

STCP19-5 Issue 004 Offshore Transmission System Compliance Process & Testing

STC Procedure Document Authorisation

Company	Name of Party Representative	Signature	Date
National Grid Electricity System Operator Ltd			
National Grid Electricity Transmission plc			
SP Transmission plc			
Scottish Hydro Electric Transmission plc			
Offshore Transmission Owners			

STC Procedure Change Control History

Issue 001	07/10/2011	New procedure
Issue 002	10/08/2016	Issue 002 incorporating PM083
Issue 003	01/04/2019	Issue 003 incorporating National Grid Legal Separation changes
Issue 004	06/04/2022	Issue 004 incorporating changes for PM0123
Issue 005		Issue 004 incorporating changes for PM0122

Introduction

1.1 Scope

- 1.1.1 To connect or use the Onshore Transmission System, an Offshore Transmission Owner (OFTO) must comply with the STC, the STCP 19-4 Stage 1 Commissioning Panel data requirements and the Transmission Owner Construction Agreement. This procedure outlines the OFTO's obligations to demonstrate compliance with STC Section K (except part relating to Neutral Earthing) to NGESO and the corresponding responsibilities on NGESO.
- 1.1.2 Where design, construction and commissioning of an Offshore Transmission System has been initiated by a Generator, the compliance process for the applicable plant and apparatus may have been partially or fully completed under the provisions of the Grid Code prior to the OFTO assuming ownership. This procedure will then only apply in relation to items not completed prior to the OFTO assuming ownership.
- 1.1.3 This procedure applies to NGESO and each TO. For the purposes of this document, the TOs are :
- NGET;
 - SPT; and
 - SHET; and
 - all Offshore Transmission Licence holders as appointed by the Authority. (For the avoidance of doubt, this includes Preferred Bidders).
- In the event that specific conditions or exceptions are made in the document relating to an Onshore TO or Offshore TO these will be prefixed accordingly.
- 1.1.4 This procedure sets out the process to be followed by each OFTO and NGESO and an Onshore TO associated with an OFTO demonstrating Compliance and details the facilities to be provided for Compliance demonstration and the Compliance testing to be completed by each OFTO.
- 1.1.5 It should be noted that other aspects of the process that is triggered by a request for connection are covered by other STCPs.

1.2 Objectives

- 1.2.1 The objectives of this procedure are to specify:
- the responsibilities of NGESO and the OFTO in relation to Compliance Process and Compliance Testing activities;
 - the requirements for exchange of information between NGESO and the OFTO and the Onshore Host TO related to Compliance activities;
- 1.2.2 This procedure includes the Parties' responsibilities in respect of Compliance which involves or affects OFTO assets.
- 1.2.3 Appendix B contains a summary of responsibilities on Parties with respect to Compliance Process and Compliance Testing.
- 1.2.4 For the avoidance of doubt the testing and energisation of Onshore Transmission Owner Plant and/or Apparatus is covered under STCP 19-4 Commissioning and Decommissioning.

2 Key Definitions

2.1 *For the purposes of STCP 19-5 Offshore Transmission Compliance Process & Compliance Testing:*

2.1.1 **Compliance** means the compliance of OFTO Equipment to the requirements of the following parts of STC Section K:

- section 2. Reactive Capability and Voltage Control; and
- section 3. Fault Ride Through Capability; and
- section 4. Additional Damping Facilities for Transmission DC Connections; and
- section 5. Frequency Capability and Signals; and
- section 7. Power Quality; and

all parts of the OFTO's Services Capability Specification and the Offshore TO Construction Agreement and the Transmission Interface Site Specification relating to these parts of the STC Section K listed above. For the avoidance of doubt, compliance with STC Section K part 6 relating to Neutral Earthing is not included in this STCP.

2.1.2 **Compliance Process** means the process set out in this STCP19-5 to be followed by OFTOs to demonstrate Compliance to NGESO.

2.1.3 **Compliance Testing** means the process validating OFTO Equipment for Compliance.

2.1.4 **Final Section K Notification (FSKN)** means a certificate issued by NGESO to the User following successful completion of the Compliance process.

2.1.5 **Interim Section K Notification (ISKN)** means a certificate issued by NGESO to the User listing the parts of the Compliance process requiring completion.

2.1.6 **Onshore Host TO** means either

- (i) the owner of the Onshore Transmission System at the Interface Point with the Offshore Transmission System; or
- (ii) in the case of an Offshore Transmission System connected to a Distribution System, the owner of the Onshore Transmission System to which the relevant Distribution System is connected.

2.1.7 **Onshore Affected TO(s)** means any Onshore Transmission Owner in relation to whose Transmission System the Relevant Connection Site satisfies the criteria set out in the STC, Schedule four. (see STC Section D, part 2, paragraph 2.2.2).

2.1.8 **Section K Notification** means either Interim Section K Notification or Final Section K Notification as the context requires.

2.1.9 **Section 8A** means the process for the award of a Transmission Licence in respect of offshore transmission as set out in Section 8A of the Electricity Act 1989.

