National Electricity Transmission System

Security and Quality of Supply Standard

Fundamental Review

Update & Consultation Report

Responses Required By: 4 June 2010

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Executive Summary

In 2008 the Security and Quality of Supply Standards Review Group established a fundamental review of the National Electricity Transmission System (NETS) Security and Quality of Supply Standard (SQSS). Significant progress has been made in a number of areas and opportunities to modify the NETS SQSS to further enhance its cost-effectiveness and accelerate the rate at which new generation can be connected have been identified. This report describes the progress made to date and the modifications which are proposed. The SQSS Review Group seeks industry views on the proposals to inform the manner in which they are progressed, prior to them being sent to Ofgem for consideration.

This consultation is the first element of the workplan outlined by the SQSS Review Group in their open letter to the industry on 30 March 2010 (included in Appendix A). The letter set out further steps to progress the review of the NETS SQSS to ensure they remain appropriate to meet the evolving needs of the industry. These include:

- Developing proposals for the integration of wind generation in SQSS, for consultation in June 2010.
- Providing further advice/information to Ofgem to assist in their assessment regarding the proposed increase to the infeed loss risk.
- Developing new SQSS governance arrangements in the second half of 2010 to reflect developments within the industry and the broader range of parties now affected by different sections of the SQSS.
- Utilising the customer engagement process envisaged for the forthcoming transmission price control review (TPCR5) to provide direction to the SQSS review group regarding the balance between security of supply and economic efficiency
- Developing a programme for the ongoing assessment and resolution of the complex and fundamental issues which remain outstanding.

This approach will rapidly address immediate issues, while allowing sufficient time for the implications of novel/complex proposals to be thoroughly investigated, the industry's views to be fully understood and considered, and the industry to smoothly transition to any significant changes to network planning and operations.

Findings

Key findings and recommendations of the review include:

- Revisions to the minimum generation connection criteria are proposed to ensure that transmission investment is more closely matched to a generator's operating regime and its contribution to overall system security. This will minimise the connection cost for new generators and maximise the value of transmission investment without compromising on the security of supply to consumers. Further refinement of the proposed categories of generation and implementation of appropriate commercial arrangements are recommended before these changes are introduced.

- Demand management has been and is presently used in transmission planning where it is expected to be available throughout the timescale under consideration. It is used to contain system frequency falls following a generation loss and in the post-fault management of thermal, voltage and stability issues. Its use can provide greater system capability and lower operating and investment costs. It is proposed to modify the standard to explicitly refer to the consideration of demand management when undertaking system analysis.

- A review of historical fault rates within the UK and the findings of a benchmarking activity comparing the NETS SQSS with transmission security standards for transmission networks of similar characteristics have highlighted the opportunity to relax the criteria that applies in England and Wales to secure the coincident fault-outage of two overhead lines strung on separate towers at the time of system peak demand, without significantly impacting on the security of supply for consumers. Relaxing this requirement will reduce the amount of new infrastructure required, facilitating the faster connection of new generation and reducing the total investment costs. This change removes a regional inconsistency in the MITS SQSS, leading to greater clarity.

- The three onshore TSOs already make extensive use of seasonal ratings in planning and operations in order to maximise the utilisation of transmission infrastructure based on likely ambient conditions. Additionally, closer to real-time, National Grid's *Met Office Rating Enhancement System* uses a day-ahead weather forecast to determine weather-corrected ratings on a number of circuits, which are factored into power system operating plans. Recognising the increasing potential of new dynamic line rating technologies to further enhance the utilisation of the network to the maximum extent permitted by ambient conditions, the NETS SQSS has been reviewed and proposals are included to explicitly address the consideration of dynamic ratings during system studies.

- A number of improvements to the voltage requirements have been identified that will enhance efficiency, remove regional variations, and improve the clarity of the requirements, including:

    1. Categorisation of voltage criteria as "hard limits" or "soft limits", with the view that all limits should be respected during investment forecasting studies, but that opportunities to save expenditure by exceeding "soft limits" (but not "hard limits") can be considered with discretion during the detailed design stage of each scheme.
    2. Greater opportunity for operations to flex the pre-fault steady-state voltages provided that the post-fault voltage limits are always respected.
    3. New GB-wide step-change limits for operational switching, specified in a way that matches the varying characteristics of the system by specifying criteria for different voltage levels and by separating operational switching into “frequent” and “infrequent” events.
    4. Including as secured events for planning and operating the power system, the loss of any generating unit and the failure of a circuit breaker where this could cause the voltage to increase beyond the upper planning limits.

- Opportunities to increase transmission capability by relaxing the stability criteria within the MITS SQSS or utilising faster protection have been investigated. In both cases it was concluded that the GB power system is already making efficient and full use of its stable operating envelope and that the changes to the stability criteria would deliver no material increase in transmission capacity.

- Recognising the increasing volume and importance of embedded generation, it is proposed to modify the MITS SQSS criteria such that it more accurately reflects the contribution of embedded generation to demand security. It is proposed that new criteria will take into account factors such as the fuel-type of generators and the potential for common mode failures to affect multiple generators within a demand group. It is also proposed that the new criteria would be applied uniformly throughout Great Britain (removing a regional variation) and will have improved alignment with the design standards applying to the distribution networks. The new criteria will ensure that grid supply points have a capacity that ensures security of supply whilst minimising the cost of new infrastructure.

- Demand and generation intertrip schemes are already used extensively throughout Great Britain (approximately 30 schemes are presently active), and new schemes are introduced each year. These schemes provide additional pre-fault network capability by automatically interrupting generation and/or demand immediately following defined network faults. However, given the risks associated with intertrips (e.g. the consequences of a scheme failing to operate when required, or mis-operating when not required) and their impact on system operations (e.g. the ability to take planned outages for maintenance and system development), their use must be considered carefully. The SQSS Fundamental Review weighed the benefits and implications of increasing the scale and complexity of intertrip schemes to provide additional pre-outage capacity on the MITS. The review found that the use of intertrips is generally only of economic benefit in managing outage conditions, and that the scale and complexity of intertrip schemes is ultimately limited by the need to ensure that voltage, stability and loss of infeed limits are not violated. Subject to these constraints, the use of post-fault intertripping of generation and demand will continue to be investigated and utilised where appropriate to ensure that year round operating criteria can be met.

- As outlined in the SQSS Review Group's open letter, a programme of ongoing assessment will be established to tackle the complex and fundamental issues which remain outstanding. Significant groundwork, including the development of a number of complex analytical tools required to support this assessment, has been completed by the Fundamental Review. This work will form an important basis for the ongoing program of assessment.

Contents

1 Introduction

The National Electricity Transmission System (NETS) Security and Quality of Supply Standard (SQSS) Review Group is responsible for ensuring that the NETS SQSS is kept up-to-date and relevant as the energy industry develops and technology advances.

The requirements of the SQSS have recently, and are currently, undergoing review. These reviews include the three Transmission Operators (TOs) and the wider industry. The drivers for review include:

- Government plans to deliver policy that facilitates investment in approximately 35GW of new renewable generation in the UK between now and 2020 to allow the UK to meet its climate change targets and ensure security of supply. Consequently, large amounts of renewable and other low carbon generation are anticipated to connect to the power system. This has two impacts:
    - Its location will mean that significant network reinforcement is needed.
    - Much of this renewable generation will be intermittent in nature, and the impact of this intermittency needs to be reflected in the SQSS.
- It is expected that new nuclear power stations will want to use generating units that are larger than presently accounted for in the SQSS.
- There are significant new interconnections to external systems currently under construction and more are planned. Interconnectors can result in large changes in flows within short timescales across the transmission system.
- The present SQSS criteria contain a number of regional differences that make them less clear to users.
- The announcement of Round 3 offshore wind developments means that very large scale windfarms may be developed far offshore. The present SQSS criteria will need to be amended or augmented to take account these developments, perhaps leading to the development of interconnected offshore transmission networks.

A number of reviews of specific aspects of the SQSS have been initiated in recent years, and these are described in this report. However, in 2008 it was recognised that a more fundamental review of the SQSS was needed. This Update & Consultation Report provides a summary of the current status of the fundamental review, an explanation of the findings and recommendations to date, and a revised plan for progressing the review. Whilst analysis is still being progressed in a number of areas, a number opportunities to develop the SQSS have been identified which would allow the transmission system to be operated more efficiently and facilitate the earlier connections of generation. Modifications to the SQSS required to realise these improvements are formally proposed in this report.

In addition to the summary information presented in the main body of this report, detailed reports from each of the working groups established to undertake different facets of the review are appended to this report. These working group reports explain in detail: the analysis undertaken by each working group, the challenges and difficulties encountered, the results obtained, along with recommendations on how to progress any outstanding issues.

The SQSS Review Group will continue to seek to engage with all stakeholders on the NETS SQSS in an open and inclusive manner. The SQSS Review Group would welcome feedback on both the principles for the modification proposals described in the report and the draft text intended to implement the principles. Responses are required by 4 June 2010, as described in Section 7.

In an open letter to the industry, published on 30 March 2010, the SQSS review group outlined its workplan for the ongoing review of the SQSS. The revised workplan seeks to rapidly address immediate issues, such as integrating intermittent generation into the transmission system in an economic and efficient manner, while allowing sufficient time for the implications of novel proposals to be thoroughly investigated, for the industry's views to be fully understood and considered, and for the industry to smoothly transition to any significant changes to network planning and operations.

The current version of the NETS SQSS is available online at:

www.nationalgrid.com/uk/Electricity/Codes/gbsqsscode/

2 SQSS Background

2.1 Historical Development of the SQSS

The transmission licensees are required to plan, operate and maintain the transmission system in an efficient and economical manner and to facilitate competition in the electricity market. Compliance with the SQSS is an electricity transmission licence requirement (NGET's standard condition C17, SPT and SHETL's standard condition D3).

Standards relating to the design and operation of the transmission system have progressively evolved from a variety of policies developed and applied within each Transmission Operator (TO), into the integrated single NETS SQSS standard presently in force throughout Great Britain. Understanding the MITS SQSS' history explains the regional variation of some criteria.

The NETS SQSS has its roots in the 1940s and has evolved from a suite of six individual standards which concerned: the design of generation connections (PLM-SP-1); the design of the supergrid transmission network (PLM-SP-2); criteria for system transient stability studies (PLM-ST-4); voltage criteria for the design of the 400kV and 275kV supergrid system (PLM-ST-9); the design of demand connections (ER P2/5); and the operational standards of security of supply (OM3).

At vesting in March 1990, these standards were inherited by National Grid and were lodged with the then Office of Electricity Regulation (Offer subsequently Ofgem) in accordance with Condition 12 of National Grid's transmission Licence and became commonly known and referred to as the Licence Standards.

The standards were written as separate, relatively independent, guidance notes for engineers. Their use by National Grid identified a number of areas of ambiguity and inconsistency both within and between the standards. A Review of Security Standards (RSS) was initiated by National Grid following a formal request by Offer (now Ofgem) in 1992. In 1996, following the conclusion of the review, Offer requested National Grid to update the standards and, in so doing, maintain the principles of the original Licence Standards except as modified by the RSS (e.g. in respect of customer choice and the greater use of operational flexibility). In meeting Offer's request, National Grid took the opportunity to combine all the standards into a single document referred to as the NGC System Security and Quality of Supply Standard (NGC SQSS). The previous six standards ceased to have effect in England and Wales from November 2000 when the new GB SQSS came into force.

However, in Scotland the transmission licensees had a different set of transmission planning and operational standards such as NSP 366, OM3 and GCI B1 and these were not part of the RSS undertaken by National Grid. Consequently, the Scottish transmission licensees continued to apply these standards. In 2003, in preparation for the introduction of the British Electricity Trading and Transmission Arrangements (BETTA), Ofgem requested that National Grid (as GBSO designate) and the three GB transmission owners (i.e. NGC, SHETL and SPT) harmonise the standards, as far as practical, while still retaining the principles of the

NGC SQSS and without altering the underlying security of the system or incurring significant infrastructure expenditure. With the introduction of BETTA on 1st April 2005 the new standard, referred to as the Great Britain Security and Quality of Supply Standard (GB SQSS), replaced the previous standards used by the three GB transmission owners (including the NGC SQSS).

More recently, Ofgem and the Department for Business and Regulatory Reform (BERR) have been working together to implement a regulatory regime for offshore transmission systems. As part of this work, Ofgem requested that the TOs extend the GB SQSS to include offshore transmission systems as well as the onshore transmission system. New criteria for offshore networks were developed on the basis of a series of cost benefit analyses, bounded by pragmatic assumptions regarding the scale and distance of the generation from shore and the technology available at the time the analyses were carried out. These assumptions were suitable for Round 1 and Round 2 offshore developments but not Round 3 developments. The final change proposals were submitted to Ofgem in April 2008. Following Ofgem's consultation process, these changes were incorporated into version 2.0 of the National Electricity Transmission System Security and Quality of Supply Standard (NETS SQSS) and published on 24 June, 2009.

2.2 Contents of the NETS SQSS

The NETS SQSS presents criteria and methodologies which the onshore transmission licensees are obliged to apply (and offshore transmission licensees will likely be obliged to apply) when planning and operating their transmission systems. The NETS SQSS presents these criteria and methodologies according to the functional aspects of the transmission system to which they primarily apply.

