations under EU law.

N/A

Impact & Assessment

Impact on the SQSS

This impact is associated with Chapter 5 of the SQSS alone. As such it primarily impacts the System Operator in providing consistency and clarity in the manner in which it operates the network and how it communicates that where appropriate to interested parties, for example ONTO and OFTOs.

Impact on the National Electricity Transmission System (NETS)

The operation of the NETS will be clarified in respect of the management of switch fault risk in real time, enabling current best practice to be captured when modifying running arrangements of substations or when planning outages to ensure the most economic and efficient overall approach.

Impact on Greenhouse Gas Emissions

N/A

Impact on relevant computer systems

N/A

Impact on core industry documents

N/A

Impact on other industry documents

N/A

Supporting Documentation

Have you attached any supporting documentation: No

If Yes, please provide the title of the attachment:

Recommendation

The SQSS Review Panel is invited to:
Approve the proposed changes as submitted.

Document Guidance

This document is used to raise a Modification Proposal at the SQSS Review Panel. Incomplete forms will not be processed and the Proposer may be asked to clarify any information that is not clear.

Guidance has been provided in square brackets within the document but please contact the SQSS Review Panel Secretary Nick Martin (nick.martin@nationalgrid.com) if you have any queries.