3 Procedure

3.1 *Compliance Process*

3.1.1 NGESO shall assess the Compliance of the Offshore Transmission System. The OFTO will provide the data, simulations and testing deemed necessary by NGESO to demonstrate Compliance. For the avoidance of doubt compliance in all aspects is the responsibility of the OFTO.

3.1.2 The process for the assessment of Compliance of the Offshore Transmission System shall be as set out in this section. NGESO may agree to a variation of the following

process for the assessment of Compliance if suggested by the OFTO and deemed appropriate in the reasonable opinion of NGESO.

3.1.3 Prior to an OFTO carrying out initial Energisation and commissioning of an Offshore Transmission System under STCP 19-4 or prior to assuming ownership for an Offshore Transmission system from a Generator, NGESO will issue the OFTO a Section K Notification.

3.1.4 Where an OFTO is assuming ownership of Plant and Apparatus fully or partially designed, constructed and commissioned by a Generator and initial energisation has occurred:

i) NGESO shall issue an Interim Section K Notification or Final Section K Notification to the OFTO after:

a. NGESO has notified the OFTO that the current OTSDUW Completion Report is acceptable; and,

b. NGESO has notified the OFTO items i) to iv) of 3.1.5 have been completed to NGESO's satisfaction

and, where this occurs prior to the commencement of Section 8A, NGESO shall issue the Interim Section K Notification or Final Section K Notification to the OFTO prior to such commencement of Section 8A . .

ii) Recognising that this process is a parallel process to the issue of the Interim Operational Notification Part A / Final Operational Notification to the Generator in respect of the Offshore Transmission System under the Grid Code, the OFTO's Interim Section K Notification or Final Section K Notification will reflect that issued to the Generator at that time. If following this (and prior to the OTSUA Transfer Time), there is a change in the Generator's operational notification, then the OFTO's Interim Section K Notification or Final Section K Notification shall be changed accordingly to reflect this.

iii) Reflecting that this is a parallel process, any Interim Section K Notification or Final Section K Notification issued shall take effect for the purposes of the STC at the OTSUA Transfer Time.

3.1.5 Where an OFTO is responsible for the design, construction and commissioning of an Offshore Transmission System the Interim Section K Notification shall be issued after the OFTO has provided the following to NGESO:

i) all the data required by STCP19-4 Commissioning Panel Stage 1 including a mathematical model in transfer block diagram format representing the automatic control of all dynamic voltage control plant and apparatus present in the Offshore Transmission System; and

ii) simulation studies demonstrating the reactive power delivery and dynamic voltage control provision as detailed evidence in section 3.3 of this STCP; and

(iii) reports demonstrating that the Offshore Transmission System together with any offshore generation connected to it conform with the specified limits at the Transmission Interface Point for Power Quality; and

iv) test procedures for the Compliance Testing detailed in section 4 of this STCP

and

NGESO having notified the OFTO that:

v) the data submitted is complete and suitable; and

vi) the performance indicated by the simulation studies and reports is consistent with the requirements of STC Section K; and

vii) the test procedures are adequate for purpose.

- 3.1.6 NGESO shall forward the appropriate technical data and information received from the OFTO to the Onshore Host TO and Onshore Affected TO(s). For the avoidance of doubt the data provided to the Onshore Host TO and Onshore Affected TO(s) shall include, but not be limited to, any data required for design and development of their Transmission System, including updates to STCP16-1 and/or 19-4 data, transfer block diagrams for dynamic voltage control plant models, and shall be provided in accordance with STC Schedule 3.
- 3.1.7 The Onshore Host TO may make reasonable requests to NGESO to review the test procedures for the Compliance Testing.
- 3.1.8 Partial testing of the dynamic voltage control system as defined in section 4.2 is to be completed before more than 20% of the Interface Point Capacity (or 50MW if less) may be used. Where an OFTO is assuming ownership of Plant and Apparatus partially designed, constructed and commissioned by a Generator under Grid Code this test may have been completed by the Generator prior to the OFTO assuming ownership.
- 3.1.9 NGESO shall notify the OFTO that Compliance has been demonstrated in respect of the Offshore Transmission System by the issue of a Final Section K Notification following,
the OFTO having:
- (i) completed the testing of reactive capability as detailed in section 4.3 and dynamic voltage control as detailed in section 4.4 at the Interface Point to the satisfaction of NGESO; and
 - (ii) completed the testing of dynamic voltage control detailed in section 4.4 at the Interface Point to the satisfaction of NGESO; and
 - (iii) completed any DC Transmission damping facility and frequency signal testing detailed in sections 4.5 and 4.6 to the satisfaction of NGESO; and
 - (iv) completed any specified power quality measurement at the Transmission Interface Point to the satisfaction of the Onshore Host TO; and
 - (v) updated any data required by STCP16-1 including the mathematical model representing the control of any dynamic voltage control plant and apparatus within the Offshore Transmission System that has been modified as a consequence of the commissioning.
- Where an OFTO is assuming ownership of Plant and Apparatus designed, constructed and commissioned by a Generator, Compliance may have been completed by the Generator prior to the OFTO assuming ownership; in which case the process in 3.1.4 will have been followed to issue the FSKN.
- 3.1.10 NGESO shall forward the appropriate updated technical data and information received from the OFTO to the Onshore Host TO and Onshore Affected TO(s). For the avoidance of doubt the data provided to the Onshore Host TO and Onshore Affected TO(s) shall include, but not be limited to, any data required for design and development of their Transmission System covered by STCP 16-1 and updates to the OFTO SCS data, transfer block diagrams for dynamic voltage control plant models, and shall be provided in accordance with STC Schedule 3.
- 3.1.11 NGESO shall forward to the Onshore Host TO the results of tests relevant to the technical specification advised by the Onshore Host TO in the TO Construction Agreement and for validating control system models referred to in 3.1.10. NGESO and each TO shall co-ordinate activities to ensure that the control system models used by each Party accurately reflects as practically as possible the actual performance of equipment.
- 3.1.12 The Onshore Host TO shall confirm that it is satisfied with the mathematical model representing the control of any dynamic voltage control plant and apparatus within the Offshore Transmission System.

