

## Stage 03: Modification Report

National Electricity Transmission System Security  
and Quality of Supply Standards (NETS SQSS)

# GSR021: Operational & Planning Criteria for 220kV Transmission Assets: Modification Report

What stage is this document at?

01	Workgroup Report
02	Industry Consultation
03	Report to the Authority

This proposal seeks to modify the NETS SQSS to include 220kV as a nominal voltage for the Onshore Transmission System and to adopt the same percentage voltage limits for planning and operating 220kV transmission assets as are used for the 275kV nominal voltage. In addition, this proposal seeks to modify the defined term “supergrid” to include 220kV by aligning this with the Grid Code definition which considers any voltage above 200kV as a supergrid voltage.

The purpose of this document is to assist the Authority in its decision of whether to implement the proposed modification to the NETS SQSS.

**Published on:** 02 December 2015



***The NETS SQSS Review Panel recommends:***

That GSR021 should be implemented as it better facilitates the applicable NETS SQSS objectives.



***High Impact:***

None identified



***Medium Impact:***

None identified



***Low Impact:***

None identified

GSR021 Modification  
Report

Date 02/12/2015

Version 1.0

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## About this Document

This Modification Report contains the information the NETS SQSS Review Panel believes is required for the Authority to progress a change to the National Electricity Transmission System Security and Quality of Supply Standards.

## Document Control

Version	Date	Author	Change Reference
1.0	02/12/2015	Bless Kuri and Nick Martin	Draft for Panel



### Any Questions?

Contact:

**Nick Martin**

Code Administrator



[nick.martin@  
nationalgrid.com](mailto:nick.martin@nationalgrid.com)



**01926 654757**

Proposer:

**Bless Kuri**

SHE Transmission



[bless.kuri@sse.com](mailto:bless.kuri@sse.com)



**01738 456526**

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## 1 Executive Summary

- 1.1 With the introduction of 220kV assets on the National Electricity Transmission System (NETS), the planning and operational criteria in the NETS SQSS needs to be modified to include this new voltage level. The first 220kV assets will be introduced to the NETS with the commissioning of the Kintyre – Hunterston subsea AC link which consists of two 220kV subsea cables between Crossaig on the Kintyre peninsula and Hunterston in Scotland in 2015.
- 1.2 Planning and operational voltage limits are specified in Section 6 of the NETS SQSS for the onshore part of the NETS and in Section 10 for the offshore part. Currently, pre-fault voltage limits, steady state voltage limits and voltage step limits are specified by explicit transmission voltage levels within the onshore criteria. This means that no onshore voltage criteria are defined for voltage levels other than those explicitly specified within the onshore voltage criteria.
- 1.3 Within Section 6 and the relevant onshore sections, a number of secured events are qualified by the term ‘supergrid’. It is important to provide clarity on whether 220kV should be considered as a supergrid voltage or not and to unambiguously specify the applicable voltage limits for the same.
- 1.4 This proposal seeks to modify the NETS SQSS to include 220kV as a nominal voltage for the Onshore Transmission System and to adopt the same percentage voltage limits for planning and operating 220kV transmission assets as are used for the 275kV nominal voltage. In addition, this proposal seeks to modify the defined term “supergrid” to include 220kV by aligning this with the Grid Code definition which considers any voltage above 200kV as a supergrid voltage.
- 1.5 This Modification Report sets out the rationale for the modification proposal and presents the proposed modification and the outcome of the impact of the proposal on the NETS SQSS, Users, core industry documents and other industry documents.