There are currently ten sections and five appendices. The first section is an introduction. Sections 2 – 6 relate to onshore portions of the NETS, while sections 7 – 10 relate to the offshore portions. Sections 2 & 7 relate to generation connection, 3 & 8 to demand connections, 5 & 9 to system operation, and 6 & 10 to voltage limits. Section 4 addresses the design of the Main Interconnected Transmission System (MITS) onshore, and does not presently have an equivalent offshore section (reflecting the fact that the offshore criteria are presently optimised for Round 1 and 2 windfarms). Each of these sections includes criteria in the form of specified secured events for which specified unacceptable conditions shall not arise. The following paragraphs provide an overview of their content.

2.2.1 Sections 2 & 7: Design of Generator Connections

The aim of the generation connection criteria is to provide an equitable balance between investment in local connection assets, operational costs and the level of generation access provided, to meet the TO/SO licence obligations, to facilitate competition in the electricity market, while, at the same time, ensuring the transmission system is planned and operated in an economic and efficient manner.

Criteria include those which relate to 'Limits to Loss of Power Infeed (LOPI) Risk' and those which relate to 'Capacity Requirements'. Application of the LOPI criteria determine the

minimum number of circuits, busbars and switchgear required while application of the 'Capacity' criteria determine the capacity of those circuits, busbars and switchgear and, depending on available circuit capacity, may lead to additional circuits being required.

The values of normal and infrequent infeed loss risk are the limits to the loss of power infeed from generation into the NETS which can be accepted for certain specified secured events. For the most common secured events no loss of power infeed is permitted, for less common secured events the normal infeed loss risk (presently 1000MW) applies, while the infrequent infeed loss risk (presently 1320MW) applies to rare secured events. These values, and perceived frequency of occurrence, are consistent with the requirements of the Electricity Supply Regulations 1989 and National Grid's policy to contain frequency response costs. That is, they represent a balance between risk and cost to the end user.

It is permissible to design to standards higher than those set out provided the higher standards can be economically justified. A lower standard is also permitted under the provisions of a 'Variation to Connection Designs' clause (i.e. customer choice).

The main developments which have the potential to impact on this standard include: the possible introduction of generation infeeds in excess of 1320MW which would naturally impact on the LOPI criteria; the introduction of new transmission access arrangements; and the introduction of high volumes of renewable (e.g. intermittent wind generation) and other low carbon generation which may require different treatments under the standard.

2.2.2 Sections 3 & 8: Design of Demand Connections

The aim of the demand connection criteria is to provide an equitable balance between investment in local demand connections, operational costs and the level of demand security provided.

Onshore, the demand connection criteria are essentially based on the time of peak demand although the maintenance period demand, which is likely to occur at off-peak times, is considered. Offshore, demand connections will most commonly be to offshore power stations to supply their auxiliary loads, with an assumed maximum capacity of 12MW. The criteria specify the minimum level of local connection to demand and are based on the original Licence Standard ER P2/5.

The unacceptable conditions that shall not arise as a result of specific secured events include loss of supply capacity beyond specified limits, unacceptable overloading, unacceptable voltage conditions and system instability. The permitted loss of supply capacity is a function of the size of demand group. Different sizes of demand group are provided with different levels of security. Onshore, an assumed effective contribution from embedded large power stations to group demand is also taken into account.

Just as for generator connections, it is permissible to design to standards higher than those set out provided the higher standards can be economically justified. A lower standard is also permitted under the provisions of a 'Variation to Connection Designs' clause (i.e. customer choice).

The main developments which have the potential to impact on this standard include: the possible need for amendments for harmonisation with ER P2/6 (an updated version of ER P2/5); and the contribution of intermittent generation (embedded or directly connected) to demand security.

2.2.3 Section 4: Design of the Main Interconnected Transmission System (MITS)

The Main Interconnected Transmission System (MITS) is defined within the NETS SQSS as comprising all 400 and 275kV elements of the onshore transmission system and, in Scotland, the 132kV elements of the onshore transmission system operated in parallel with the supergrid.

The level of demand security is determined, in part, by the capacity of generating plant available to the system in excess of the ACS peak demand. The MITS provides the vital link between generation and the delivery of electricity to the demand customer and it is important that sufficient transmission capacity is provided to ensure that the MITS does not unduly restrict the ability of generation to meet demand. Additionally, the MITS plays a vital role in facilitating a competitive energy market. Any change in the reliability of the MITS will impact on consumers' demand security, generators' access to market, and operational costs. An aim of the MITS criteria is to provide an equitable balance between investment in the MITS, generation access, demand security and operational costs (e.g. constraints and losses).

The MITS criteria are applied to the boundaries between the two contiguous parts of the MITS, including the boundaries between the Transmission Areas of the three existing transmission owners (i.e. NGET, SHETL and SPT). Application of the criteria defines minimum transmission capabilities that the MITS must be capable of providing following a number of specific secured events without incurring a loss of supply capacity beyond specified limits, unacceptable overloading, unacceptable voltage conditions or system instability. The criteria make reference to two appendices, namely: Appendix C (Modelling of Planned Transfer); and Appendix D (Application of the Interconnection Allowance). These two appendices describe methodologies which are fundamental to the MITS planning criteria.

Appendix C describes the techniques which are used for modelling the planned transfer condition. The appendix describes how a peak demand generation scenario is built up, assuming some generation to be contributory and others not. It is this appendix which specifies a 20% plant margin for use in planning studies.

Appendix D describes how an allowance for security (i.e. the interconnection allowance) is calculated and added, in whole or in part, to transfers arising out of the planned transfer condition. This allowance is designed to take account of the expected variation in flows as a result of uncertainty in the demand and generation availability and merit order. The entire interconnection allowance is applied when studying single circuit contingencies, while half of the interconnection allowance is applied when studying double circuit contingencies. In conjunction with the Appendix C the overall result is to deliver an acceptable Loss of Load Probability.

The addition of an interconnection allowance applies to the situation where MITS can be divided into any two contiguous parts such that the smaller part contains more than 1500MW of demand at the time of the ACS peak demand.

In addition to studying the peak demand generation scenario, the criteria require that the MITS be capable of securely meeting any reasonably foreseen operating condition, considering: forecast demand cycles, typical power station operating regimes, and typical planned outage patterns.

As for other sections of the NETS SQSS, it is permissible to design to standards higher than those set out provided the higher standards can be economically justified (subject to guidance provided in Appendix E of the MITS SQSS). However, because the design of the MITS affects many generation and demand customers, unlike other sections of the NETS SQSS, the deterministic criteria for the MITS represent a minimum requirement. Variations in design which would result in a reduction below the minimum set by the criteria are not permitted and, accordingly, there is no 'Variation to Connection Designs' clause (i.e. customer choice).

The main developments which have the potential to impact on the MITS criteria and associated methodologies (i.e. Appendices C & D) include the contribution of intermittent generation to demand security and year-round competition to energy supply, and the treatment of large demand zones with little generation. At the time the SQSS Fundamental Review commenced, a change in transmission access arrangements (resulting from the Transmission Access Review) was also considered to be highly influential. Any change to the MITS criteria will impact on transmission investment, the level of transmission access for generation and the level of demand security within the NETS.

2.2.4 Sections 5 & 9: Operation of the Transmission System

These criteria are concerned with the day to day operation of the transmission system and, accordingly, are applied against the background of prevailing system conditions (i.e. considering the actual demand and generation profile, planned outages etc.).

The secured events include a fault outage of the 'most onerous loss of power infeed' rather than a specific value of normal or infrequent infeed loss risk.

The unacceptable conditions which shall not arise include overloading of equipment, system instability, loss of supply capacity beyond specified limits, and unacceptable frequency or voltage conditions.

Conditional further operational criteria are also included which cover situations where conditions are adverse and during periods of major system risk.

2.2.5 Sections 6 & 10: Voltage Limits in the Transmission System

Section 6 describes the maximum and minimum voltage limits applying onshore, including: pre-fault planning voltage limits, voltage step change limits (in both planning and operational timeframes) and steady state voltage limits (again, in planning and operational timescales).

Section 10 defines the maximum and minimum voltage limits applying offshore, with a single set of values that applies to both the pre-fault planning voltages and the steady state voltages. There are presently no voltage step limits specified within an offshore transmission system.

Different voltage criteria are defined for each nominal transmission voltage level.

2.3 Key Drivers for the Fundamental Review

The current NETS SQSS was established for a power system predominantly supplied by conventional generation and has facilitated the development of an economic and efficient transmission system over the years.

However, there have been a number of recent developments and technological advances in generation which have led to the concern that the NETS SQSS may no longer specify an appropriate level of transmission capacity and may have become a barrier to the timely connection of the large volumes of renewable energy projects seeking access to the transmission system. The developments leading to this perception are summarised in paragraphs 2.3.1 to 2.3.10 below. Most of the developments relate generally to the need to facilitate the timely connection of renewable and other low carbon generation to meet the Government's targets while ensuring effective competition in generation through efficient and economic transmission investment and operation. Other drivers to the Fundamental Review (i.e. items 2.3.9 and 2.3.10) are also relevant.

2.3.1 Growth in Renewable Generation

The amount of renewable generation, particularly wind generation, is increasing as a consequence at least in part, of the government’s aspirations to reduce greenhouse gas emissions from electricity generation and thereby meet the UK’s share of the EU renewable targets by 2020 and beyond. The 'Gone Green' scenario has been developed, in which the UK marginally complies with its EU targets (this scenario was used as the basis of the ENSG's 'Our Electricity Transmission Network: A Vision for 2020' work). In 'Gone Green', over 17GW of wind and 1GW of wave and tidal generation is developed offshore, plus 6GW of additional wind onshore. At the same time, a significant portion of the UK’s existing conventional and nuclear generation capacity will need to be replaced with new lower carbon generation.

2.3.2 Transmission Access Arrangements

The Transmission Access Review (TAR) was announced by the Government in its Energy White Paper 2007. The review was prompted by the delays presently facing large volumes of

renewable and other forms of generation seeking connection to the transmission system and the potential effect that these delays may have on enabling the Government to achieve its climate change targets. The ‘Transmission Access Review – Final Report’ was published in June 2008 and includes, inter alia: actions that allow faster connection of some renewable generation to the GB transmission system in the short-term; steps to introduce new enduring grid access arrangements that allow faster connection and expansion of transmission capacity; and measures to identify the new transmission infrastructure necessary to meet the UK share of the 2020 EU renewable energy targets.

Following on from the publication of the TAR, 'interim connect and manage' arrangements have been put in place whereby projects that are ready and able to connect to the network can do so without needing to wait for associated MITS reinforcements to be completed. The resulting additional congestion is managed operationally by National Grid in its capacity as National Electricity Transmission System - System Operator (NETS SO). DECC and Ofgem are currently considering various enduring transmission access options.

DECC has indicated that it will use its powers to introduce an Enduring Connect & Manage regime. This is expected to be introduced during summer 2010 and continues key aspects of the Interim Connect & Manage regime introduced in 2009.

For further information, please refer to:
http://www.decc.gov.uk/en/content/cms/consultations/improving_grid/improving_grid.aspx

2.3.3 Integration of Intermittent Generation

The intermittent nature of much of the renewable generation (e.g. wind, solar, wave, tidal etc), seeking connection to the transmission system led to the need to review the contribution of the different generation technologies assumed in the application of the SQSS, to both ensure that an appropriate level of demand security is maintained and that the level of transmission developed appropriately reflects the variable contribution of different generation types.

Another consequence of the anticipated growth in intermittent generation is that the overall plant margin will increase (i.e. the total volume of generation capability as a percentage of peak demand). This will lead to a greater variety of ways in which generation can be dispatched and a wider range of flows on the network. In light of this, the appropriateness of existing SQSS methodologies should be reviewed.

2.3.4 External Interconnections

The increasing number and capacity of External Interconnections with External Systems connecting to the NETS led to the need to consider the appropriate level of security that should be provided for exports to or relied upon for imports from External Systems, and the subsequent implications for the design of the MITS.

2.3.5 Offshore Networks

Development of offshore generation necessitates the development of offshore networks to transport the power back to shore, where consumers are located. Such networks energised at 132kV or above will be classified as offshore transmission systems and will form part of the overall NETS.

Previous work on extending the SQSS to include offshore transmission systems focussed on developing criteria appropriate for the connection of Round 1 and Round 2 offshore developments. These criteria were incorporated into version 2.0 of the NETS SQSS, published on 24 June 2009. However, the significantly larger scale and distance from shore of some of the Round 3 developments has led to the need to assess whether additional criteria, optimised for these developments, are required. Round 3 developments are more likely to benefit from interconnecting multiple circuits and multiple generators to improve overall reliability (as opposed to independent links dedicated to an individual wind farm), and may incorporate onward interconnection with External Systems (i.e. other countries).

2.3.6 Larger Generating Units

The anticipated building of new nuclear power stations is likely to lead to the connection of new generating units of greater size than is presently accounted for in the SQSS. This will affect the largest infeed loss criteria discussed in section 2.2.1. This issue has been considered separately and is described in section 3.3.

