

## DRAFT Minutes

<b>Meeting Name</b>	NETS SQSS Sub-Synchronous Oscillations (SSO) Workgroup
<b>Meeting Number</b>	3
<b>Date of Meeting</b>	28 November 2014
<b>Time</b>	10:00 – 14:00
<b>Location</b>	SSE Offices, Glasgow and Teleconference

## Attendees

<b>Name</b>	<b>Role</b>	<b>Initials</b>	<b>Representing</b>
Graham Stein	Chair	GS	-
Nick Martin	Secretary	NM	-
Bieshoy Awad	Member	BA	National Grid SO
David Adam	Member	DA	SPT
Yash Audichya	Member	YA	SSE
Alastair Frew	Member	AF	Scottish Power
Ankit Patel	Member	AP	SSE

## Apologies

<b>Name</b>	<b>Role</b>	<b>Initials</b>	<b>Representing</b>
Andrew Dixon	Member	AD	National Grid SO
Danson Joseph	Member	DJ	National Grid TO
Cornel Brozio	Member	CB	SPT
Lorna Short	Member	LS	RWE
John Reilly	Member	JR	EdF
Mayure Daby	Authority	MD	Ofgem

## 1 Introductions & Apologies

GS opened the meeting by thanking all of those in attendance. The apologies were also noted.

## 2 Approval of Minutes

The draft minutes from the previous meeting were approved without the need for any changes. These shall now be published onto the National Grid NETS SQSS Website.

## 3 Review of Actions

a) Actions From Previous Meeting:

Action	Description	Action Owner	Due Date
2.0	NGET to raise the issue concerning roles and responsibilities in the management of SSO phenomena at the next Grid Code Review Panel (GCRP) meeting. <i>Update: This has not yet been completed and shall therefore be rolled over to the next workgroup meeting. GS aims to discuss this at the January 2015 Grid Code Review Panel (GCRP).</i>	GS	ASAP
2.1	NGET to update the WG ToR for this workgroup to include the provision of recommendations on any modifications required to the Grid Code. <i>Update: This has been completed and is now available on the National Grid NETS SQSS Website.</i>	NM	ASAP
2.2	NGET to confirm that when a transmission project affects a specific Transmission System User (Affected User) there are no securities / liabilities required from that Affected User. <i>Update: It has been confirmed by Commercial Policy that there are no liabilities against an Affected User due to changes to the transmission system beyond their control. In certain circumstances there may be a requirement to compensate the Affected User.</i>	BA	December 2014
2.3	SHE Transmission to provide the literature they recommend to use as a basis for defining SSO. <i>Update: This action was discussed but remains on-going.</i>	YA	ASAP
2.4	All workgroup members to consider what (if any) suggestions they might have for improving the definition(s) at this stage. <i>Update: This was further discussed during the workgroup meeting. No feedback had been received prior to the meeting; however, YA presented some draft sample text he had prepared for the workgroup to consider.</i>	ALL	December 2014
2.5	NGET to circulate a doodle poll to determine the most appropriate date for the next workgroup meeting. <i>Update: This action has been completed and can be closed.</i>	NM	ASAP

## 4 Updated Workgroup Terms of Reference (WG ToR)

As previously discussed, the Grid Code Review Panel (GCRP) has recommended that this NETS SQSS GSR018 workgroup provides recommendations on any modifications required to the Grid Code as well as to the NETS SQSS. This has also subsequently been ratified by the NETS SQSS Review Panel. As such, the GSR018 workgroup Terms of Reference have been updated to include the provision of recommendations on any modifications required to the Grid Code as well as to the NETS SQSS. These can be found on the National Grid NETS SQSS Website.

## 5 Discussion Items

BA gave a presentation to the workgroup. He started by re-emphasising the purpose of this workgroup in that it is to determine an appropriate statement to be included within the NETS SQSS to cover-off sub-synchronous oscillations (SSO) phenomena. BA explained that this statement could be in the form as presented on Slide 3 of the accompanying slide-pack but that the workgroup still needs to determine what X, Y and Z should be.

BA also explained that he held conversations within National Grid and with Scottish Power to better understand their thoughts and plans with respect to SSO to facilitate the tasks of this workgroup. A similar discussion with SHE Transmission was scheduled to take place shortly after the workgroup meeting.

The workgroup subsequently moved on to discuss some relevant project examples including HVDC Interconnectors, the Western HVDC Link and the Anglo-Scottish Series Compensation.