## 2 Why Change?

- 2.1 The first 220kV assets will shortly be introduced onto the National Electricity Transmission System (NETS) with the commissioning of the Kintyre-Hunterston subsea AC link that shall consist of two 220kV subsea cables between Crossaig on the Kintyre peninsula and Hunterston. These connect to the onshore transmission network via two 220/132kV transformers at Crossaig (Scottish Hydro Electric Transmission) and two 400/220kV supergrid transformers at Hunterston (Scottish Power Transmission).
- 2.2 It is envisaged that further 220kV AC projects will be developed for inclusion on the NETS, especially with the connection of some offshore wind farms. Indeed a number of contracted offshore developers / offshore transmission owners (OFTOs) have indicated plans to connect to the Onshore Transmission System at 220kV. The 220kV nominal voltage is largely dictated by the submarine cable technology currently available.
- 2.3 Pre-fault voltage limits, steady state voltage limits and voltage step limits are specified by explicit transmission voltage levels within the onshore criteria meaning that onshore voltage limits are effectively not defined at any transmission voltage that is not explicitly specified on the Onshore Transmission System.
- 2.4 Within the onshore chapters of the NETS SQSS, distinction is made between supergrid assets and transmission assets in general. "Supergrid" is a defined term within the NETS SQSS, referring to the "part of the transmission system operated at a nominal voltage of 275kV and above". As currently defined, 220kV assets would not be considered as supergrid assets.
- 2.5 Within Section 6 and the relevant onshore sections, a number of secured events are qualified by the defined term "supergrid". It is therefore important to provide clarity on whether 220kV should be considered as a supergrid voltage or not and to unambiguously specify the applicable voltage limits for the same.
- 2.6 This change is necessary in order to ensure that new assets at the 220kV voltage level are planned and operated to a common set of criteria which facilitates equipment and design standardisation, helping to achieve investment efficiency and safer systems of electricity transmission.

### 3 Solution

- 3.1 Planning and operational voltage limits are specified in Section 6 of the NETS SQSS: “Voltage Limits in Planning and Operating the Onshore Transmission System” and Section 10: “Voltage Limits in Planning and Operating an Offshore Transmission System”. Section 6 voltage limits are applicable to Sections 2, 3, 4 (onshore part of the Main Interconnected Transmission System (MITS)) and Section 5, whilst Section 10 voltage limits are applicable to Sections 7, 8, 9 and 4 (offshore part of the MITS).
- 3.2 Section 10 of the NETS SQSS, which specifies voltage limits for Offshore Transmission Systems, provides voltage limits for all nominal voltages less than 400kV down to 132kV inclusive. Thus there is no ambiguity with voltage limits at 220kV on the Offshore Transmission System. There is also no reference made to the defined term “supergrid” in the offshore chapters of the NETS SQSS.
- 3.3 This proposal therefore focuses on addressing the introduction of 220kV as a nominal voltage on the onshore part of the NETS SQSS as well as the inclusion of the 220kV voltage within the range of voltages covered by the definition of the term “supergrid”. Whilst this proposal seeks to include the 220kV nominal voltage within the NETS SQSS, it also recognises that as technology advances, the voltage ratings of subsea cables are likely to rise. Thus, it is possible that nominal voltages other than those currently in operation on the NETS will emerge in the foreseeable future.
- 3.4 Two approaches were considered for the inclusion of the 220kV criteria into the SQSS text. The first approach was to introduce the voltage criteria by explicit voltage level, amending the tables in Section 6 as appropriate. This was the preferred approach as it is consistent with the IEC standard voltages and would ensure that the voltage limits can readily be specified to within standard equipment design voltages.
- 3.5 The alternative approach, which was not pursued, was based on modifying the 275kV criteria by introducing a voltage range for which the existing 275kV would be applied. This voltage range would include the 220kV nominal voltage. While this approach would remove the need to update the SQSS for any potentially new future nominal voltages within the voltage range, it was felt that the benefits of standardisation of equipment voltage ratings could be lost, with the possibility of introducing confusion in the interpretation of voltage limits in the standard when compared against standard equipment design voltages.
- 3.6 The proposed solution is to modify the NETS SQSS to include 220kV as a nominal voltage for the Onshore Transmission System and to adopt the same percentage voltage limits for planning and operating 220kV transmission assets as are used for the 275kV nominal voltage. The inclusion would explicitly specify the voltage limit for the 220kV nominal voltage in a similar fashion to the criteria for existing nominal voltages.
- 3.7 In addition, the proposed solution also covers the modification of the defined term “supergrid” to include 220kV by aligning this with the Grid Code definition which considers any voltage above 200kV as a supergrid voltage.