The parallel operation of large nuclear units and a significant volume of intermittent wind generation will have implications for system operation. The size of nuclear units and the intermittency of wind will need to be considered when determining levels of reserve and response holding. Challenges will include managing 'extreme' operating situations (e.g. high-wind and low-demand, or low-wind and high-demand conditions) and the potentially rapid transition of the power system between very different operating conditions. Changes may need to be made to the manner in which the NETS is designed to ensure that it can continue to be operated reliably.

2.3.7 New SMART Transmission and Distribution Network Technologies

Transmission technologies have continued to develop with time, as have the tools with which the transmission system can be analysed. Some industry participants, including the Centre for Sustainable Electricity and Distributed Generation (SEDG), have suggested that the present SQSS might discourage the use of certain novel transmission technologies and apply some unnecessarily generous assumptions given the accuracy with which the network can now be modelled. It is expected that the future development of SMART grids with features including active demand management may affect the future requirements of transmission and distribution systems.

2.3.8 Transmission System Operational Review Group (TSORG)

The TSORG was established by Ofgem to assist them with a review of whether additional transmission capacity could be made available on the NETS by optimising the operation of the system. The TSORG final report was published on 8 October 2007 and concluded that whilst robust operational processes already enabled full engineering utilisation of the NETS, within the then-current GB SQSS and transmission licence, that there was scope for some improvements which could marginally reduce constraint volumes. Accordingly, the TSORG recommended further consideration of several matters, including the:

- Increased use of real time ratings (i.e. enhanced monitoring to permit the rating of a circuit to be increased temporarily if ambient conditions permit this);
- Review of a particular GB SQSS generation criterion to possibly allow the use of local intertripping arrangements to be considered in planning timescales; and
- Review the GB SQSS to assess if the underlying principles are still considered valid (e.g. whether the contingency criteria is supported by recent operational experience) and to quantify the impact of relaxing the criteria.

2.3.9 Large Demand Zones with Little Generation

The present SQSS criteria for when to add an 'interconnection allowance' to the required transfer capability of a boundary are based on whether there is 1500MW of demand on both sides of the boundary (at the time of ACS peak demand), and does not consider the amount of generation of either side of the boundary. It has been recognised that, in the case of zones with over 1500MW of demand but little or no generation, the resultant security provided by application of the criteria can be lower than would otherwise be the case. It was accordingly felt that the suitability of these criteria should be subject to review.

2.3.10 Regional Inconsistencies

In 2005 the 'NGC SQSS' was extended to also apply to the Scottish STO's SHETL and SPT, becoming known as the 'GB SQSS'. Criteria from SHETL and SPT's previous standards were therefore incorporated into the document. Whilst effort was put into harmonising the standards (without incurring significant infrastructure expenditure), some regionally specific criteria remain. Although these regional inconsistencies were not a core driver for the SQSS Fundamental Review, the Fundamental Review nevertheless has provided an opportunity to explore opportunities to improve the uniformity of criteria across the NETS.

3 Previous or Parallel Initiatives

Exisitng SQSS Reviews GSR003 and GSR007 were already significantly advanced when the SQSS Fundamental Review was established and deemed to be somewhat independent, and were therefore not amalgamated into the Fundamental Review. Conversely, although GSR001 was significantly advanced, having already gone to consultation, it was deemed to have sufficient interaction with the scope of the Fundamental Review to be amalgamated with it. For context, the progress and findings of these three reviews are briefly reviewed below.

The proposals of SQSS Review GSR002 relate to general housekeeping changes to the MITS SQSS. The proposals have been the subject of industry consultation and a report containing the final recommendations is being finalised prior to submission to Ofgem.

Existing reviews GSR004, 5 & 6 relate to: the consideration of bus coupler faults, the voltage limits in planning and operations, and the SQSS' stability criteria, respectively. All three of these issues were referred to the Fundamental Review's Working Group 4.

3.1 GSR001 Review for Onshore Intermittent Generation

SQSS review GSR001 was established to investigate methodologies for identifying the optimum level of transmission capability (i.e. minimising the combined infrastructure, operational and outage costs), in situations with a high penetration of intermittent generation.

As this review was taking place, the Fundamental Review of the SQSS was initiated. Given the significant implications of the GSR001 review on the SQSS, it was deemed appropriate to refer the findings of GSR001 to the Fundamental SQSS review for consideration alongside the other issues in its scope of work.

As indicated in the SQSS Review Group's 30 March 2010 Open Letter to the industry, the findings of GSR001 along with the subsequent analysis performed by the Fundamental Review's Working Group 3, have been referred to a special working group to undertake further analysis and consult in June 2010.

3.2 GSR003 Review of the Design of Generation Connections

SQSS review GSR003 was established in response to concerns that there are occasions when the deterministic generation connection criteria in the SQSS were uneconomic, placing the Licensees in breach of the Electricity Act. To date, the review findings have not been taken to industry consultation. They were considered by a working group of the Fundamental Review (WG2) which proposed that subject to approval by the SQSS Review Group they should be put to consultation. The SQSS Review Group discussed the proposals and their interaction with the WG2 proposals (refer to section 5.2.1) and agreed that the GSR003 findings should not go to consultation at this stage but should instead be re-evaluated against a background of the NETS SQSS requirements that include the WG2 proposals.

Progression of this review will be considered further following the re-evaluation and the outcome of this consultation and any consequent modification of the NETS SQSS.

3.3 GSR007 Review of Infeed Loss Risk Limits

SQSS review GSR007 was raised in response to a request by EDF Energy plc to consider the merits of increasing the normal and infrequent infeed loss risk from 1000 and 1320MW to 1320 and 1800MW respectively, to facilitate the development of modern large-scale thermal generators (most notably, for the medium-term nuclear build).

Because of the advanced state and relatively independent nature of the review, it was not amalgamated into the Fundamental SQSS Review. A consultation document was published on 4 February 2009, and on 10 September 2009 the SQSS Review Group chair wrote of Ofgem recommending that Ofgem endorse the proposed change.

Ofgem subsequently requested that NGET undertake a consultation regarding the charging implications of the proposed change. To this end, NGET undertook an initial round of 'pre-consultation' in late 2009 and intend to conduct a more detailed consultation in early-mid 2010.

4 Review Approach

Given the number of drivers for change, and the diversity of issues to consider, it was thought that a co-ordinated fundamental review of the SQSS was warranted.

Under the guidance of a central steering group, responsibility for investigating the range of issues was apportioned between five core working groups.

Membership of the steering and working groups comprised representatives of the three TSO's (NGET, SHETL and SPT), SEDG, and Ofgem. In addition, some of the working groups include representatives of Generators and DNOs.

An overview of each working group's focus is listed below. The detailed working group reports appended to this report contain a copy of each working group's detailed terms of reference.

Working Group 1 (WG1) – International Benchmarking

Conduct an international comparison of planning and operational criteria and methodologies. Of particular relevance is the treatment of high volumes of onshore and offshore renewable generation.

Working Group 2 (WG2) – Transmission Entry and Exit Principles

Review the onshore generation connection and onshore demand connection planning criteria of the GB SQSS and develop change proposals as appropriate taking due account of the impact of the findings of the Transmission Access Review. This review will take due account of the impact of the conclusions of the 'Review of Design of Generation Connections' (GSR003). Offshore generation and demand connection criteria fall within the scope of the Offshore Transmission Systems work area (item 5 below).

Working Group 3 (WG3) – Main Interconnected Transmission System (MITS) Principles

Review the criteria and methodologies for planning and operating the MITS (onshore) and develop change proposals as appropriate taking due account of the impact of the findings of the Transmission Access Review. This will include areas relating to onshore demand security and onshore generation access to the MITS and will take due account of the impact of the conclusions of the 'Review of Need for Intermittent Generation Parameters in the GB SQSS' (GSR001).

Working Group 4 (WG4) – Planning and Operational Contingency Criteria

Review the planning and operational onshore contingency criteria used throughout the onshore sections of the GB SQSS (onshore generation connection, onshore demand

connection and MITS) and develop change proposals as appropriate. This will include consideration of criteria relating to N – n, voltage, stability, use of intertrips, and switch faults.

Working Group 5 (WG5) – Offshore Transmission Systems

Review the GB SQSS change proposals for offshore transmission systems which were submitted to Ofgem on 29 April 2008. The current change proposals are based, inter alia, on cost benefit analyses appropriate to Round 1 and Round 2 offshore developments. Ofgem has explained that the offshore generation connection criteria require further development to analyse and define the basis for an offshore security standard that can cater for generation projects of the size and location of Round 3 projects. Ofgem has also explained that the offshore generation connection criteria require further development to analyse and define the basis for an offshore security standard that can cater for the connection of External Interconnections (from External Systems) to offshore transmission systems.

5 Review Progress & Findings

Progress on the SQSS Fundamental Review has been made by each of the working groups. A summary of the progress and findings of each working group are listed below. Further details are available in the individual reports for each working group appended to this document.

While some working groups have clear recommendations others have yet to develop specific recommendations. The absence of clear proposals in some cases is largely attributable to the breadth of the scope and complexity of the problem rather than the effectiveness or efforts of the working group. The rapid, multi-faceted, and interactive changes taking place within the power industry make it difficult to predict the background conditions against which criteria ought to be optimised. This uncertainty is further complicated by the significant capital cost and long economic life of transmission infrastructure and the very significant impact on both the reliability and cost of electricity on society in general.

5.1 Working Group 1 – International Benchmarking

To facilitate the comparison of the SQSS with approaches used in other companies and countries, WG1 prepared a questionnaire and distributed it to several overseas utilities. The questionnaire sought to capture information regarding the methodologies and criteria employed, and the market and strategic environment in which they are applied.

Questionnaires were sent to companies identified as having experience with operating island systems, managing significant levels of renewable generation and/or implementing new transmission planning methodologies. Seven companies responded: RTE France, REE Spain, Eirgrid Ireland, National Grid USA, Transpower New Zealand, Transelec Chile, Elia Belgium, and Tohoku EpCo Japan. Follow-up workshops were subsequently held with a number of the respondents to better understand their circumstances and approach.

Transmission criteria are often expressed in the 'N-X' shorthand notation, where 'X' denotes the type/severity of contingency that the system should be able to withstand without the system become unstable or exceeding its design-parameters. For clarity:

- 'N – 1' refers to the loss of any single item of plant (e.g. a circuit or a transformer) from a previously intact system. In some countries N-1 refers to the loss of a single transmission tower carrying 2 circuits, which we refer to in the UK as N-D. This means simple country comparisons cannot be made without referencing the full standard.
- 'N – 2' refers to the simultaneous loss of any two items of plant from a previously intact system. This requirement is more onerous than N-1, requiring additional infrastructure but providing a greater level of reliability.
- 'N – D' refers to the simultaneous loss of two circuits that are strung on the same double circuit pylon (i.e. acknowledging that there are single modes of failure that can affect both circuits on a double circuit line).

- 'N – 1 – 1' refers to the loss of any single item of plant from a system which is already depleted by the outage of any single item of plant (due to a maintenance outage or a prior fault). This criteria is less onerous than 'N – 2' because the two events are generally assumed to have occurred long enough apart (generally 30 minutes) for available operational measures (e.g. redispatching generation) to have been utilised following the first event to minimise the consequences of a subsequent fault.

In general, WG1 concluded that:

- The process and criteria defined within transmission planning standards are often detailed and complex, with multiple criteria working in an integrated fashion to deliver an overall level of security and efficiency. For example, the GB transmission system is built almost exclusively using double circuit overhead lines whereas there are examples internationally of systems built almost exclusively of single circuit lines (i.e. one circuit per tower). In such cases, because there are fewer mechanisms by which two single circuits could be lost via a single event, the likelihood of a double circuit fault is less likely. Therefore, not considering double circuit faults in operational time phases (i.e. using N-1 instead of N-2 or N-D) would not significantly alter the overall level of reliability to end users.
- The security standards considered consist of many subtle but material differences which are not readily apparent from a first assessment. As such it is difficult to conduct a side by side comparison of international standards.
- On many systems where double circuit towers are widely utilised, consideration of double circuit faults for contingency planning is normal. In France, circuits which are more at risk to double circuit faults are assessed against n-d while the majority of the network is assessed against n-1 criteria.
- Similarly, several of the respondents indicated that they utilised an n-1-1 approach to planning where there is a specified time interval between the first and the second outage.
- The type of special protection schemes implemented on the NGET System (i.e. generation intertripping, post fault tapping of transformers and quad boosters, low frequency demand shedding) are similar to those currently in use by the respondents to the questionnaire.
- With the exception of Spain, the respondents are presently experiencing a similar proportion of wind generation to Great Britain (Spain has a much higher proportion with 19GW of onshore wind and 3.5GW of photo voltaic currently connected, with a peak demand of approximately 45GW). All parties expect that the level of wind generation will increase significantly over time. To cope with the volume of wind connections in Ireland, the transmission organisations there have adopted a gated approach to issuing new connections.
- It is generally expected that the increased connection of wind generation will lead to the requirement for more analysis, considering the impact of different levels of wind and different levels of system load. In Belgium, the firm capacity provided for renewable energy varies by season. This is in line with operational experience which demonstrates a seasonality of windfarm output levels.

- In summary, the criteria utilised within the existing SQSS are broadly consistent with those used internationally. However there are some alternative practices which will be considered in developing future proposals for the revised SQSS as outlined in the open letter.