3.2 Lifetime Compliance

- 3.2.1 If NGESO or the Onshore Host TO, acting reasonably, believes that an OFTO is not in Compliance as addressed in this STCP, then NGESO shall notify the OFTO.
- 3.2.2 NGESO and the OFTO shall exchange such information as they have available concerning the suspected non-compliance and NGESO and the OFTO shall meet to discuss and agree any further action to be taken, which may include:
- gathering further information;
 - NGESO requiring the OFTO to undertake further Compliance verification including but not limited to, further simulation studies and testing in the presence of NGESO which may form part of a Service Restoration Proposal;

3.3 Simulation Studies

3.3.1 Reactive Capability across the voltage range

3.3.1.1 The OFTO shall supply simulation studies to demonstrate the capability to meet STC Section K by submission of a report containing:

- (i) a load flow simulation study result to demonstrate the capability of the Offshore Transmission System to export the required maximum Reactive Power to the Onshore Transmission System at the total rated output of the offshore Power Park Modules connected to the Offshore Transmission System when the Interface Point voltage is at 105% of nominal.
- (ii) a load flow simulation study result to demonstrate the capability of the Offshore Transmission System to import the required maximum Reactive Power from the Onshore Transmission System at the total rated output of the offshore Power Park Modules connected to the Offshore Transmission System when the Interface Point voltage is at 95% of nominal.

3.3.1.2 NGESO's agreement is required where the load flow simulation studies show that the individual Offshore Power Park Units deviate from nominal voltage to contribute Reactive Power to assist in meeting the Offshore Transmission Owner's Reactive Power obligations.

3.3.1.3 NGESO shall notify the OFTO when, in NGESO's reasonable opinion, the simulations studies have adequately demonstrated compliance with the reactive capability across the voltage range.

3.3.2 Voltage Control and Reactive Power Stability

3.3.2.1 The OFTO shall provide a report to demonstrate the dynamic capability and control stability of the plant and apparatus. The report shall contain:

- (i) a dynamic time series simulation study result of a sufficiently large negative step in Interface Point voltage to cause a change in Reactive Power from zero to the maximum lagging value at the total rated output of all the offshore Power Park Modules connected to the Offshore Transmission System.
- (ii) a dynamic time series simulation study result of a sufficiently large positive step in Interface Point voltage to cause a change in Reactive Power from zero to the maximum leading value at total rated output of all the offshore Power Park Modules connected to the Offshore Transmission System.
- (iii) a dynamic time series simulation study result to demonstrate control stability at the lagging Reactive Power limit by application of a -2% voltage step while operating within 5% of the lagging Reactive Power limit.
- (iv) a dynamic time series simulation study result to demonstrate control stability at the leading Reactive Power limit by application of a +2% voltage step while operating within 5% of the leading Reactive Power limit.
- (v) a dynamic time series simulation study result to demonstrate the performance following the application of +2% and -2% voltage steps while exporting OMVAr to allow model verification against test results.

3.3.3 All the above studies should be completed with a nominal system voltage for zero Reactive Power transfer at the Interface Point unless stated otherwise and the fault level at the Interface Point at minimum as agreed with NGESO.

3.3.4 In the case of an Offshore Transmission System requiring some or all of the dynamic voltage control at the Interface Point to be provided from any connected offshore Power Park Module(s), the OFTO shall ensure provision of a report covering the conditions laid out in section 3.3.2.1(i) to (v) in respect of the Offshore Transmission System requirements. However, in this case the report may be provided direct to NGESO by the offshore generator provided the report represents the action of all relevant Plant

and Apparatus connected within both the Offshore Generator system and the Offshore Transmission System.

- 3.3.4.1 NGESO shall notify the OFTO when, in NGESOs reasonable opinion, the simulations studies have adequately demonstrated Compliance with the dynamic voltage control and reactive stability requirements.