## 4 Consultation

- 4.1 The GSR021 consultation was published on 21 September 2015. Responses were invited upon the proposals outlined in the consultation with a closing date of 16 October 2015.
- 4.2 Responses were invited to the following questions:
- (i) Do you support the introduction of planning and operational criteria to include 220kV in the NETS SQSS?
  - (ii) Do you agree that the planning and operational criteria for 220kV should be aligned to the current 275kV criteria?
  - (iii) Do you support the proposal to align the definition of the term 'supergrid' in the NETS SQSS to that in the Grid Code?
  - (iv) Do you support the proposed implementation approach of 10 business days following an Authority decision?
- 4.3 Responses were received from one party: Vattenfall. This is included in Annex 2 of this document. The response was supportive of the modification proposal. However, it should be noted that the respondent suggests that having introduced 220kV into the NETS SQSS for use on the onshore NETS, it may be necessary to introduce this voltage level into the Connection and Use of System Code (CUSC) also, for instance in Section 14, to establish a transparent connection and use of system charging basis.

### NETS SQSS Review Panel Assessment

#### 5.1 National Grid

The view of National Grid is that the proposed changes are beneficial in that they will recognise the use of 220kV equipment on the Onshore Transmission System and will provide greater clarity on the planning and operation of those parts of the network using this voltage.

#### 5.2 Scottish Power Transmission Limited (SPT)

The view of Scottish Power Transmission is that the proposed changes are beneficial in that they will recognise the use of 220kV equipment on the Onshore Transmission System and will provide greater clarity on the planning and operation of those parts of the network using this voltage.

#### 5.3 Scottish Hydro Electric Transmission plc. (SHE Transmission)

The view of SHE Transmission is that the proposed changes are beneficial in that they will recognise the use of 220kV equipment on the Onshore Transmission System and will provide greater clarity on the planning and operation of those parts of the network using this voltage.

#### 5.4 Offshore Transmission Owners (OFTOs)

The view of the OFTO representatives is that the proposed changes should proceed to the Authority for a decision.

#### 5.5 Generators

The Generator representative is supportive of the proposal and is of the view that the proposed changes should proceed to the Authority for a decision.

#### 5.6 Distribution Network Operators (DNOs)

The view of the DNO representative is that the proposed modifications do not have any implications for Distribution Networks.

#### 5.7 NETS SQSS Review Panel members agreed that the proposed changes should be submitted to the Authority in the form of this Report to the Authority on 2 December 2015.

### Impact on the NETS SQSS

#### 5.8 Introducing voltage limits for the new 220kV nominal voltage without changing the limits for any other currently specified voltages will have no impact upon the NETS SQSS. It is important to ensure that the drafting changes to the NETS SQSS text, to facilitate this modification, do not unduly impact upon any other NETS SQSS criteria.

#### 5.9 The proposed definition for the term “supergrid”, which covers a wider voltage range, would mean that more assets would now be included when considering secured events involving supergrid assets. However, the additional assets would only be the assets at the new 220kV nominal voltage at this stage. Therefore, modifying the term “supergrid” in the NETS SQSS to align with the Grid Code definition will therefore have no impact on the NETS SQSS given that there are currently no system nominal voltages between 132kV and 275kV in the NETS SQSS and that the 220kV assets are being introduced for the first time on the NETS.

5.10 GSR021 requires amendments to the following parts of the NETS SQSS:

(a) *Section 6: Voltage limits in planning and operating the Onshore Transmission System*

- Table 6.1 Pre-fault planning voltage limits;
- Table 6.3 The steady state voltage limits in planning timescales; and
- Table 6.5 The steady state voltage limits in operational timescales.