WG1's detailed report is available in Appendix E.

5.2 Working Group 2– Transmission Entry and Exit Principles

WG2 considered the issues associated with the generation connection criteria (SQSS Section 2) and demand connection criteria (SQSS Section 3) applicable to the onshore transmission system.

5.2.1 Generation Connection Criteria

At present, the generation connection criteria for connection to the transmission system does not differentiate, in respect of connection security, between base load power stations and those with intermittent fuel sources or indeed power stations of differing capacities. System access, charging and compensation is based upon compliance with the SQSS and this principle flows through the Connection and Use of System Code (CUSC), which constitutes the contractual framework for connection to, and use of, the high voltage transmission system.

Currently all generation customers are able to choose to have a connection to the system that is below the deterministic minimum required which will result in reduced access to the transmission system and the electricity market which has a consequential impact on some commercial aspects of their development.

WG2 considered that providing a fully redundant connection to a small generator with a low load factor may necessitate building an uneconomic amount of infrastructure that will be poorly utilised. Conversely, allowing large generators with a high load factor to opt for a non-redundant connection could increase the risk of there being inadequate generation available to meet peak demand.

WG2 therefore explored proposals to alter the focus of the methodology by revising the level of security provided as a deterministic minimum (with an associated reduction in access to the electricity market), with the ability for the customer to choose a higher level of connection security. The deterministic minimum criteria could be a function of the differing size and intermittency of new generation technology, effectively reducing the transmission system capacity provided for smaller and intermittent generation. This approach, which would need to be coordinated with amendments in the commercial and charging regime, could establish more targeted incentives for each generator to determine the exact security of their connection to the transmission system.

The group proposes the introduction of eight standard minimum connection arrangements. Generators will be offered one of these on the basis of size and load factor but may opt for alternate connection arrangements. It is not intended to introduce this arrangement until

appropriate commercial arrangements are developed. A CUSC amendment proposal will be required to initiate a review of the current arrangements.

Further work remains necessary to determine the impact that significant volumes of smaller generators collectively connected through a single transmission circuit could have on the overall integrity of the transmission system.

It was noted by the working group that National Grid has previously reviewed, consulted upon with the industry and had approved the charging incentives for individual generators to select a lower level of connection security under the current SQSS and these remain in force today.

5.2.2 Demand Connection Criteria

The primary area for consideration by WG2 was the consistency and transparency of the contribution towards security which is assumed for generation embedded within a demand group. Distribution network operators are required by their Licence to comply with Engineering Recommendation P2/6 which considers the contributions of embedded generation at a very detailed level. The SQSS currently considers contributions at a much less granular level.

WG2 concluded that, while a more detailed assessment of expected generation contribution to an SQSS group would be ideal, the two standards should broadly align in terms of philosophy and approach. WG2 has therefore developed proposals which aim to ensure that the treatment and impact on demand assumptions for the purposes of security assessments are consistent in the SQSS and ER P2/6, both in concept and application. This includes a review of SQSS Table 3.2 (treatment of large embedded power stations) and the provision of additional guidance in the 'National Grid Guidance Notes for Network Operators – Submission of Grid Code Data' regarding the security contribution of small and medium embedded power stations. It is proposed that a revised Table 3.2 would apply throughout Great Britain, and that the then-redundant Table 3.3 (presently applying to SPT and SHETL areas) would be removed.

5.2.3 Further Work

Subject to feedback received from this consultation, WG2 recommends further analysis, including:

- Cost benefit analysis for the generation connection methodology to inform and adjust the proposed thresholds
- Assessment of the risk to system security with a number of small generators on a single circuit connection
- Once further operational experience is obtained, re-assessing the contribution of embedded generation to group demand security
- Combined assessment of the SQSS with P2/6 to align the assessment of group demand

- Ongoing adjustment of the Grid Code to require Network Operators to provide additional transparency of the implicit assumptions regarding the operation of small and medium power stations with their estimate of group demand.
- Assessment of the impact of variable minimum generation connection standards on commercial codes
- Further development of standard connection configurations that ensure compliance with the different tiers of required connection resilience.

WG2's detailed report is available in Appendix F.

5.3 Working Group 3 – Main Interconnected Transmission System Principles

WG3 had the widest remit, to review the MITS criteria and methodologies and explore and report on:

- whether those criteria and methodologies remain appropriate given wider industry developments (e.g. the findings of the Transmission Access Review)
- options available for change
- the development of scenarios to demonstrate how each potential option might work in practice

In particular the group was asked to focus on the following three broad, interrelated areas:

- Appropriate criteria and methodologies whereby market access signals may be converted into transmission capacity requirements
- The use of cost benefit analysis; including consideration of the appropriate balance between operational and investment costs, sharing methodology (taking due account of the findings of the Transmission Access Review), and overrun (e.g. where a generator may exceed its share allocation)
- Regional differences in criteria and methodologies (i.e. between the NGET, SPT and SHETL transmission systems)

To support the group's work, WG3's initial aim was to develop methodologies and tools to enable the cost-effective balance between new transmission infrastructure, transmission-constraints, pre-fault preventive actions, and post-fault corrective actions covering different operating conditions (fair/adverse weather conditions, market prices, network reliability performance, etc), to be studied. Two different tools have been developed:

- The 'O+X' model, which identifies the transmission operating strategy that minimises the combined cost of unsupplied energy (X) and operating costs (O), including transmission constraints; reserve, response and intertripping (holding and expected utilisation), for a single MITS boundary.
- The 'DTIM' model, which optimises the balance of infrastructure and constraint costs over time and across multiple boundaries, using a simplified representation of the MITS

The O+X model can be run repeatedly with different transmission capacities and configurations to quantify the total cost of each and allow the merits of different reinforcement options and operating strategies to be compared.

The complex nature of the problems being investigated, combined with uncertainty regarding appropriate values for a significant number of input parameters and the significant sensitivity of the results to variations in the input parameters, has meant that the working group has thus far experienced difficulty in drawing firm and generally-applicable conclusions from the analysis.

Nevertheless, the development of the O+X and DTIM models provide a basis for ongoing investigation. Given adequate time to fully investigate the issues and understand the implications of novel proposals, together with a reduction in the uncertainty regarding what SMART will bring to the UK network and a clearer understanding of the relative importance of economics and security of supply, it is believed this line of research will assist in defining the long-term standards to be applied to the national transmission system. This assessment will be fully informed by ongoing discussion with customers, government and the regulator.

WG3's detailed report is available in Appendix G.

5.4 Working Group 4 – Planning and Operational Contingency Criteria

WG4 reviewed the contingency criteria used throughout the onshore sections of the NETS SQSS (onshore generation connection, onshore demand connection and MITS), to ensure that it delivers the appropriate level of access, demand security and quality of supply against a system background with significant volumes of new generation technologies. This review considered the criteria relating to N – n, voltage, stability, use of intertrips and switch faults.

Within WG4's terms of reference, it endeavoured to carry out as much work as was practicable and significant work has been carried out in most of the areas. The analysis that was performed and the findings obtained are described under the sub-headings below. However, due to the complexity of the problem and finite resources, the working group could not bring this work to full completion and there remain areas where the review could benefit from further work. It should be noted that not all of the findings of this report have been fully agreed by all members of WG4 (where there was disagreement, this has been indicated). Nevertheless, WG4 has made a number of recommendations and conclusions.

WG4's detailed report is available in Appendix H.

5.4.1 Review of Fault Statistics

The likely frequency of a ‘secured event’ and its potential impact are important factors to be considered when setting the policy of the security standard. Fault statistics are an important tool in the investigation of the probability of faults occurring and subsequently in determining appropriate rules of the security standard. WG4 collected fault data across the three TOs and

made comparisons on the derived fault statistics where it was possible, thus making it possible to consider the occurrence of faults and their relevance to the current standard. The purpose of this exercise was to determine faults statistics of the three TO systems and make comparisons among them to inform the review of the planning and operational contingency criteria of the NETS SQSS.

The Working Group found no evidence to suggest that there is need to make significant changes to the NETS SQSS criteria on account of the observed transmission fault rates if the same level of customer security is to be maintained. However, the low probability of single circuit faults led the SQSS Review Group to review the need to consider coincident single circuit outages at the time of peak demand in the design of the MITS in England and Wales. This is discussed further in Section 5.6.2.

The limited analysis of geographic differences suggests that the frequency of faults increases the further north the geographical area lies. With single circuit fault rate (per 100km circuit per year) increasing from 0.485 in the south of England and Wales to 0.88 in the north of England to 1.23 in the south of Scotland. There is a noticeable occurrence of double circuit faults, with 76 noted in England and Wales in the 10 year period analysed with only half of these due to the weather. These included an airplane crash and several fires under overhead lines.

The observed fault rate of 132KV double circuits in the SPT area is broadly equivalent to the general double circuit fault rate. Unlike in the NGET and SHETL areas, these events are not presently defined as a secured event in the NETS SQSS. Notwithstanding the recommendations of the WG3 (MITS working group), it was concluded that before removing this regional variation in the SPT area, SPT would need to carry out extensive studies to determine the consequent derogations and system investments that would result.

5.4.2 Review of Treatment of Switch Faults

Review Request GSR004, submitted in October 2007, sought to ensure that the security standard is consistent and unambiguous with regard investment driven by switch fault outages. WG4 undertook a review of the likelihood and consequences of switch faults to investigate the rationale for the treatment of a single switch fault as a secured event in the NETS SQSS. Statistics relating to the fault outage of transmission switches indicate the probability of a fault outage of any such switch to be considerably lower than other types of faults that occur on high voltage transmission systems. However, the consequences of a fault outage of any switch can be significantly more severe than fault types with greater frequency of occurrence, potentially involving the widespread loss of demand and generation.

WG4 found that it is appropriate that busbar coupler, busbar section or mesh circuit breaker fault outages continue to be secured events in NETS SQSS Section 2.6, and that busbar coupler, busbar section or mesh circuit breaker fault outages need not be introduced to the set of secured events in NETS SQSS Section 4. A detailed impact assessment would need to be undertaken to assess the implications of including the requirement for acceptable post-fault thermal, voltage and stability performance under intact system conditions pre-fault.

Given the potentially severe consequences of particular switch faults, WG4 recommends that consideration be given to the introduction of a requirement to consider the impact of Major System Faults at the planning stage, including busbar coupler, busbar section, mesh circuit breaker fault outages and stuck breaker events and the economic case for securing the event or mitigating the risk of the event.

Circuit breaker faults causing unacceptable voltage rise should be reinstated in the set of secured events at the planning stage. Alternatively, they could be considered under the category of Major System Faults as described above.

5.4.3 Review of Voltage Criteria

In reviewing the voltage criteria within the standard, the WG4 considered the SQSS Review Group Request GSR005, submitted in November 2007, which asked for investigation of the extent to which network transmission capacity might be increased by widening the voltage limits in the NETS SQSS. WG4 considered this request in the course of its work and also took the opportunity to address other issues such as inconsistencies and regional differences.

The current NETS SQSS specifies steady-state voltage criteria as well as voltage step-change criteria for each of the three regional transmission owners in both planning and operational timescales. The standard also includes voltage step-change criteria for operational switching in England and Wales, but not in Scotland. In its review of the voltage criteria, WG4 considered the significant factors taken into account when determining transmission voltage criteria for both steady-state voltage and voltage step-changes in planning and operational timescales

Investigations by WG4 found that relaxing the HV voltage limits as suggested in GSR005 would provide little extra bulk transmission capacity, at the expense of increased security risk.

The existing voltage criteria in the NETS SQSS contain a number of inconsistencies. A draft revision of the voltage criteria which deals with the inconsistencies as well as the regional variations was developed and is provided in WG4's detailed report (in Appendix H). The following points are addressed in the draft revised voltage criteria:

- It is recommended that in operations, the pre-fault steady-state voltage limits can be flexed but the post-fault limits must always be enforced.
- It is recommended that the secured events for planning the system should include circuit breaker faults, where these could cause voltage rise beyond the upper planning limits.
- It is recommended that the secured events for planning and operating the system should include the loss of any generating unit.
- Regional variations in the voltage step-change criteria can be eliminated by varying the criteria according to the voltage at which customers or distribution networks are supplied.
- It is recommended to introduce a new category of ‘Infrequent Operational Switching’ with more relaxed voltage step-change limits than normal ‘Operational Switching’.

Further work was suggested in the areas of regional difference in the voltage step-change allowed after a *double circuit* fault on the supergrid as well as the definition of insufficient *voltage performance margins*.

5.4.4 Review of Stability Criteria

In reviewing the stability criteria within the standard, WG4 considered the SQSS Review Group Request GSR006 – 'Review of stability criteria in the GB SQSS'). In summary, GSR006 requested a review of the SQSS in respect of the following two aspects: (i) the stability criteria for use in stability studies (to cover credible stability related events); and (ii) whether the stability criteria should form part of the standard and to what detail it should be.

The stability criteria within the SQSS define the conditions for which individual or groups of generators remain in synchronism with the remainder of the system. It also defines criteria for power frequency oscillatory damping on the system resulting from small perturbations such as switching events.