3.4 User Data Format

- 3.4.1 To facilitate data sharing and organisation, all data provided by the OFTO to NGESO as part of the Offshore Transmission Compliance Process will be located within a file structure provided by NGESO.

4 Compliance Testing of an OFTO and Offshore Power Park Module(s)

4.1 General Provisions for Compliance Testing

- 4.1.1 This section outlines the general voltage control and reactive range testing requirements for an OFTO to demonstrate Compliance. In addition the OFTO must facilitate Grid Code compliance tests for any connected Offshore Power Park Modules as outlined in 4.1.8.

- 4.1.2 The voltage control and reactive range tests specified in this section will normally be sufficient to demonstrate compliance however NGESO may:

- (i) agree an alternative set of tests provided NGESO deem the alternative set of tests sufficient to demonstrate Compliance; and/or
- (ii) require additional or alternative tests if information supplied by the OFTO to NGESO suggests that the tests in this Section will not fully demonstrate Compliance; and/or
- (iii) require additional tests if a Power System Stabiliser is fitted to the OFTO's Plant and Apparatus.

- 4.1.3 The OFTO is responsible for carrying out the tests set out in and in accordance with this Section and the OFTO retains the responsibility for the safety of personnel and plant during the test. NGESO will witness all of the tests outlined or agreed in relation to this Section unless NGESO decides and notifies the OFTO otherwise. The Onshore Host TO may, with the OFTO agreement, witness Compliance Testing. Reactive Capability tests may be witnessed by NGESO remotely from the NGESO control centre. For all on site NGESO witnessed tests the OFTO must ensure suitable representatives from the OFTO and / or voltage control system / reactive compensation equipment manufacturer (if appropriate) are available on site for the entire testing period. In all cases and in addition to any recording of signals conducted by NGESO the OFTO shall record all relevant test signals as outlined below in section 4.1.6.

- 4.1.4 The signals which shall be provided by the OFTO for connection to NGESO's recoding equipment shall be of at least the following sample rates:

- (i) 1 Hz for reactive range tests
- (ii) 100 Hz for voltage control tests
- (iii) 10Hz for frequency response testing (to facilitate Offshore Generator tests)

4.1.5 Unless otherwise agreed, for on site witnessed tests NGESO will connect monitoring equipment in addition to that of the OFTO. The OFTO should generally provide all relevant signals as per section 4.1.6 for this purpose in the form of d.c. voltages within the range -10V to +10V. In exceptional circumstances some signals may be accepted as d.c. voltages within the range -60V to +60V with prior agreement between the OFTO and NGESO. All signals shall:

- (i) be suitably terminated in a single accessible onshore location at the OFTO's site.
- (ii) be suitably scaled across the range. The following scaling would (unless NGESO notify the OFTO otherwise) be acceptable to NGESO:
 - (a) 0MW to maximum Active Power 0-8Vdc
 - (b) Maximum leading Reactive Power to maximum lagging Reactive Power -8 to 8 Vdc
 - (c) 48 – 52Hz as -8 to 8Vdc
 - (d) Nominal voltage -10% to +10% as -8 to 8Vdc

The OFTO shall provide to NGESO a 230V power supply adjacent to the signal terminal location.

4.1.6 During any tests, the following signals shall be provided to NGESO by the OFTO in accordance with sections 4.1.4, 4.1.5 and 4.1.8:

- (i) Total Active Power transfer at the Interface Point (MW)
- (ii) Total Reactive Power transfer at the Interface Point (MVar)
- (iii) The Interface Point line-line voltage (kV)
- (iv) System frequency (Hz)
- (v) Injected voltage signal (per unit voltage) or test logic signal (Boolean) when appropriate
- (vi) Power System Stabiliser signal when appropriate
- (vii) In the case of a OFTO where the Reactive Power is provided from more than one Reactive Power source, the individual Reactive Power contributions from each source, as agreed with NGESO
- (viii) Any other signals as agreed between the Generator or OFTO and NGESO or as specified in the Offshore TO Construction Agreement and Services Capability Specification

4.1.7 In addition to the dynamic signals supplied in section 4.1.6 the OFTO shall inform NGESO of all relevant transformer tap numbers prior to the commencement of the tests and any changes during the tests.

4.1.8 For all NGESO witnessed testing, including that required in respect of any connected Offshore Power Park Modules, the OFTO shall either

- (i) provide to NGESO all signals outlined in section 4.1.6 direct from the OFTO control system without any attenuation, delay or filtering which would result in the inability to fully demonstrate the objectives of the test, or identify any potential safety or plant instability issues, and with a signal update rate corresponding to section 4.1.4;

or

- (ii) provide signals limited to those described in section 4.1.6 (i) to (iv) direct from one or more transducer(s) connected to current and voltage transformers for monitoring in real time on site on condition that:
 - (a) all signals outlined in section 4.1.6 are recorded and made available to NGESO by the OFTO from the OFTO's control systems as a download once the testing has been completed; and

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- (b) the full test results can be provided by the OFTO to NGESO within 2 working days of the test date to NGESO unless NGESO agrees otherwise; and
- (c) all data is provided with a sample rate in accordance with section 4.1.4 unless NGESO agrees otherwise; and
- (d) in NGESO's reasonable opinion, the solution does not unreasonably add a significant delay between tests or impede the volume of testing which can take place on the day.