With respect to HVDC Interconnectors, the Grid Code requires these not to cause any sub-synchronous torsional interactions (SSTI). Developers therefore design the damping controllers required to ensure this. Intertrips and / or any other means are then used to mitigate against any risks that were not accounted for in the initial design.

The Western HVDC Link, on the other hand, is not covered by the Grid Code since it is not owned by a Transmission System User. However, Transmission Licensees took a view that the Western HVDC Link should be designed to meet the same SSO requirements as if it was an Interconnector. It is expected that the same logic will apply for the Caithness-Moray HVDC Link.

With respect to the Series Compensation, a lot of work has been done to consider a variety of system conditions. Two approaches were used. For the TCSC solution, NGET specified that there shall not be negative electrical damping or SSO phenomena between 5Hz and 45Hz. For the fixed capacitor solution, SPT specified a maximum value for the negative electrical damping at different frequencies. These values were chosen such that they are less than the positive mechanical damping of the corresponding mechanical mode. The design accounted for a comprehensive set of combinations of circuit outages (up to three circuits) and generation backgrounds. Critical outages that were not covered in the design stage were secured for by means of an auto-closure scheme that would bypass the fixed capacitors if any of these outage combinations would take place.

In operational timescales, the series capacitors are expected to be bypassed unless the flow on the AC system is above the stability limit. All credible outage patterns with potential flows above 3.3GW have been catered for either in the design stage or by means of the auto-closure scheme. Additional outage combinations would reduce the thermal limits to the extent that stability is no longer an issue and that series capacitors can be bypassed. In the rare occasions that these measures are not sufficient and the System Operator foresees a potential unacceptable SSO condition, the System Operator will manage generation via the Balancing Mechanism to reduce the flow below the stability limit and then bypass the capacitors.

DA then presented a minimum damping curve. DA explained that the curve was for a very specific application within the SPT transmission area only and that the plotted data points were from a literature survey of generators and was therefore likely to include machines from outside of Great Britain. However, it only includes units of capacity of around 660MW. Smaller units may have different characteristics. In addition, DA emphasised that this was very much a transmission based solution rather than a generator based solution.

BA explained that, during operational time scales, SSO risks will be managed via actions on the Transmission System. It is not anticipated to require any System to Generator intertripping schemes or SSO protection. Any actions taken on Generators are expected to be minimal and will be executed via the Balancing Mechanism.

Some plants have been requested by SPT to install monitoring equipment. None have been required to install protection equipment. Generators willing to install SSO protection on their plant may have to coordinate this with NGET. National Grid has not requested any monitoring to date. Views and comments of the affected parties (i.e. JR - EdF) will probably shed some light on any concerns with respect to monitoring. DA confirmed that SPT have been liaising with EdF as necessary.

Next BA asked the workgroup for their opinions on two statements presented on Slide 7 of the accompanying slide-pack:

Using system stability as a base case is the workgroup happy to agree that:

- (i) The current NETS SQSS provides the right balance between investment and operational costs whilst not exposing generators to unnecessary risks.
- (ii) The risks imposed on generating units from an SSO event are of the same order of magnitude to that of a pole slip event.

BA questioned that if the workgroup was comfortable with these two statements, could we agree to secure the system as we do for stability? AF and AP requested clarification on the exact risks we are exposing generators to and the frequency and number of events. BA confirmed that we are securing the generators against system instability. Experience suggests that for every 100km of overhead line a double circuit fault happens approximately every ten years. The NETS SQSS stipulates that if a double circuit fault occurs there should be no pole slip. The workgroup subsequently agreed that we should not go above and beyond the current requirements for system instability. It was also agreed that we should extend the operational criteria for system instability to SSO phenomena as well. This would require the addition of “unacceptable sub-synchronous oscillations” to the following clauses within the NETS SQSS: 2.9.4; 2.10.11; 4.5.4; 4.6.10; 4.8.4; 5.1.10; 5.3.7; 5.5.8; 7.15.4; 7.16.11 and 9.1.10.

Next BA moved on to discuss what background conditions it would be considered reasonable to secure against. Through conversations with National Grid and SPT it has been concluded a generating unit is more vulnerable to SSO when it is lightly loaded. This is in contrast to thermal or voltage issues. BA then presented two proposed changes to Section 2.8.1 and Section 7.14.1 to account for said background conditions. However, DA believes there is no need for additional text here and that the current text already captures what is trying to be achieved. DA was concerned that we may be making it more complex than it needs to be. YA also questioned the value of over specifying the background conditions and expressed concerns that this might inadvertently inhibit analysis. DA agreed that we do not want the NETS SQSS to become a guidance note as to how to do the analysis itself. GS summarised that the general consensus was to apportion background conditions specifically for SSO phenomena. However the required wording is less easy to agree upon. Therefore an action shall be taken to draft some further proposed wording and to agree on this at a later date / the next workgroup meeting.