The possibility of releasing additional transmission capacity by relaxing stability criteria as detailed in review request GSR006 was also investigated. WG4 found that no material additional transmission capacity would be released by relaxing the stability criteria in the current SQSS. Based on the work carried out the following points were noted:

- When considering the impact of different fault types, it was found that the post-fault transmission system strength was the dominant factor in determining the maximum stability constrained power transfer capability across a boundary.
- Relaxing fault clearance times does not release significant additional transmission capacity.

WG4's analysis identified no evidence to suggest that there is sufficient justification or benefit to change from the most onerous 3-phase to earth fault criteria to a single phase to earth or 2-phase to earth fault. WG4 therefore recommends the retention of a 3-phase fault as the basis for the stability criteria. Similarly WG4 have insufficient evidence to justify changing the stability criteria with respect to fault clearance times.

5.4.5 Review of Use of Dynamic Ratings

It was recognised that the three TSOs already make extensive use of seasonal ratings that that National Grid already uses revised ratings on selected circuits based on day ahead predicted weather using the Met Office Rating Enhancements system.

WG4 investigated the extent to which additional transmission capacity could be realised by using dynamic ratings. WG4 subsequently concluded that the NETS SQSS does not currently present a barrier to the use of dynamic ratings as it allows the use of time dependant ratings. The definitions of 'Pre-Fault Rating' and 'Unacceptable Loading' already require that "due allowance shall be made for specific conditions (e.g. ambient/seasonal temperature), …" Nevertheless, it is proposed to modify these definitions to explicitly state that allowance should be made for dynamic ratings where suitably reliable data is available. Proposed text is included in Appendix B.

The most significant enhancements are likely to be achieved when the weather is windy as the air flow across the conductor has the most impact on removing the heat from the conductor. However, 'wind shadow' can reduce this cooling effect for example if the circuit is in a valley or runs through a forest. The rating of a circuit must be based on the minimum capability of any section, and so localised effects such as wind shadow will determine the rating for a whole circuit. Additionally, pre-fault system flows must be managed in such a way that following any secured event, the post-fault systems flows will be within the short-term capability of equipment that remains in service.

5.4.6 Review of Use of Intertrips

One of the areas intensely debated within WG4 was the use of Intertrips in creating transmission capacity. There are currently around 30 intertrip schemes installed on the NETS. The decision whether to use an intertrip scheme is based on year round planning analysis and careful consideration of the additional risk incurred and the capital or operational costs saved. Intertrip schemes are most commonly used to manage conditions when planned outages are taken. Their use to provide transmission capacity to meet peak demand levels is limited.

WG4 considered the merits and demerits of using intertrips in planning to provide transmission capacity. WG4 members were divided on the principle of the applicability of intertrips in planning timescales, and in particular drew differing conclusions from the O+X work of WG3 (MITS working group). The following conclusions reflect the views of the majority of WG4:

- Operational intertrips are frequently used on the GB system, and are useful to reduce the volume and cost of constraints.
- If an intertrip is installed for commercial and not operational reasons, it is extremely unlikely to be economic against the alternative of transmission reinforcement.
- If a sole boundary is under consideration, installation of an operational intertrip is cheaper than the transmission reinforcement. It could presumably be accommodated securely on a one-off basis.
- Only up to the largest infeed loss risk criteria (normal or infrequent loss) of such intertrip of this form is ever valuable on one boundary. Beyond the applicable largest loss criteria, further intertrips are of zero value.
- Furthermore, commitment to intertrips in planning timescales is asymmetric. Non-commitment of an intertrip on a boundary allows for temporary accommodation of further generation behind the boundary subject to intertrip. Conversely, if the intertrip has already been committed, then no further generation can be accommodated without risk of non-maintenance of transmission on that boundary, or ultimately insecurity leading to risk of blackouts.
- The use of intertrips in preference to transmission reinforcement to support the intact operation of the transmission system reduces the network's ability to sustain planned outages to facilitate maintenance and development. Obtaining access to the network is an increasing difficulty that is becoming critical given the high volumes of network development needed over the next two decades. Difficulties obtaining access cause

additional cost and delays in delivering projects and subsequently impedes the connection of new generation.

WG4 therefore recommend that the current practice be retained, that intertrips do not provide an alternative to reinforcement at time of winter peak, except in limited circumstances, but should be considered as an option in ensuring year round operating criteria can be met.

5.5 Working Group 5 – Offshore Transmission Systems

Criteria relating to Round 1 and 2 offshore generation connections were incorporated into the NETS SQSS in June 2009. These criteria were developed on the basis of a cost-benefit analysis that was optimised for and used assumptions appropriate for Rounds 1 and 2, including a maximum generation capacity of no greater than 1500MW and a connection to the first onshore substation no longer than 100km. The developed criteria lead to offshore generation being connected radially with no interconnection between generation sites.

Some Round 3 developments are greater than 1500MW in capacity and up to 300km from the shore. Therefore, WG5 was tasked with reviewing the appropriateness of the existing criteria and defining an offshore security standard appropriate for generation of the scale and location of Round 3 developments, potentially incorporating interconnectors to external systems (i.e. transmission networks in other countries).

WG5 agreed that the analysis tools should be based on those used in developing the Round 1 and 2 criteria, although it acknowledged that they would require further development to accommodate the scope of work. Additionally, it was agreed that additional equipment and network configurations may be utilised, and the characteristics of this equipment would need to be specified. The group's work to date has therefore focussed on developing the tools and establishing the parameters.

This initial work is largely complete and the group is in a position to begin analysis in support of developing criteria for the connection of Round 3 offshore generation.

WG5's detailed report is available in Appendix I.

5.6 Other Issues Considered

Two issues that form part of the fundamental review have been considered outside of the working groups. These are the use of demand management in transmission system planning and the possible relaxation from the requirement to plan to N-1-1 criteria at peak demand levels to an N-D peak demand criteria.

5.6.1 Demand Management

The use of demand management is considered in transmission system planning and is used when it is found to be the most appropriate means of economically ensuring system security.

Currently demand response is likely to be triggered by an intertrip, often together with a generator intertrip, or by frequency based relays initiated by frequency changes following a generation loss. Demand intertrips on their own have been used to resolve local issues and are the subject of commercial contracts. In these cases, the demand to be tripped is limited to ensure its loss will not adversely impact on overall system security. The use of generation intertrips was considered by working group 4 and is discussed in the group report (Appendix H). In general their use is limited to the management of outages where a double circuit loss could result in transmission connected generation up to the infeed loss risk being connected only to a DNO network. The frequency based response can either occur according to contracts or as part of the defensive Low Frequency Demand Disconnection (LFDD) Scheme. Contract based tripping will occur at higher frequencies as part of response provision to manage the frequency to prevent LFDD operation. The transmission system is planned such that LFDD operation will not occur for defined credible events. Contracted demand response is not used extensively. This is primarily due to uncertainty about the nature of the services available and the duration for which services will be provided under contracts. Demand response is only of value in offsetting transmission reinforcement if it can be secured for the timescales being considered, often several years.

It is anticipated that technological developments in the coming years will increase the ability of demand to contribute to system security through its response to changing conditions. These developments form part of the envisaged “SMART” networks. They may take the form of changes in total demand, requiring matching generation changes, or re-distribution of demand. At present the technologies are under development and their performance characteristics are not well understood. Consequently their potential benefit to the system is currently unclear. The TO’s are involved with a number of industry groups currently considering the potential use of SMART networks.

There is a perception that the NETS SQSS provides a barrier to the introduction of further demand services. The SQSS Review Group does not believe this to be the case. However, it is acknowledged that greater clarity could be provided in this area within the NETS SQSS.

In relation to the use of demand management to offset generation intertripping, changes are proposed to the two sections covering Loss of Power Infeed Risks: it is proposed to modify clauses 2.5.3 and 7.7.2 to clarify that any demand expected to trip according to a contract rather than LFDD operation should be netted off the generation loss in calculating the lost infeed.

Changes are also proposed to the definitions of the background conditions to be considered in MITS design (NETS SQSS Section 4) to include the use of demand management expected to be available in the scenario.

Suggestions for further clarifications will be welcomed. The provisions of the SQSS in this area will be kept under review and modified as appropriate as more detail and certainty of demand services emerge. Proposed draft text is included in Appendix C.

5.6.2 Peak Demand Outage Criteria

Chapter 4 describes background generation and demand conditions against which the transmission system must be designed to be secure for specified outage criteria. The

requirements include the loss of a single transmission circuit, a reactive compensation device, and a double circuit overhead line on the supergrid at the time of peak demand.

In England and Wales the criteria also include the outage of a single transmission circuit together with a prior outage of another single transmission circuit, generator or reactive power source at peak demand conditions: an N-1-1 condition (clause 4.6.5). This requirement does not apply in Scotland.

The SQSS review group have considered whether this regional variation can be removed, with consideration of both the probability of occurrence and possible impacts of an N-1-1 event.

Transmission system planning ensures that transmission circuit outages are not taken during the winter when system demands are highest and can be high for long periods. Delayed auto-reclose systems are used on all transmission circuits meaning that faults are usually cleared in less than 30 seconds. When combined with the already low probability of the occurrence of circuit faults, it is highly unlikely that coincident single circuit outages will occur at peak demands. However, there is concern that some transmission circuits contain cable sections which can be subject to lengthy outage following faults. Similarly generation, reactive compensation plant and transformers can be subject to longer outages. There is therefore a higher probability that single circuit faults will coincide with the prior outage of a circuit containing a cable element, a generator, a transformer, or a reactive compensation device.

On this basis the group concludes that the design criteria to be applied at the time of peak demand can be relaxed in England & Wales. The requirement of clause 4.6.5 currently requires that a single circuit outage is considered with the prior outage of another transmission circuit or a generating unit, reactive compensator or other reactive power provider. It is proposed to modify this clause such that a single circuit outage is considered with the prior outage of another transmission circuit only when the circuit on prior outage contains a transformer or a cable section wholly or mainly outside a substation (i.e. circuits that only contain overhead line sections will not be considered). The condition that the cable section should be located wholly or mainly outside a substation is proposed so that circuits with only short cable sections (i.e. low risk) in the highly-accessible land (i.e. relatively fast repair time) within substation compounds are not considered as a prior outage. The requirement to consider a circuit outage with the prior outage of a generating unit, reactive compensator or other reactive power provider will remain.

The existing requirement in Chapter 4 to consider year round operating conditions when planning the system will not be altered. This requirement includes the consideration of N-1-1 outages at times other than peak demand when long duration maintenance outages are taken. During these maintenance periods there is a higher probability of coincident single circuit outages.

The operational criteria in Section 5 of the NETS SQSS require that the system is secured against prevailing background conditions. Prevailing conditions will include planned circuit outages, particularly during the off-peak period from Spring to Autumn. Further unplanned fault outages to be considered do not include concurrent single circuits but do include double circuits. No changes are proposed to the Chapter 5 requirements.

Proposed draft text is included in Appendix D.

6 Way Forward

In an open letter to the industry, published on 30 March 2010, the SQSS review group outlined its workplan for the ongoing review of the SQSS. The workplan includes:

- Consulting on the proposals developed to date and making recommendations to OFGEM (the aim of this report)
- Developing proposals for the integration of wind generation in SQSS, for consultation in June 2010
- Assisting Ofgem to conclude their assessment of the proposed increase to the infeed loss risk and make a decision later this year
- Developing new SQSS governance arrangements in the second half of 2010 to reflect developments within the industry and the broader range of parties now affected by different sections of the SQSS
- Developing a programme for the ongoing assessment and resolution of the complex and fundamental issues which remain outstanding, including:
    - reviewing the balance between the costs of developing and operating the network and the level of service the network provides to its stakeholders (e.g. the level of security it provides, the extent of transmission congestion, the rate at which new generation can be connected etc.)
    - agreeing procedures for forecasting/deciding the inputs to transmission investment cost-benefit analyses, including the use of observable constraint costs or theoretical marginal costs, the future price of greenhouse gas emissions, and the cost of building transmission.
    - ensuring alignment of the SQSS security standard with transmission charging and access arrangements (e.g. providing improved cost-reflective signals to the industry)
    - determining the appropriate balance between user commitment and anticipatory investment
    - the implications and means of managing greater interconnection and market-coupling with other European nations, including the extent to which interconnector flow can be relied upon to meet demand and avoid constraining generation
    - the increased utilisation of demand-side management and other non-network services, potentially offsetting the need for transmission investment
    - increasing levels of complexity within the power system, including the risks associated with the unforeseen interaction of issues and/or failure of automated systems established to manage the complexity
    - the risks and potential costs associated with low-likelihood but high impact cascading faults
    - the implications of other industry initiatives such as Ofgem's RPI-X@20 review
    - ongoing consideration of emerging network and non-network technologies
- Utilising the customer engagement process envisaged for the forthcoming transmission price control review (TPCR5) to inform the SQSS Review Group's understanding of industry stakeholders' views on these outstanding issues

This approach will rapidly address immediate issues, while allowing sufficient time for the implications of novel proposals to be thoroughly investigated, the industry's views to be fully understood and considered, and the industry to smoothly transition to any significant changes to network planning and operations.

7 Recommendations for Consultation

This section summarises the recommendations of the SQSS Fundamental Review. In some cases, retaining the existing MITS SQSS criteria is recommended, while in other areas proposals have been put forward to modify the criteria.