4.1.9 The transducers connected to current and voltage transformers shall meet the following specification

- (a) The transducer(s) shall be permanently installed at the location of the Interface Point to easily allow safe testing at any point in the future, and to avoid a requirement for recalibration of the current transformers and voltage transformers.
- (b) The transducer(s) should be directly connected to the metering quality current transformers and voltage transformers or similar.
- (c) The transducers shall either have a response time no greater than 50ms to reach 90% of output, or no greater than 300ms to reach 99.5%.

4.1.10 In advance of any testing, the OFTO shall seek permission for testing from NGESO in accordance with STCP08-3. In addition to the proposed test procedure the notification shall provide an indication of the expected Reactive Power changes arising from the test procedure along with the date and time of the testing.

4.1.11 Testing not witnessed by NGESO on-site

4.1.11.1 Where NGESO has decided not to witness testing on-site, the results shall be submitted to NGESO in spreadsheet format with the signal data in columns arranged as follows. Signal data denoted by "#" is not essential but if not provided the column should remain in place but without values entered. Where two signal names are given in a column these are alternatives related to the type of plant under test.

4.1.11.2 Where NGESO has requested addition signals to be recorded prior to the testing these signals shall be placed in columns to the right of the spreadsheet.

4.1.11.3 Offshore Transmission System Voltage Control & Reactive Capability

	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
1	Time	Onshore Interface Point Active Power	Onshore Interface Point Reactive Power	Onshore Interface Point Voltage	Speed /Frequency #	Freq Injection #	Logic / Test Start #	Statcom or Windfarm Output
	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15	Col 16
1	Power Available	Wind Speed	Wind Direction	Voltage Setpoint				

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2	State of Charge	m/s						
# Columns may be left blank but the column must still be included in the files								

4.1.12 Logsheet

4.1.12.1 Where test results are completed without any presence of NGESO but are relied upon as evidence of the compliance they should be accompanied by a logsheet. This sheet should be legible, in English and detail the items as indicated below: Time and Date of test

- Name of Power Station and module if applicable.
- Name of Test engineer(s) and company name.
- Name of OFTO representative(s) and company name.
- Type of testing being undertake e.g. Voltage Control.
- Ambient conditions e.g. temperature, pressure, wind speed, wind direction.
- Controller settings, e.g. voltage slope, frequency droop, voltage setpoint, UEL & OEL settings

4.1.12.2 For each test the following items should be recorded as relevant to the type of test being undertaken. Where there is uncertainty on the information to be recorded this should be discussed with NGESO in advance of the test.

4.1.12.3 Voltage Control Tests

- Start time of each test step.
- Active Power.
- Reactive Power.
- Interface Point Voltage.
- Voltage Control Setpoint, if applicable or changed.
- Voltage Control Slope, if applicable or changed.
- OFTO transformer tap position or Grid Transformer tap position, as applicable.
- Number of Power Park Units in service in each Power Park Module, if applicable.
- Offshore Grid Entry Point Voltage.

4.1.12.3 Reactive Power Capability Tests

- Start time of test.
- Active Power.
- Reactive Power.
- Interface Point Voltage.
- OFTO transformer tap position or Grid Transformer tap position as applicable.

- Number of Power Park Units in service in each Power Park Module, if applicable.
- Offshore Grid Entry Point Voltage.

4.1.12.3 Material changes during the test period should be recorded e.g. Units tripping / starting, changes to tapchange positions.

4.2 Pre 20% (or 50MW) Synchronised Offshore Power Park Module Tests

Description of Test:

- 4.2.1 Before 20% of the Interface Point Capacity (or 50MW if less) may be used, either voltage control test described in section 4.4.7(i) or (ii) must be completed.

Test Assessment:

- 4.2.2 This test will be assessed by NGESO against the requirements specified in STC Section K and in the Offshore TO Construction Agreement and in the Services Capability Specification

4.3 Reactive Capability Test

Description of Test:

- 4.3.1 This section details the procedure for demonstrating the reactive capability of an OFTO. These tests should be scheduled at a time where there are at least 95% of the Power Park Units within any connected Offshore Power Park Module in service. There should be sufficient MW resource forecasted in order to generate at least 85% of Interface Point Capacity.
- 4.3.2 The tests shall be performed by modifying the voltage set-point of the voltage control scheme of the OFTO by the amount necessary to demonstrate the required reactive range. This is to be conducted for the operating points and durations specified in STC Section K.
- 4.3.3 In situations where the tests may have an adverse impact upon any host Distribution Network, NGESO will only require demonstration within the limits acceptable to the host Distribution Network Operator.
- 4.3.4 In the case where the Reactive Power metering point is not at the same location as the Reactive Power capability requirement, then an equivalent Reactive Power capability for the metering point shall be agreed between the OFTO and NGESO.