(b) *Section 11: Terms and Definitions*

- Definition of the term 'supergrid'

5.11 The text required to give effect to this proposal is contained in Annex 1 of this Modification Report.

### **Impact on the National Electricity Transmission System (NETS)**

5.12 The proposed changes will have no impact on the NETS.

### **Impact on GSR008 Modification Proposal**

5.13 The GSR008 modification proposal covers regional variations and wider issues and is now with the Authority for approval. As this 220kV proposal is introducing a new voltage, the same modifications proposed to the NETS SQSS text would be applicable to the GSR008 NETS SQSS text.

5.14 GSR008 proposes to remove the regional variations on the 275kV high voltage limit in operational timescales. The relaxation to allow the 275kV voltage to rise to 115% (316kV) in Scotland was removed. The proposal also changed the 275kV high voltage limit from 110% (303kV) to 109% (300kV) on the NETS. This is in recognition of the IEC standard voltages where equipment operated at a nominal voltage of 275kV is rated to 300kV.

5.15 Should GSR008 be approved, the proposal to remove the regional variation and the high voltage relaxation should be applied to the proposed 220kV criteria in this proposal. However, the high voltage limit of 109% proposed in GSR008 should not be applied to the 220kV criteria as the standard maximum system voltage for 220kV is 245kV in IEC. Instead the 110% (242kV) limit should be retained for the 220kV voltage as proposed in this modification report.

### **Impact on NETS SQSS Users**

5.16 The proposed changes will provide clarity to NETS SQSS Users with regards to planning and operational criteria for 220kV. No impact is envisaged on User systems required to accommodate the modification.

### **Impact on Greenhouse Gas Emissions**

5.17 The proposed modification will have no impact on Greenhouse Gas Emissions.



## Assessment Against NETS SQSS Objectives

5.18 The NETS SQSS Review Panel considers that the proposed changes would better facilitate the NETS 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;

By including 220kV in the planning and operational criteria, this will allow consistent designs and equipment standardisation which helps with ensuring efficiency in the long term.

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

Inclusion of 220kV in the planning and operational criteria will allow consistent designs across sites which helps standardise site design and maintenance regimes. This enhances the safe operation of the NETS.

- (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

Official recognition of the 220kV nominal voltage in the SQSS facilitates the economic and efficient connection of large generators where 275kV and 400kV overhead lines are not viable from an economic and consenting perspective.

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

The proposal has a neutral impact on this objective.

## Impact on Core Industry Documents

5.19 An impact assessment of the proposed modification was carried out on the Grid Code, Distribution Code and a number of key Engineering Recommendation Documents and associated Engineering Technical Reports. The findings from this are available in Table 1 of the attached Panel Paper.

## Impact on Other Industry Documents

5.20 The proposed modification does not impact on any other industry documents.

## Implementation

5.21 The NETS SQSS Review Panel proposes that GSR021 should be implemented 10 business days after an Authority decision.

## Annex 1 – Proposed Legal Text

This section contains the proposed legal text to give effect to the proposals. The proposed new text is in red and is based on NETS SQSS Version 2.2, Dated March 5 2012.

### Voltage Limits:

Table 6.1 Pre-fault planning voltage limits

Nominal voltage	Minimum	Maximum
400kV	390 kV (97.5%)	410 kV (102.5%) Note 1
275kV	261 kV (95%)	289 kV (105%)
220kV	209 kV (95%)	231 kV (105%)
132kV in SPT's transmission system and SHETL's transmission system.	Note 2	139 kV (105%)
<275kV in NGET's transmission system and <132kV in SPT's transmission system and SHETL's transmission system.	Note 3	105%

Notes... (no notes applicable for 275kV, hence 220kV)

Table 6.3 The steady state voltage limits in planning timescales

Nominal voltage	Minimum	Maximum
400kV	380kV (95%) Note 1	410kV (102.5%) Note 2
275kV	248kV (90%)	289kV (105%)
220kV	198kV (90%)	231kV (105%)
132kV	Note 3	139kV (105%)
<132kV	Note 3	105%