Please refer to each working group's detailed report (appended to this document), for more information about the background to each proposal and, in some cases, draft wording for implementing the proposed change.

It should be noted that some changes are developed to the point where they can be implemented immediately, while other changes will require further refinement and investigation. In either case, the industry's perspective of the proposed changes is sought to inform the decisions of the SQSS Review Group regarding how the proposals should be progressed. More specifically:

- Do you agree with the principles of the proposals? If not, could you please explain your concerns and describe any thoughts that you have regarding alternative proposals.

- Where drafting has been included in the appendices of the working group reports, do you agree that the drafting reflects the principles discussed in this report and in each of the working group reports? If not, please explain your concerns and suggest alternative wording.

Feedback should be forwarded in writing to:

eni.sqss@uk.ngrid.com

or:

Mark Perry
Electricity Network Investment
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
United Kingdom
CV34 6DA

All feedback should be received by **4 June 2010**.

7.1 Basis of Generation Capacity (WG2)

It is proposed to supersede the term 'Registered Capacity' with the term 'Local Capacity Nomination' (LCN) as the basis for capacity within the SQSS (especially Section 2 – generation connection criteria). LCN was developed during the Transmission Access Review (TAR) and is being incorporated into the Connection and Use of System Code (CUSC). LCN reflects the commercial position of the generation, rather than the physical capability of the generation, and is open to change or trade over time. This proposal will be kept under review and finalised to align with the outcomes of the ongoing CUSC amendment proposals arising from the TAR.

7.2 Minimum Generation Connection Resilience (WG2)

Presently the generation connection criteria in the SQSS do not consider the typical operating characteristics of a generator, and therefore provide an equally resilient connection for high-capacity thermal base-load power stations and for relatively-small intermittent generators. All connectees however, can choose to have a connection to the system that is below the deterministic minimum.

WG2 considered that providing firm connections to low load-factor generators could be uneconomic, while allowing base-load power stations to choose a non-firm connection could negatively impact demand security. Therefore, WG2 proposed a deterministic methodology which will enable the establishment of appropriate levels of connection security base on the aggregate of the local capacity nomination (LCN) and generation load factor. A draft implementation of this proposal is shown in the table over page. Whilst this specifies the minimum allowable connection resilience, customers would be free to request connection designs higher than the proposed minimum standards, enabling the customer to consider the incremental cost of doing so against the economic benefits of reduced risk and improved access to market.

Further cost benefit analysis is proposed to inform and fine-tune the capacity band and load factor thresholds, plus investigation into the impact on other industry codes and commercial arrangements. Clearly the SQSS technical Standard and the commercial Codes, such as the Connection and Use of System Code (CUSC) and the Statement of the Connection Charging Methodology must be complementary and consistent. The impact of these proposals will mean a lower standard of connection (and the consequential access restrictions and use of system charging discount), for particular users. Whilst the connection design variation criteria will provide a means for users that require an alternative standard of connection to request them, the charging treatment of this decision will need to be reviewed to ensure consistency. Discussions with the Commercial Charging activities within NGET have been initiated. Therefore, the working group recommends that the SQSS changes are not implemented until suitable commercial mechanisms have been fully considered.

Generation Group	Group Aggregate Generation Capacity (Local Capacity Nomination)		Source Fuel Load Factor	Timescale	Initial and Subsequent System Conditions						
					Intact						Planned outage of any single transmission circuit, single section of busbar or mesh corner
	Minimum	Maximum			Planned outage of a single transmission circuit or single section of busbar	Planned outage of a single generator circuit	Fault of a single transmission circuit	Fault of a single generator circuit	Fault of any two transmission or generator circuits (on same double circuit overhead line)	Fault of a single section of busbar or mesh corner	Fault of any single transmission circuit, single section of busbar or mesh corner
A	0	< 50	<= 40%	Immediately	Nil	Nil	Nil	Nil	Nil	Nil	Nil
				In time to restore outage	Total Group Generation Capacity	Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	
			40 – 70%	Immediately	Nil	Nil	Nil	Nil	Nil	Nil	Nil
				In time to restore outage	Total Group Generation Capacity	Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	
			70 – 100%	Immediately	Nil	Nil	Nil	Nil	Nil	Nil	Nil
				In time to restore outage	Total Group Generation Capacity	Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	
B	>=50	< 100	<= 40%	Immediately	Nil	Nil	Nil	Nil	Nil	Nil	Nil
				In time to restore outage	Total Group Generation Capacity	Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	
			40 – 70%	Immediately	Nil	Nil	Nil	Nil	Nil	Nil	Nil
				In time to restore outage	Total Group Generation Capacity	Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	
			70 – 100%	Immediately	Nil	Nil	Nil	Nil	Nil	Nil	Nil
				In time to restore outage	Total Group Generation Capacity	Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	
C	>=100	<300	<= 40%	Immediately	Nil	Nil	Nil	Nil	Nil	Nil	Nil
				In time to restore outage	Total Group Generation Capacity	Total Group Generation Capacity					50% of Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity
			40 – 70%	Immediately	Nil	Nil	Nil	Nil	Nil	Nil	Nil
				In time to restore outage	Total Group Generation Capacity	Total Group Generation Capacity					50% of Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity
			70 – 100%	Immediately	50% of Total Group Generation Capacity	Nil	50% of Total Group Generation Capacity	Nil	Nil	Nil	Nil
				In time to restore outage	Total Group Generation Capacity	Total Group Generation Capacity					50% of Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity
D	>=300	<700	<= 40%	Immediately	50% of Total Group Generation Capacity	Nil	50% of Total Group Generation Capacity	Nil	Nil	Nil	Nil
				In time to restore outage	Total Group Generation Capacity	Total Group Generation Capacity					50% of Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity
			40 – 70%	Immediately	50% of Total Group Generation Capacity	Nil	50% of Total Group Generation Capacity	Nil	Nil	Nil	Nil
				In time to restore outage	Total Group Generation Capacity	Total Group Generation Capacity					50% of Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity
			70 – 100%	Immediately	Total Group Generation Capacity	50% of Total Group Generation Capacity	Total Group Generation Capacity	Nil	Nil	Nil	Nil
				In time to restore outage		Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	
E	>=700	Normal Infeed Loss (1,320)	<= 40%	Immediately	Total Group Generation Capacity	50% of Total Group Generation Capacity	Total Group Generation Capacity	Nil	Nil	Nil	Nil
				In time to restore outage		Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	
			40 – 70%	Immediately	Total Group Generation Capacity	50% of Total Group Generation Capacity	Total Group Generation Capacity	Nil	Nil	Nil	Nil
				In time to restore outage		Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	
			70 – 100%	Immediately	Total Group Generation Capacity	50% of Total Group Generation Capacity	Total Group Generation Capacity	Nil	Nil	Nil	Nil
				In time to restore outage		Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	
F	>=Normal Infeed Loss (1,320)	<Infrequent Infeed Loss Risk (1,800)	<= 40%	Immediately	Total Group Generation Capacity	50% of Total Group Generation Capacity	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	Nil	Nil	Nil
				In time to restore outage		Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	
			40 – 70%	Immediately	Total Group Generation Capacity	50% of Total Group Generation Capacity	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	Nil	Nil	Nil
				In time to restore outage		Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	Total Group Generation Capacity	
			70 – 100%	Immediately	Total Group Generation Capacity	50% of Total Group Generation Capacity	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	Total Group Generation Capacity	Nil	Nil
				In time to restore outage		Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity		Total Group Generation Capacity	
G	> =Infrequent Infeed Loss Risk (1800)	<2 x Infrequent Infeed Loss Risk (3,600)	<= 40%	Immediately	Total Group Generation Capacity	50% of Total Group Generation Capacity	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	TGGC less Infrequent Infeed Loss Risk
				In time to restore outage		Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity		Total Group Generation Capacity	
			40 – 70%	Immediately	Total Group Generation Capacity	50% of Total Group Generation Capacity	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	TGGC less Infrequent Infeed Loss Risk
				In time to restore outage		Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity		Total Group Generation Capacity	
			70 – 100%	Immediately	Total Group Generation Capacity	50% of Total Group Generation Capacity	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	TGGC less Infrequent Infeed Loss Risk
				In time to restore outage		Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity		Total Group Generation Capacity	
H	> =2 x Infrequent Infeed Loss Risk (3,600)	-	<= 40%	Immediately	Total Group Generation Capacity	50% of Total Group Generation Capacity	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	TGGC less Infrequent Infeed Loss Risk
				In time to restore outage		Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity		Total Group Generation Capacity	
			40 – 70%	Immediately	Total Group Generation Capacity	50% of Total Group Generation Capacity	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	TGGC less Infrequent Infeed Loss Risk
				In time to restore outage		Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity		Total Group Generation Capacity	
			70 – 100%	Immediately	Total Group Generation Capacity	50% of Total Group Generation Capacity	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	Total Group Generation Capacity	TGGC less Normal Infeed Loss Risk	TGGC less Infrequent Infeed Loss Risk
				In time to restore outage		Total Group Generation Capacity					Total Group Generation Capacity
				In time to restore fault			Total Group Generation Capacity	Total Group Generation Capacity		Total Group Generation Capacity	

7.3 Exporting Grid Supply Points (WG2)

Given the increase in embedded generation, grid supply points that are capable of exporting power into the transmission system (i.e. when the local generation exceeds the local demand) are becoming more common. Notwithstanding the commercial and constraint implications for exporting GSPs, it is presently unclear within the SQSS whether an exporting GSP should be considered as a demand group or a generator. This issue becomes particularly relevant if smaller and low load-factor generation (often embedded) are to be offered a non-firm transmission connection (as proposed in section 7.2). In order to protect demand group security, additional paragraphs within the Standard are proposed to expand on the previous 'overlap of criteria' section to ensure that the demand group security is not detrimentally impacted by the presence of generation which results in the host GSP exporting back to the transmission system.

7.4 Regional Generation Connection Variations (WG2)

There are two regional variations currently contained within Section 2 of the SQSS:

Clause 2.8.3 relates to the assumed reactive power output level of generators within SPT and SHETL areas when assessing system stability. It was included because the application of clause 2.8.2 (applicable in NGET areas), would be unnecessarily onerous for some pre-existing generators in Scotland. It is proposed that the regional variation can be removed if a 'reasonableness' test can be applied, where considered appropriate, across the GB network. This would consolidate paragraphs 2.8.2 and 2.8.3 with a suitable 'reasonableness' test appended to the consolidated paragraph.

Clause 2.10.3 describes the need for the assumed post-fault background conditions to include the fault outage of a double circuit line, except where the line is not part of the supergrid and both circuits of the line are entirely within the SPT area. Given that the criteria is appropriately also included in Section 4 of the SQSS (MITS) and the exemption only applies to the 132kV SPT system, WG2 considers the inclusion of the criteria within Section 2 of the SQSS to be inappropriate and therefore recommends its removal.

7.5 Group Demand Estimation (WG2)

There is an anomaly between the security assessments of the SQSS and P2/6 in the circumstances that the Demand Group contains demand blocks with non-simultaneous peaks, significant embedded generation, and/or merchant generators, which may have the effect of masking the true Group Demand. This arises due to potential inconsistencies in the derivation of the demand level to be secured and the contribution of generation to the group security.

Given that resolution of the differences cannot be achieved within the SQSS in isolation and some reservations exist regarding the spread of supporting data behind the P2/6 tables, WG2 recommend a joint assessment and modification process. The full alignment of the

standards may also require refreshing the generator contribution assessment by considering the improved generator population and historical output data.

Until such time as the joint review is undertaken, in order to improve the transparency, consistency and quality of the assessment, WG2 propose that procedural changes and improved data capture are implemented to enable the TO/SO and the network operators to better align their respective security assessments:

- As part of the annual system security assessment and Grid Code compliant data submission, Network Operators assess the demand levels at a transmission interface point, taking due account of demand diversity and demand masked by embedded generation within their network. In general terms, generation visible to Network Operators will be Medium or Small power stations and in assessing the demand which will reasonably be imposed on the transmission system, the Network Operators consider any future demand increases which would be imposed arising from a change in the operating regime of an existing medium or small power station.

- Large power station output and the demand supplied locally to be visible to TOs/SO irrespective of whether the large power station is connected at the transmission interface point or deeper within the Network Operator's network.

It is considered that the 'Week 24' data and improved data exchange process under B/07 will provide sufficient information to the TO/SO to facilitate the SQSS assessment without significant impact on the complexity of the process. As part of the 'Week 24' process, clarity will be sought on generator assumptions, technology types, and common-mode failure mechanisms in order to enable an assessment of the probability and risk.

7.6 Generation Contribution to Demand Security (WG2)

Contributions to demand group security has been structured in the SQSS with differing criteria and methodology for large power stations and medium/small stations embedded within NGET, SHETL and SPT networks. It is proposed to harmonise the methodology across GB by eliminating the regional differences between Tables 3.2 and 3.3 (and then removing the redundant Table 3.3). Additionally, it is considered that the tables do not necessarily reflect the current plant portfolio or operating regimes. Therefore, it is additionally proposed to re-focus the contribution of large power stations to be technology-specific which permits consideration of both intermittent and non-intermittent fuel sources. In order to align philosophies with P2/6, persistence of generation over various time periods is proposed. The proposed values are, in the main, consistent with the P2/6 methodology and judgment although some values are indicative at this point in time and will be fine-tuned in a follow-on phase of assessment.