Test Assessment:

- 4.3.5 The test results will be assessed by NGESO against STC Section K and relevant parts of the Offshore TO Construction Agreement and Services Capability Specification.

Tests:

- (i) Operation in excess of 50% Interface Point Capacity and maximum continuous lagging Reactive Power for 60 minutes. For the avoidance of doubt this test must start with power output in excess of 85% of Interface Point Capacity as 4.3.1 and must not fall below 50% of Interface Point Capacity during the 60 minutes.
- (ii) Operation in excess of 50% Active Power Transfer Capability at the Interface Point and maximum continuous leading Reactive Power for 60 minutes. For the avoidance of doubt this test must start with power output in excess of 85% of Interface Point Capacity as 4.3.1 and must not fall below 50% of Interface Point Capacity during the 60 minutes.

- (iii) Operation at 50% Interface Point Capacity and maximum continuous leading Reactive Power for 5 minutes.
- (iv) Operation at 20% Interface Point Capacity and maximum continuous leading Reactive Power for 5 minutes.
- (v) Operation at 20% Interface Point Capacity and maximum continuous lagging Reactive Power for 5 minutes.
- (vi) Operation at less than 20% Interface Point Capacity and unity Power Factor for 5 minutes – This test only applies to systems which do not offer voltage control below 20% of the Active Power Transfer Capability at the Interface Point.
- (vii) Operation at 0% Interface Point Capacity and maximum continuous leading Reactive Power for 5 minutes. This test only applies to systems which offer voltage control below 20% Active Power Transfer Capability at the Interface Point and hence establishes actual capability rather than required capability.
- (viii) Operation at 0% Interface Point Capacity and maximum continuous lagging Reactive Power for 5 minutes. This test only applies to systems which offer voltage control below 20% Interface Point Capacity and hence establishes actual capability rather than required capability.

4.3.7 For the avoidance of doubt, lagging Reactive Power is the export of Reactive Power from the Offshore Transmission System to the Onshore Transmission System and leading Reactive Power is the import of Reactive Power from the Onshore Transmission System to the Offshore Transmission System

4.4 Voltage Control Tests

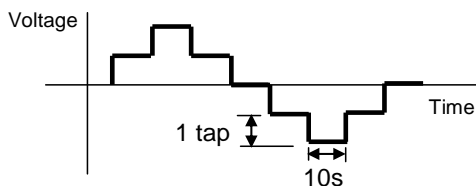
Description of Tests:

- 4.4.1 This section details the procedure for conducting voltage control tests on OFTOs. These tests should be scheduled at a time where there are at least 95% of the Power Park Units within any connected Offshore Power Park Module in service. There should be sufficient MW resource forecasted for any connected Offshore Power Park Module to generate at least 65% of Interface Point Capacity.
- 4.4.2 The voltage control system shall be perturbed with a series of step injections to the OFTO voltage control system voltage reference, and where possible, multiple upstream transformer taps.
- 4.4.3 For steps initiated using System tap changers the OFTO will need to coordinate with the System Operator and Host Onshore Transmission Owner. The time between transformer taps shall be at least 10 seconds as per section 4.4.7(i).
- 4.4.4 For step injection into the OFTO voltage reference, steps of $\pm 1\%$ and $\pm 2\%$ and $\pm 4\%$ shall be applied to the voltage control system reference summing junction. The injection shall be maintained for a minimum of 10 seconds as per section 4.4.7(ii).
- 4.4.5 Where the voltage control system comprises of discretely switched plant and apparatus (e.g. Mechanically Switched Shunt Reactors or Capacitors) additional tests will be required to demonstrate that the overall performance of the voltage control system when switching these devices as part of the response is in accordance with STC and Offshore TO Construction Agreement and Services Capability Specification requirements.

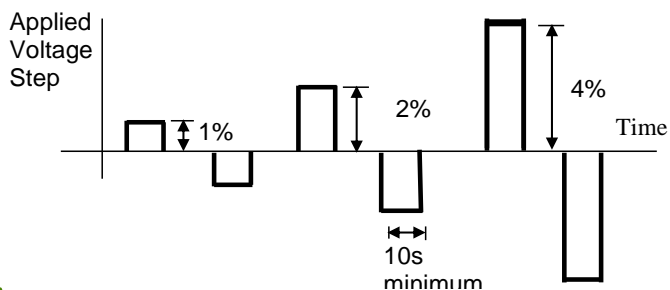
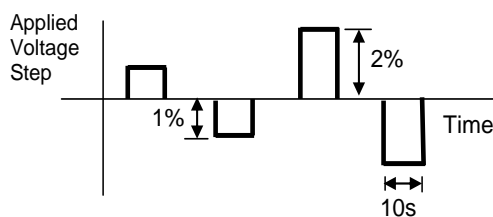
Test Assessment:

- 4.4.6 The tests will be assessed by NGESO against the requirements specified in STC Section K and in the Offshore TO Construction Agreement and in the Services Capability Specification
- 4.4.7 Tests:
 - (i) Transformer tap sequence for voltage control tests

Commented [A1]: In the original legal that was presented to March Panel, this figure was "+2%" and incorrect. We will need to note this to the panel when we re-circulate for approval (dependant on the GC0138 decision)



(ii) Step injection sequence for voltage control tests



Field Code Changed

4.4.8 In the case of an Offshore Transmission System that does not provide voltage control down to zero Active Power a test to demonstrate the smooth transition from voltage control mode to unity Power Factor shall be carried out. The Offshore Transmission System voltage setpoint should be altered to produce lagging Reactive Power or absorbing leading Reactive Power at a low Active Power level where voltage control is provided. The Power Park Module Active Power should then be reduced to zero Active Power as a ramp over a short period (60 seconds is suggested).

4.5 Tests For Damping Facilities on Transmission DC Connections

Description of Tests:

- 4.5.1 Where the Offshore Transmission System employs a Transmission DC Converter and the Offshore TO Construction Agreement and/or the Services Capability Specification requires the OFTO to provide sub-synchronous resonance damping control facilities the requirements for testing these facilities will be determined by NGESO prior to or as part of Commissioning Panel Stage 1 work under STCP19-4.

Test Assessment:

- 4.5.2 The test results will be assessed by NGESO against STC Section K and the Offshore TO Construction Agreement and/or the Services Capability Specification.

4.6 Tests For Frequency Capability and Signals

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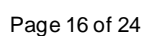
Description of Tests:

- 4.6.1 Where the Offshore Transmission System employs a Transmission DC Converter the OFTO is required to provide frequency capability and signals to the offshore AC system and offshore Generator. Requirements for testing these facilities will be determined by NGESO prior to or as part of Commissioning Panel Stage 1 work under STCP19-4.

Test Assessment:

- 4.6.2 The test results will be assessed by NGESO against STC Section K and the Offshore TO Construction Agreement and/or the Services Capability Specification.

Note that the Process Diagrams shown in this Appendix A are for information only. In the event of any contradiction between the process represented in this Appendix and the process described elsewhere in this STCP, then the text elsewhere in this STCP shall prevail.



Appendix B: Register of Responsibilities on Parties

B.1 Responsibilities on NGESO

- Assess whether the OFTO complies with any site specific technical conditions as set out in STC Section K and the Services Capability Specification and the Offshore TO Construction Agreement.
- Review any Compliance issues.
- Ensures that test procedures for Compliance Testing have been reviewed and that their suitability has been notified to the OFTO.
- Witness Compliance Testing as necessary.
- Notifies OFTO on whether simulations and test results demonstrate Compliance.

B.2 Responsibilities on OFTO

- Provide mathematical models in the form of Laplace Transforms to represent the automatic control of any reactive plant and apparatus used to comply with STC Section K dynamic voltage control requirements.
- Provide simulations to demonstrate Compliance
- Provides facilities for the connection of NGESO recording equipment for the purposes of witnessing Compliance Testing.
- Provide test procedures for Compliance Testing prior to ION
- Undertakes Compliance Testing as required by this procedure to demonstrate Compliance of the Offshore Transmission System
- Facilitates compliance testing on any Offshore Power Park Module using the Offshore Transmission System
- Notifies NGESO of any non-compliance with STC Section K and the Services Capability Specification and the Offshore TO Construction Agreement

B3: EXAMPLE OF INTERIM SECTION K NOTIFICATION DOCUMENT

Our Ref: []

Date: []

**Customer
Agreements**

**National Grid Electricity
System Operator Ltd**
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

Tel No: 01926-65####
Fax No: 01926-656605
Mobile: #####
Jo.bloggs@uk.ngrid.com

[power station] - Interim Section K Notification

Dear XXXXXX,

National Grid Electricity System Operator Ltd ("The Company") and [party]
are parties to a [????] (the "Offshore TO Construction Agreement") dated []
providing for commissioning into the NETS at [Interface Point]

You have notified The Company of your intention to energise the [] Offshore
Transmission System on or after [day, date]. Under the STC The Company is
required to notify you that the provisions of the STC Section K have been complied with (if that
is the case) and that [] at the [Interface Point] can therefore be energised and
commissioned.

There are a number of matters which are unresolved at present which must be resolved before
The Company can issue a Final Section K Notification ("FSKN") in respect of [] Offshore
Transmission System. The current situation is summarised in the attached Schedule of
Unresolved Compliance Issues. The unresolved matters do not however prevent The
Company from issuing an Interim Section K Notification (ISKN).

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The Company therefore confirms the issue of an ISKN effective from [date] to [date] (the "Term") subject to the condition that significant progress be made towards the resolution of the unresolved issues within the timescales listed in the schedule during the Term. On completion of the Term The Company will decide whether to issue a further ISKN for a fixed period or an FSKN.