***ACTION: BA to provide some further proposed wording with respect to the background conditions to secure SSO phenomena against and to share this with the workgroup.***

The workgroup then moved on to discuss an SSO definition and corresponding criteria. At a previous meeting, the workgroup had ruled out using the definition for system instability. BA has previously provided alternative definitions. At this meeting, YA had also produced a definition. YA explained that his definition originates from previous discussions and other code references. However, DA believed that the first paragraph of the note was solely applicable to HVDC systems and explained how that we want to avoid the standards dictating what type of technology we use on the transmission system. Reference to a damping controller therefore isn't suitable either.

The workgroup moved on to discuss other potential sources for SSO definitions, such as the IEEE. DA also provided a definition from an American study which read: “SSO is comprised of but not limited to.....” However, YA explained that the workgroup had previously agreed to treat SSO as an umbrella term and to not consider each constituent element separately.

The workgroup then discussed the interaction between the SSO definition and other system stability issues such as inter-area oscillations. DA explained that his preference would be to include a range (i.e. “generally in the range 5Hz to 45Hz). BA pointed out that the original proposal from NGET excludes “transient stability” as a part of the definition. However, DA disagreed that this would solve the problem as it is not a defined term within the NETS SQSS. This made the workgroup reluctant to use it to describe other phenomena (i.e. SSO). BA pointed out that the difference between SSO and inter-area oscillations and other transient stability phenomena is that only SSO will excite torsional mechanical modes and there might be some value of considering this when drafting the definition. DA subsequently agreed to draft a definition of SSO, attempting to include all of the options discussed to date.

***ACTION: DA to draft a definition of SSO, attempting to include all of the options discussed to date and to share this definition with the workgroup.***

AF explained that we need to state that unacceptable SSO is not permitted and questioned whether this could be classified as anything that causes a destabilising effect. DA disagreed, explaining that we're reducing the stability margin but we are not making the system unstable. AP suggested that it may be best to use different terms from “stable” and / or “unstable” because it draws too much attention back to transient stability, which as already agreed is different to SSO. However, YA stated that these terms come from the European Codes, which are binding for Great Britain. GS summarised that our definitions currently make reference to “damping” and “oscillations” but that we need to produce definitions that are aligned with the European Codes.

BA then proposed to modify the criteria for “Unacceptable SSO” originally proposed by NGET to refer specifically to the modes of oscillations of concern such that the definition reads “*Unacceptable SSO are SSO with the relevant modes of oscillations having either 1) negative or zero damping, such that the magnitude of oscillations will not eventually decay to zero; or 2) very low positive damping such that the combined effect of the low positive damping and the magnitude of oscillation will significantly reduce the lifetime of generator shafts due to fatigue*”. YA agreed that this might be a potential way forward.

***ACTION: The workgroup is to provide a view on the modification proposed to the original criteria.***

## 6 Any Other Business

None

## 7 Next Meeting

The next meeting was agreed to be scheduled for late February 2015. This is due to be at National Grid House in Warwick and via teleconference. Further details shall be circulated nearer the time.

***ACTION: NM to circulate a doodle poll to determine the most appropriate date for the next workgroup meeting.***

## 8 Summary of Actions

a) On-Going Actions:

2.0	NGET to raise the issue concerning roles and responsibilities in the management of SSO phenomena at the next Grid Code Review Panel (GCRP) meeting.	GS	January 2015
2.3	SHE Transmission to provide the literature they recommend to use as a basis for defining SSO.	YA	ASAP

Otherwise all actions from previous meetings have been previously discussed and / or closed.

b) New Actions:

Action	Description	Action Owner	Due Date
3.0	BA to provide some further proposed wording with respect to the background conditions to secure SSO phenomena against and to share this with the workgroup.	BA	Next Meeting
3.1	DA to draft a definition of SSO, attempting to include all of the options discussed to date and to share this definition with the workgroup.	DA	Next Meeting
3.2	The workgroups to provide a view on the modification proposed to the original criteria.	ALL	Next Meeting
3.3	NM to circulate a doodle poll to determine the most appropriate date for the next workgroup meeting.	NM	January 2015