Where network assets are insufficient to meet the security requirements it is proposed that, until such time as a joint SQSS / P2/6 review is possible, assessment of support from generation would be considered as follows:

- *Small or Medium Power Stations* – as the Network Operator's assessment of group demand inherently takes account of embedded small or medium power stations and

their impact on group demand, there is no requirement to consider this support separately (where the changes to the operating regime of a small or medium power station is foreseen, the consequential impact on group demand will have been considered by the Network Operator).

- *Large Power Stations* – taking account of relevant factors such as source fuel, common mode failure mechanisms and the persistence of the technology indicated in Table 3.2, an assessment by the TO/SO of an appropriate level of support which possesses the relevant characteristics for support.

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7.7 Introduction Modifications (WG2)

The implication of clause 1.10 and the definition for generation point of connection is that connections arising from the application of Section 2 will become part of the MITS. This may not always be the case when, for example, generators can be directly connected to the GB transmission system via 132kV radial circuits, which do not fall under the definition of *MITS*. Furthermore, with proposals to specify single circuit connections as minimum designs for lower classes of generation, not all proposed future connection designs can be classed as *MITS*. As a consequence it is suggested that the wording of clause 1.10 altered to:

> The generation connection criteria applicable to the *onshore transmission system* are set out in Section 2 and cover the connections which extend from the *grid entry points (GEPs)* and reach into the *MITS*. The criteria also cover the risks affecting the *national electricity transmission system* arising from the *generation circuits*.
>
> (change marked in red)

7.8 Fault Statistics (WG4)

WG4 found no evidence to suggest that there is a need to make significant changes to the SQSS criteria on account of observed transmission fault rates if the same level of customer security is to be maintained. In particular, WG4 noted the following:

- The limited analysis of geographic differences suggests that the frequency of faults increases the further north the geographical area lies. With single circuit fault rate (per 100km of circuit per year) increasing from 0.485 in the south of England and Wales to 0.88 in the north of England to 1.23 in the south of Scotland.
- There was a noticeable occurrence of double circuit faults during the 10-year period analysed, with 76 events noted in England and Wales. Only half of these faults were due to the weather. Other leading causes included several fires under overhead lines and an airplane crash.
- There is no consistent definition of fair weather or adverse weather. This has two consequences; (i) possible inconsistencies due to differing personal interpretations at the time of recording the faults and (ii) it makes it difficult to make recommendations on different operating standards based on weather.

- It is also worth noting that there have not been any recent coastal pollution events where there is a long dry spell with offshore winds depositing salt on the substation and overhead line insulation.
- The observed fault rate of 132KV double circuits in the SPT area is broadly equivalent to the general double circuit fault rate. Currently, for SPT these are not secured events in the NETS SQSS, unlike in the NGET and SHETL areas.
- Notwithstanding the recommendations of WG3 (the MITS Working Group), it was concluded that SPT would need to carry out extensive studies to determine the consequent derogations and system investments before removing this regional variation in the SPT area.

7.9 Switch Faults (WG4)

WG4 carried out analysis regarding the treatment of a single fault outage of a switch as a secured event in the NETS SQSS and arrived at the following conclusions:

- It is appropriate that busbar coupler, busbar section or mesh circuit breaker fault outages continue to be secured events in NETS SQSS Section 2.6, *Limits to Loss of Power Infeed Risks*.
- Busbar coupler, busbar section or mesh circuit breaker fault outages need not be introduced to the set of secured events in NETS SQSS Section 4, *Design of the Main Interconnected Transmission System*.
- A detailed impact assessment would need to be undertaken to assess the implications of including the requirement for acceptable post-fault thermal, voltage and stability performance under intact system conditions pre-fault.
- Consideration ought to be given to the introduction of a requirement to consider the impact of Major System Faults at the planning stage, including busbar coupler, busbar section, mesh circuit breaker fault outages and stuck breaker events and the economic case for securing the event or mitigating the risk of the event.
- Circuit breaker faults causing unacceptable voltage rise should be reinstated in the set of secured events at the planning stage. Alternatively, they could be considered under the category of Major System Faults as described above.

7.10 Voltage Criteria (WG4)

WG4 conclusions and recommendations regarding voltage criteria are as follows:

- Relaxing the HV voltage limits as suggested in GSR005 would provide little extra bulk transmission capacity, at the expense of increased security risk.
- The existing voltage criteria in the NETS SQSS contain a number of inconsistencies. A draft revision of the voltage criteria which deals with the inconsistencies as well as the regional variations is provided in WG4's detailed report (in Appendix H). The following points are addressed in the draft revised voltage criteria:

- Voltage criteria can be categorised as “Hard Limits” and “Soft Limits”. In planning timescales, it is recommended that all limits are observed in investment forecasting studies, but that at the detailed scheme design stage the “soft” limits should be applied with discretion in consultation with interested parties.
- It is recommended that in operations, the pre-fault steady-state voltage limits can be flexed but the post-fault limits must always be enforced.
- It is recommended that the secured events for planning the system should include circuit breaker faults, where these could cause voltage rise beyond the upper planning limits.
- It is also recommended that the secured events for planning and operating the system should include the loss of any generating unit.
- Regional variations in the voltage step-change criteria can be eliminated where possible by varying the criteria according to the voltage at which customers or distribution networks are supplied.
- GB-wide step-change limits for operational switching can be specified in a way that matches the varying characteristics of the system by separating operational switching into “frequent” and “infrequent” events. The former would include routine daily switching for voltage control for example, while the latter would include switching out circuits for maintenance.
- It is therefore recommended to introduce a new category of ‘Infrequent Operational Switching’ with more relaxed voltage step-change limits than normal ‘Operational Switching’.

Consideration was given to removing the regional variation in the allowable voltage step-change following a *double circuit* fault on the supergrid. WG4 noted that aligning the requirement in Scotland with the current England and Wales standard could incur additional investment costs, while modifying the England and Wales requirement to align with the current Scottish standard may incur risks in terms of quality of supply and general system performance, for no investment saving that can currently be identified. WG4 recommends that further work is undertaken in this area with the aim of justifying a common standard.

The existing definition of insufficient *voltage performance margins* need to be reviewed in the light of the introduction of large amounts of intermittent and variable generation. The information needed to conduct such a review is not yet available and WG4 recommend that work should continue in this area as operational experience is acquired.

7.11 Stability Criteria (WG4)

The main conclusion of WG4's review of stability criteria is that no material increase in transmission capacity would be achieved by relaxing the stability criteria. The following were noted:

- Given the short fault clearance times currently in operation on the GB MITS, post-fault transmission system strength is the dominant factor in determining the maximum stability constrained power transfer capability across a boundary.
- The analysis conducted for this exercise and the review of previous analyses suggest that any increase in maximum transfers attributable to changes in fault clearance times is small, suggesting that there would be little benefit in relaxing the clearance times specified in the security standard. On that basis, WG4 concludes that the current wording with regard to fault clearance times for stability analysis should be retained.
- The analysis carried out on the impact of different fault types suggest that there is insufficient justification or benefit to change from the most onerous 3-phase to earth fault to a single phase to earth or 2-phase to earth fault. Although 3-phase faults occur infrequently, there could potentially be a significant increase in risk of a widespread system disturbance if a fault occurs on the transmission system that has not been studied. WG4 therefore recommends the retention of a 3-phase fault as the basis for the stability criteria.
- WG4 recommends that further work be carried out to further substantiate the conclusions from this study, in particular to consider the impact of the fault location on the results and also to assess stability results from a different simulation package such as DigSilent PowerFactory.

7.12 Use of Dynamic Ratings (WG4)

WG4 reach the conclusion that the NETS SQSS does not currently present a barrier to the use of dynamic ratings as it allows the use of time and condition-dependant ratings. The definitions of 'Pre-Fault Rating' and 'Unacceptable Loading' already require that "due allowance shall be made for specific conditions (e.g. ambient/seasonal temperature),"

Nevertheless, for clarity it is proposed to modify these definitions to explicitly state that allowance should be made for dynamic ratings. Proposed text is included in Appendix B.

7.13 Use of Intertrips (WG4)

WG4 members were divided on the principle of the applicability of intertrips in planning timescales, and in particular drew differing conclusions from the O+X work of WG3 (MITS working group). The following conclusions reflect the views of the majority of WG4:

- Operational intertrips are frequently used on the GB system, and are useful to reduce the volume and cost of constraints.
- If an intertrip is installed for commercial and not operational reasons, it is extremely unlikely to be economic against the alternative of transmission reinforcement.

- If a sole boundary is under consideration, installation of an operational intertrip is cheaper than the transmission reinforcement. It could presumably be accommodated securely on a one-off basis.
- Only up to the largest infeed loss risk criteria (normal or infrequent loss) of such intertrip of this form is ever valuable on one boundary. Beyond the applicable largest loss criteria, further intertrips are of zero value.
- Furthermore, commitment to intertrips in planning timescales is asymmetric. Non-commitment of an intertrip on a boundary allows for temporary accommodation of further generation behind the boundary subject to intertrip. Conversely, if the intertrip has already been committed, then no further generation can be accommodated without risk of non-maintenance of transmission on that boundary, or ultimately insecurity leading to risk of blackouts.
- Intertrips reduce the system access available - an increasing problem that is becoming critical given the high volumes of network investment needed over the next two decades.

WG4 therefore recommend that the current practice be retained, that intertrips do not provide an alternative to reinforcement at time of winter peak, except in limited circumstances, but should be considered as an option in ensuring year round operating criteria can be met.

7.14 Demand Management

The SQSS Review Group concluded that the present NETS SQSS criteria do not present a barrier to the use of demand management in system planning. Where facilities are secured across the planning timescales being considered, they are included in planning analysis.

Nevertheless, for clarity it is proposed to modify NETS SQSS clauses 2.5, 4.4, 4.7 and 7.7 so that they explicitly refer to the consideration of demand management when undertaking system analysis. Proposed new text is included in Appendix C.

7.15 N-1-1 Requirement

The SQSS Review Group has considered the requirements of NETS SQSS clause 4.6.5, a regional variation that, within England and Wales, requires that a single circuit outage be considered with the prior outage of another transmission circuit or a generating unit, reactive compensator or other reactive power provider when designing the transmission system against a peak demand background.

Both the probability of an N-1-1 event at peak demand, and the possible impacts of such an event were considered.

The SQSS Review Group recommends that clause 4.6.5 of the NETS SQSS is modified so that a single circuit outage is considered with the prior outage of another transmission circuit only when the circuit on prior outage contains a transformer or a cable section wholly or mainly outside a substation (i.e. circuits that only contain overhead line sections will not be

considered). The condition that the cable section should be located *wholly or mainly* outside a substation is proposed so that circuits with only short cable sections (i.e. low risk) buried in the highly-accessible land (i.e. relatively fast repair time) within substation compounds are not considered as a prior outage. The requirement to consider a circuit outage with the prior outage of a generating unit, reactive compensator or other reactive power provider will remain.

The group considers that the requirement to consider N-1-1 conditions in design at times when maintenance outages may be taken remains appropriate, as do the operational criteria of chapter 5.

Appendices

Appendix An Open Letter on SQSS

30 March 2010

Open letter on SQSS

I am writing to you in my new capacity as chairman of the SQSS Review Group. The Security & Quality of Supply Standard (SQSS) is a set of criteria established as a licence condition on transmission companies which help specify how transmission networks are planned and operated. Over the last 18 months, significant work has been undertaken to consider and progress changes to the standards, however, there remains much more to do to ensure that they remain fit for new circumstances and challenges including our low carbon future.

I would like to take this opportunity to bring the industry up to speed on the current status of this work and our proposed ambitious workplan for 2010. All three transmission licensees remain committed to strong customer engagement, and I would like to take this opportunity to outline how we would like to achieve enhanced customer engagement through governance and process changes as we move forward.

It is recognised that there has been a considerable effort and contribution made, not only by the transmission licensees, but a number of other interested parties. I would like to take the opportunity to thank everyone who has participated for your contribution to date, and I look forward to continuing to work with you in the delivery of the plan that we have outlined below. I would also welcome any comments/observations you may have on the proposed workplan.

Workplan for 2010 (and Beyond) in taking the review forward

All three transmission licensees recognise the pressing need to complete the review of the SQSS and, given the wide and increasing scope of a fundamental review, acknowledge that we need to be more proactive in the future in terms of keeping the

industry appraised of progress. As the SQSS underpins the case for development of the transmission networks, it is important that we progress quickly and address the relevant issues resulting from technology and policy developments, especially the implications of new 'SMARTer' technology and the demands of meeting a low carbon energy system.

We fully recognise the complex interaction between demand security, increased network utilisation and the technology required to develop 'SMARTer' grids. We are also cognizant that the volumes of demand management likely to be required post 2020 are not presently sufficiently developed to really understand SMARTer grid network needs. Given this we have concluded that it would be more appropriate to take forward the fundamental review in a phased approach. This allows us to address the more immediate issues such as integrating intermittent energy into the transmission system in an economic and efficient manner, but also permits sufficient time to allow full consultation on how we take forward networks to accommodate tomorrow's low carbon energy system.