This ISKN is issued without prejudice to the exercise of any rights The Company may have under the STC, the Offshore TO Construction Agreement and Bilateral Agreement, including without limitation the Disconnection and/or De Energisation of the OFTO Equipment.

Terms defined in the STC, CUSC, the Offshore TO Construction Agreement, the Bilateral Agreement and the Grid Code have the same meaning in this letter.

Should you require any further information regarding this matter or the attached schedule please contact [], telephone 01926-[].

Company Secretary & General Counsel

cc [] Network Design, NGESO
[] Compliance & Data, NGESO
[] Operations & Trading, NGESO
[] Engineering Services, NGESO
[[] [Customer and Performance Director and [Named Contact], SPT/ TBA, SHETL] [host onshore TO]]
[[] [Customer and Performance Director and [Named Contact], SPT/ TBA, SHETL] [Affected onshore TO]]

[] Interface Point

**Schedule of Unresolved Compliance Issues in respect of [offshore
Transmission System]**

as at [date]

Item	STC Section K Ref	Issue – Brief Description	Programme to Resolve Including Expected End Date	Contact NGESO/OFTO
1				
2				
3				
4				
5				

B4: EXAMPLE OF FINAL SECTION K NOTIFICATION

Date: []

Our Ref: []

Your Ref:

Customer Agreements

For the Attention of []

Company Secretary

[]

[]

[]

[]

[]

National Grid Electricity
System Operator Ltd

National Grid House

Warwick Technology Park

Gallows Hill

Warwick

CV34 6DA

Tel No: 01926-65####

Fax No: 01926-656605

Mobile: #####

Jo.bloggs@uk.ngrid.com

Dear XXXXXX

**[] Offshore Transmission System
- Final Section K Notification**

National Grid Electricity System Operator Ltd ("The Company") and [party
] are parties to a [Agreement] providing for extension of the National Electricity
Transmission System ("NETS") at [Interface Point] as .

On [date] The Company issued an Interim Section K Notification ("ISKN") in respect
of [] Offshore Transmission System which has
subsequently been extended to remain in force until [date] (the "Term"). The
unresolved issues associated with the ISKN were set out in the 'Schedule of Unresolved
Compliance Issues' attached to the letter dated []. The ISKN was issued
subject to the condition that significant progress be made towards the resolution of the
unresolved issues and on completion of the Term The Company would decide whether
to issue a further ISKN for a fixed period or a Final Section K Notification ("FSKN").

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The Company is pleased to confirm that these issues have now progressed to the point where an FSKN for [] Offshore Transmission System can be issued with effect from [].

Terms defined in the STC, CUSC, Bilateral Agreement, Offshore TO Construction Agreement and Grid Code have the same meaning in this letter.

I should like to take this opportunity to wish every success to your Offshore Transmission System in its future operation.

Should you require any further information regarding this matter please contact [Connection Agreement Manager] on 01926-65####.

Yours faithfully

General Counsel & Company Secretary

cc	[CAM]	Customer Agreements, NGESO
	[]	Network Design, NGESO
	[]	Compliance & Data, NGESO
	[]	Operations & Trading, NGESO
	[]	Engineering Services, NGESO
	[]	New Connection Agreements, NGESO
	[[]	[Customer and Performance Director and [Named Contact], SPT/ TBA, SHETL] [host onshore TO]]
	[[]	[Customer and Performance Director and [Named Contact], SPT/ TBA, SHETL] [Affected onshore TO]]

Appendix C: Abbreviations & Definitions

Abbreviations

CUSC	Connection and Use of System Code
DNO	Distribution System Operator
FCCCR	Final Connection Conditions Compliance Report
SHET	Scottish Hydro Electric Transmission plc
SPT	SP Transmission plc
SOC	Statement of Completeness
SOR	Statement of Readiness
STC	System Operator Transmission Owner Code
TO	Transmission Owner

Definitions

STC definitions used:

Apparatus
Connection
Generator
Interface Point Capacity
National Electricity Transmission System
NGESO
NGET
Offshore TO Construction Agreement
Offshore Transmission Owner
Onshore TO Construction Agreement
Onshore Transmission Owner
Plant
Service Capability Specification
Service Restoration Proposal
Transmission Interface Site Specification

CUSC definitions used:

Bilateral Connection Agreement
Operational Notification
Services Capability Specification

Grid Code definitions used:

Offshore Transmission System
Onshore Transmission System

Definition used from other STCPs:

Schedule of Unresolved Compliance Issues	As defined in STCP 19-3: Operational Notification & Compliance Testing
Statement of Completeness	As defined in STCP 19-3: Operational Notification & Compliance Testing
Distribution System Operator (DNO)	As defined in STCP 19-3: Operational Notification & Compliance Testing
Affected Transmission Owner	As defined in STCP 18-1: Connection and Modification Application
Host Transmission Owner	As defined in STCP 18-1: Connection and Modification Application
Stage 1 Commissioning Panel	As required under STCP 19-4: Commissioning and Decommissioning STCP 16-1: Investment Planning

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