Notes... (no notes applicable for 275kV, hence 220kV)

Table 6.5 The steady state voltage limits in operational timescales

Nominal voltage		Transmission System		
		NGET	SPT	SHETL
400kV	Minimum	360kV (90%)	360kV (90%)	360kV (90%)
	Maximum	420kV (105%) Note 1	420kV (105%) Note 2	420kV (105%) Note 2
275kV	Minimum	248kV (90%)	248kV (90%)	248kV (90%)
	Maximum	303kV (110%)	303kV (110%) Note 3	303kV (110%) Note 3
220kV	Minimum	198kV (90%)	198kV (90%)	198kV (90%)
	Maximum	242kV (110%)	242kV (110%) Note 5	242kV (110%) Note 5
132kV	Minimum	119kV (90%)	119kV (90%)	119kV (90%)
	Maximum	145kV (110%)	145kV (110%) Note 4	145kV (110%) Note 4
Less than 132kV	Minimum	94%	95%	94%
	Maximum	106%	105%	106%

Notes

1. May be relaxed to 440kV (110%) for no longer than 15 minutes
2. May be relaxed to 440kV (110%) for no longer than 15 minutes following a major system fault
3. May be relaxed to 316kV (115%) for no longer than 15 minutes following a major system fault
4. May be relaxed to 158kV (120%) for no longer than 15 minutes following a major system fault
5. May be relaxed to 253kV (115%) for no longer than 15 minutes following a major system fault

Definition of the Defined Term: "Supergrid":

That part of the National Electricity Transmission System operated at a nominal voltage of ~~275kV~~ 200kV and above.

## Annex 2 – Consultation Responses

Respondent:	Andy Causebrook St Andrews House Haugh Lane Hexham Northumberland, NE46 3QQ
Company Name:	Vattenfall Wind Power
Do you support the proposed implementation approach?	Yes. Vattenfall Wind Power believe that 220kV offers an economic and efficient alternative to 275kV and / or 132kV for transfer of power onshore in GB and may facilitate economic connection of clusters of renewable or other generators. Establishing 220kV as a standard supergrid voltage therefore has the potential to reduce the cost and improve the viability of certain new generation circuits and associated infrastructure.
Do you believe that GSR021 better facilitates the appropriate NETS SQSS objectives?	<p><i>(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;</i></p> <p>Yes. The changes facilitate wider use of 220kV assets, which offer an economic and efficient alternative to 275kV and / or 132kV for transfer of power in the indicative range 200-700MW and may facilitate economic connection of clusters of renewable or other generators or smaller NETS interconnections.</p> <p><i>(ii) ensure an appropriate level of security and quality of supply and safe operation of the National Electricity Transmission System;</i></p> <p>Not applicable.</p> <p><i>(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</i></p> <p>Yes. By facilitating the economic and efficient connection of large generators or clusters of generators where 275 / 400kV overhead lines are not viable from an economic and / or consenting perspective.</p> <p><i>(iv) facilitate electricity Transmission Licensees to comply with their obligations under EU law.</i></p> <p>No comment.</p>

Do you support the introduction of planning and operational criteria to include 220kV in the NETS SQSS?	Yes. In view of the merits of using 220kV onshore in GB it is necessary to introduce such criteria to govern its use.
Do you agree that the planning and operational criteria for 220kV should be aligned to the current 275kV criteria?	Yes. We see no reason to have different criteria.
Do you support the proposal to align the definition of the term 'supergrid' in the NETS SQSS to that in the Grid Code?	Yes.
Do you support the proposed implementation approach of 10 business days following an Authority decision?	Yes. We see no good reason to delay implementation, especially given the imminent operation of such assets in GB.
Do you have any additional comments?	Having introduced 220kV into SQSS for use in the onshore NETS, it will be necessary to introduce this voltage level into CUSC, for instance in Section 14, to establish a transparent connection and use of system charging basis.