Given our desire to make timely progress, the SQSS Review Group proposes to take forward the SQSS review in the following phases:-

Phase 1

- Issue 1st consultation on SQSS in April 2010. This will address changes identified by TSORG (Transmission Short term Operating Review Group), that can be considered standalone. These include, amongst other things:-
    - Removal of Regional variations (variations in requirements in Scotland and England) which were introduced with the implementation of BETTA[1]
    - Review of appropriate criteria to be applied in determining transmission capacity in meeting security requirements
    - Review of generation connection options to allow users greater choice when it does not impact on other users
    - Giving greater clarity on demand management which would be considered in determining optimum transmission capacity requirements

- Undertake further detailed analysis and consult in June 2010 on wind generation integration. This is important to ensure the efficient design of the network for the next decade as large scale intermittent wind generation is connected to meet 2020 targets. This will consider, amongst other things:-
    - Connection criteria appropriate for local connections and the opportunity for greater customer choice
    - Recognising wind generation is predominately an energy source (i.e due to intermittent nature of output provides limited demand security), the criteria to be applied in integrating wind generation in an economic and efficient manner

[1] British Electricity Trading Arrangements

- Work with Ofgem to provide any additional information they require to conclude their assessment and make a decision later this year, on increasing the largest infeed loss from 1320MW to 1800MW. This is an important critical step in enabling new nuclear to connect, improving fuel diversity and meeting 2020 carbon targets.

Phase 2

To codify the approach to establishing a network suitable for accommodating electrification of vehicles and heating on a large scale as well as new low carbon demand management technologies, the work plan will then look to:

- Develop new SQSS governance arrangements in the second half of 2010 to reflect developments in offshore transmission and potentially to formalise the arrangements such that future modifications can be well specified and robustly considered.
- Use the customer engagement process envisaged for the forthcoming Transmission Price Control Review 5 (TPCR5) to provide clear direction to the Review Group on the optimum balance of security of supply and economic efficiency for the network of the future.
- Develop a programme for the assessment of modifications associated with the more complex elements of the SQSS review, which will be informed by the customer engagement process outlined above, which will consider:-
    - Balancing security of supply with economics, deterministic with probabilistic standards
    - How best to incorporate a massive growth in demand side management as electric vehicles and heat become more prevalent as we approach 2020

This phased approach has the advantage of ensuring we make necessary progress on all outstanding actions, whilst prioritising the short/medium term challenges needed to facilitate 2020 renewable targets that we presently face, in a safe, secure and efficient manner. In taking this work forward we are seeking to ensure that industry views are fully considered, as is security of supply. We propose to strengthen the role of the Industry Review Group, and we will be scheduling a number of industry workshops to ensure the concerns of the industry, government and the regulator are addressed in taking this work forward.

Background to the Existing Review

In the Energy White Paper in May 2007, Ofgem and BERR were requested to assess the arrangements for transmission access and identify potential improvements to both the short term and long term regimes. This work was taken forward through two Workstreams:-

- The Short Term Access Governance (STAG) Review which examined the steps being taken to optimise access to the network in the short term; and,
- The Transmission Access Review (TAR) which considered more substantial reform of the access arrangements in the longer term.

Transmission Short term Operating Review Group (TSORG) was established by Ofgem to undertake a review of transmission system operation. The work has been carried out by the three transmission licensees, in conjunction with Ofgem and BERR, so as to identify ways in which additional capacity might be made available using existing transmission system infrastructure.

STAG, TAR and TSORG all made recommendations that had implications for the SQSS and suggested the need for a fundamental review. In particular, certain options for developing the transmission access arrangements explored in TAR and the implications of large offshore wind concentrations implied by the round 3 offshore wind leases highlighted both new opportunities and challenges that might require alternative approaches in the SQSS. On this basis, and with the agreement of Ofgem, the GBSQSS review group changed focus from addressing potential adaptations to the SQSS towards considering the changes that would be more appropriate for the longer term.

In reviewing the SQSS, the existing transmission licensees recognised the interest of network customers and so established an Industry Review Group to ensure participation by interested parties. Over the last 18 months the group received a number of requests for reviews/updates of the SQSS from various sources, but as many relate to accommodating new low carbon generation technologies, the emphasis within the companies has been placed on developing specific development proposals for achieving 2020 targets and justifying these in Ofgem's subsequent reviews rather than attempting the more complex elements of the fundemental review of SQSS criteria in isolation from the development plans.

Since starting a more fundamental review, the role of the electricity networks has come under increasing policy focus. The Select Committee[2] looking at the future of Britain's electricity networks noted that there are "some concerns that the existing regulatory framework is driving the case for transmission investment presented by the industry at the expense of other more cost-effective options that seek better to utilise the existing network infrastructure. The current fundamental review of the Security and Quality of Supply Standards (SQSS) therefore presents a major opportunity to address these issues." The Select Committee also notes that "reform of the SQSS will be vital for the development of a future SMART grid" and they stressed the importance of urgently completing and publishing a review.

In developing a revised project plan, not only have we have recognised the need to make timely decisions where appropriate, but also the need to ensure that we have appropriate level of customer engagement at each stage. For the first Phase of this ongoing review we will be undertaking an open consultation with interested parties within the Industry. But given the complex nature of the Phase 2, and given the potential impact on the service provided to the end consumer, we feel it is more appropriate to link consultation to the customer engagement process we will be undertaking for the forthcoming Transmission Price Control Review (TPCR),

[2] House of Commons Energy and Climate Change Committee "The future of Britain's electricity networks" Second report of session 2009-10.

particularly given that the development of the fundemental review proposals, if adopted, could have a direct impact on level of service provided to the end consumer.

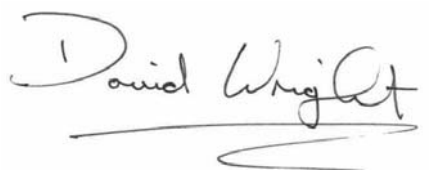
Feedback to proposals

I would welcome your feedback on:-

1) The proposed Workplan for 2010
2) The proposed enhanced customer engagement & consultation processes for Phases 1 & 2 of this project plan
3) The form of governance required for the SQSS as we move forward

We are committed to keeping you informed as our work progresses and will issue further open letters as required if there are any material changes to our proposed workplan. If you have any comments, please do not hesitate to contact either Andy Hiorns (01926 655421), myself (telephone), or any of the SQSS Review Group members.

Yours sincerely



David Wright

SQSS Review Chairmen

Review Group Members:

David Wright	National Grid, Chair
Colin Bayfield	Scottish Power
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Appendix B Consideration of Dynamic Ratings

Proposed changes to the existing NETS SQSS criteria are shown in red.

Pre-fault Rating	The specified pre-fault capability of transmission equipment. Due allowance shall be made for specific conditions (e.g. ambient/seasonal temperature), dynamic ratings, agreed time-dependent loading cycles of equipment and any additional relevant procedures.
Unacceptable Overloading	The overloading of any *primary transmission equipment* beyond its specified time-related capability. Due allowance shall be made for specific conditions (e.g. ambient/seasonal temperature), dynamic ratings, pre-fault loading, agreed time-dependent loading cycles of equipment and any additional relevant procedures.

Appendix C Clarification of Demand Management Usage

Proposed changes to the existing NETS SQSS criteria are shown in red.

Limits to Loss of Power Infeed Risks

2.5 For the purpose of applying the criteria of paragraph 2.6, the *loss of power infeed* resulting from a *secured event* on the *onshore transmission system* shall be calculated as follows:

2.5.1 the sum of the *registered capacities* of the *generating units* disconnected from the system by a *secured event*, plus

2.5.2 the planned import from any *external systems* disconnected from the system by the same event, less

2.5.3 the *forecast minimum demand* disconnected from the system by the same event but excluding (from the deduction) any demand forming part of the *forecast minimum demand* which may be automatically tripped for system frequency control purposes as part of the Low Frequency Demand Disconnection scheme and excluding (from the deduction) the demand of the largest single end customer, less

2.5.4 any further demand planned to be disconnected and expected to be available for disconnection.

Minimum *Transmission capacity* Requirements

At *ACS peak demand* with an *intact system*

4.4 The *MITS* shall meet the criteria set out in paragraphs 4.5 to 4.6 under the following background conditions:

4.4.1 *generating units*' outputs shall be set to those which ought reasonably to be foreseen for that demand;

4.4.2 power flows shall be set to those arising from the *planned transfer condition* (using the appropriate method described in Appendix C) prior to any fault, and such power flows modified by an appropriate application of the *interconnection allowance* (using the methods described in Appendix D) under *secured events*;

4.4.3 sensitivity cases on the conditions described in 4.4.2 shall comprise *generating units* with output equal to their *registered capacities* such that the required power transfers described in 4.4.2 above are approximated by selection of individual units; ~~and~~

4.4.4 the expected availability of generation reactive capability shall be set to that which ought reasonably to be expected to arise. This shall take into account the variation of reactive capability with the active power output (for example, as defined in the machine performance chart). In the absence of better data the expected available capability shall not

exceed 90% of the Grid Code specified capability, (unless modified by a direction of the *Authority*) or 90% of the contracted capability for the active power output level, whichever is relevant; and

4.4.5 account shall be taken of any demand management expected to be available other than that resulting from operation of the automatic low frequency demand disconnection scheme.

Under conditions in the course of a year of operation

4.7 The *MITS* shall meet the criteria set out in paragraphs 4.8 to 4.10 under the following background conditions:

4.7.1 conditions on the *national electricity transmission system* shall be set to those which ought reasonably to be foreseen to arise in the course of a year of operation. Such conditions shall include forecast demand cycles, typical *power station* operating regimes and typical *planned outage* patterns; ~~and~~

4.7.2 the expected availability of generation reactive capability shall be set to that which ought reasonably to be expected to arise. This shall take into account the variation of reactive capability with the active power output (for example, as defined in the machine performance chart). In the absence of better data the expected available capability shall not exceed 90% of the Grid Code specified capability, (unless modified by a direction of the *Authority*) or 90% of the contracted capability for the active power output level, whichever is relevant; and

4.7.3 account shall be taken of any demand management expected to be available other than that resulting from operation of the automatic low frequency demand disconnection scheme.

Limits to Loss of Power Infeed Risks

7.7 For the purpose of applying the criteria of paragraphs 7.8 to 7.13, the *loss of power infeed* resulting from a *secured event* shall be calculated as follows:

7.7.1 the sum of the *registered capacities* of the *offshore power park modules* or offshore gas turbines disconnected from the system by a *secured event*, less

7.7.2 the *forecast minimum demand* disconnected from the system by the same event but excluding (from the deduction) any demand forming part of the forecast minimum demand which may be automatically tripped for system frequency control purposes as part of the Low Frequency Demand Disconnection scheme and excluding (from the deduction) the demand of the largest single end customer, less

7.7.3 any further demand planned to be disconnected and expected to be available for disconnection.

Appendix D Regional Variation in Peak Demand Planning Criteria

Proposed change to the existing NETS SQSS criteria is shown in red.

Minimum *Transmission Capacity* Requirements

4.6 The minimum *transmission capacity* of the *MITS* shall also be planned such that for the conditions described in paragraph 4.4 and for the *secured event* of a *fault outage* of any of the following:

4.6.1 a single *transmission circuit*, a reactive compensator or other reactive power provider;

4.6.2 a double circuit overhead line on the supergrid;

4.6.3 a *double circuit overhead line* where any part of either circuit is in the England and Wales area or the SHETL area;

4.6.4 a section of *busbar* or mesh corner; or

4.6.5 provided both the *fault outage* and prior outage involve plant in the England and Wales area, any single *transmission circuit* with the prior outage of another *transmission circuit* containing either a transformer or a cable section located wholly or mainly outside a substation, or a *generating unit*, a reactive compensator or other reactive power provider,

there shall not be any of the following:

4.6.6 *loss of supply capacity* (except as permitted by the demand connection criteria detailed in Section 3 and Section 8);

4.6.7 unacceptable overloading of any primary transmission equipment;

4.6.8 unacceptable voltage conditions or insufficient voltage performance margins; or

4.6.9 system instability.

Appendix E Working Group 1 – International Benchmarking

Please refer to:
http://www.nationalgrid.com/NR/rdonlyres/CC7B6196-C148-4A59-B8D1-A7E9085A3A53/40826/WG1.pdf

Appendix F Working Group 2– Transmission Entry and Exit Principles

Please refer to:
http://www.nationalgrid.com/NR/rdonlyres/01F4AE03-F634-4863-B5B4-3F0A0F36B7AA/40827/WG2.pdf

Appendix G Working Group 3 – Main Interconnected Transmission System Principles

Please refer to:
http://www.nationalgrid.com/NR/rdonlyres/D23F1431-F2F5-445D-B117-B2A0CE254853/40828/WG3.pdf

Appendix H Working Group 4 – Planning and Operational Contingency Criteria

Please refer to:
http://www.nationalgrid.com/NR/rdonlyres/89EB789A-0541-410F-A59F-A81135CA6161/40829/WG4.pdf

Appendix I Working Group 5 – Offshore Transmission Systems

Please refer to:
http://www.nationalgrid.com/NR/rdonlyres/440C0D78-8E36-4D80-A0F7-30AD071923F4/40830/WG5.pdf