

STCP22-1 Issue 004

Production of Models for GB System Planning

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	30/09/2005	Issue 001 following BETTA Go-Live
Issue 002	14/02/2012	Issue 002 Incorporating OFTOs
Issue 003	23/03/2017	Issue 003 incorporating changes from SYS to GB Models
Issue 004	01/04/2019	Issue 004 incorporating National Grid Legal Separation changes

1 Introduction

1.1 Scope

- 1.1.1 This procedure shows the information flows required between Parties to produce GB Models for the various processes that require system studies to be undertaken. These processes include those in STCP 16-1: Investment Planning, STCP 20-1: Electricity

Ten Year Statement, STCP 18-1: Connection and Modification Applications and STCP 18-2: Use of System Application.

1.1.2 This procedure applies to NGENSO and to each TO. For the purposes of this document, TOs are:

- National Grid Electricity Transmission plc
- SP Transmission plc;
- Scottish Hydro Electric Transmission plc;
- All OFTOs;

1.2 Objectives

1.2.1 The objectives of this STCP are to detail how GB Models are produced and agreed; and to address how the information is managed across the interface between NGENSO and the TOs to ensure consistency of the GB Models.

2 Key Definitions

2.1 For the purposes of STCP 22-1 Production of Models for GB System Planning:

2.1.1 **Confirmed Network Reinforcement** means a scheme that has been identified by the relevant Party as having a high probability of being delivered.

2.1.2 **Contracted Generation** means a Generator that has connected to the GB Transmission System or accepted an offer for connection to or modification or use of system offer from NGENSO.

2.1.3 **Master Lookup Table** means a table created to facilitate the conversion of data between different formats. Any extract from this table shall be referred to as a Data Lookup Table.

2.1.4 **Investment Planning** means the process to produce the Transmission Investment Plan.

2.1.5 **GB Model** means a representation of the GB Transmission System including a representation of the appropriate Future Energy Scenarios (FES) data (generation, demand and interconnectors).

2.1.6 **TO Model** means a representation of a TO Transmission System including a representation of appropriate Future Energy Scenarios (FES) data, although the specific values associated with generation output are not critical.

2.1.7 **Project Listings Document (PLD)** means a document detailing a set of planned changes to a TO Transmission System.

3 Procedure

3.1 Committees/Liaison Groups

3.1.1 The Joint Planning Committee (JPC) shall co-ordinate the production of the GB Models.

3.2 Determination of Boundary of Influence

3.2.1 The criteria to be used by the JPC for the assessment of the Boundary of Influence are specified in Appendix C. These criteria may require amendment from time to time to take into account revisions suggested by Parties during Investment Planning.

3.2.2 If the JPC agree that a revision to the Boundary of Influence may be required, then the process determined in the remainder of this section shall be followed.

3.2.3 The JPC shall first review the criteria in Appendix C. If the JPC agree that the criteria in Appendix C should be revised, they shall use reasonable endeavours to agree revised criteria. If the JPC agrees revised criteria, then

- NGENSO shall propose a formal amendment to this STCP in respect of Appendix C, and
- The agreed proposed criteria shall be used in the study process below.

If either the JPC agree not to revise the criteria, or no agreement is reached on revised criteria, the existing Appendix C criteria shall be used in the study process below.

3.2.4 Each TO shall submit to NGENSO, a proposed list of transmission sites for modelling the impact of additional generation. The choice of transmission sites shall reflect the geographic spread, the mix of relevant substation voltages within each company area, and take account of any transmission sites where there is a specific concern over current fault duties being close to Plant ratings.

3.2.5 NGENSO shall take the relevant change criteria, the sites proposed by the TOs and its own list of Generation sites, and undertake GB Transmission System analysis to determine the draft Boundary of Influence.

3.2.6 NGENSO shall produce the results of the draft Boundary of Influence in the form of a table and/or diagram, and circulate this to the TOs. The table and/or diagram will be such that all sites within the relevant TO's Transmission System experience a change less than that allowed by the above criteria when an additional Generator of an agreed size is connected outside of the Boundary of Influence.

3.2.7 If the TOs disagree with the draft Boundary of Influence, the JPC will use reasonable endeavours to agree actions to ascertain if a modification to the Boundary of Influence is required. Depending on the results of this analysis, NGENSO may then redraft the Boundary of Influence and re-issue to the TOs.

3.2.8 When all Parties agree, the JPC shall approve the Boundary of Influence. NGENSO shall propose any changes to Schedule 4 of the STC required as the result of the revised Boundary of Influence via the STC Change Procedure (STC Part B section 7.2).

3.3 Creation of GB Models

3.3.1 Before any models are created, the JPC shall agree on which Future Energy Scenarios to use for creating the models.

3.3.2 NGENSO shall provide to each TO a draft Ranking Order for the scenario to be studied explicitly listing all plant expected to be running at the time of study for each of the years

in the investment planning timeframe together with an associated GB demand forecast (both active and reactive demand), a forecast of demand and embedded generation for

each of the Transmission Interface Points with DNOs and Directly Connected Customers (both active and reactive demand), and an estimate of losses for each year.

- 3.3.3 Each TO shall submit any comments on the draft Ranking Orders or demand forecasts to NGENSO. If the Parties agree that changes are required to the draft Ranking Orders or demand forecasts following comments by the TOs, these shall be incorporated into the Ranking Orders or demand forecasts, which NGENSO, shall re-issue to each TO for comment with the aim of reaching agreement on the Ranking Orders or demand forecasts.
- 3.3.4 The TOs shall take the Future Energy Scenario data (which includes demand, generation background and interconnector output) and use them to populate TO Models of their own Transmission System. The TOs shall include all Confirmed Network Reinforcements at this stage. The TOs shall ensure that they have submitted PLDs to NGENSO in respect of the Confirmed Network Reinforcements. All Parties shall ensure that they have exchanged PLDs with each other Party for Confirmed Network Reinforcements within the Boundary of Influence.
- 3.3.5 The TOs shall submit their TO Models to NGENSO for all the years and scenarios under study as agreed by the JPC.
- 3.3.6 Each TO shall ensure that all TO Model entries and PLDs are supported by entries in the Master Lookup Table to allow for conversion between model formats. The process to update the data in the Master Lookup Table is described in section 3.5.
- 3.3.7 On receipt of the TO Models from each TO, NGENSO shall analyse the models to examine year on year changes. NGENSO shall cross-reference the network configuration changes to the PLDs and the generation changes to the FES generation background. Comments on any changes to TO Models that do not cross-reference to PLDs or FES generation background as appropriate shall be fed back to the appropriate TO as soon as reasonably practicable. The TOs will then have the opportunity to issue new PLDs or to revise and resubmit the TO Models to NGENSO, with a view to reaching a consistent submission. Relevant Parties may agree to an additional iteration as necessary.
- 3.3.8 NGENSO shall perform data verification to ensure correct TO Model conversion and that the network configuration is maintained and that the parameters for all lines, transformers, reactors, etc. are properly converted. The JPC Modelling Group shall keep track of any issues and resolutions that may arise during the data conversion process.
- 3.3.9 NGENSO shall then create GB Models from the TO Models, from NGENSO's own Transmission System model, and through applying the Future Energy Scenarios data. The models shall contain generation capacity balanced to meet the appropriate FES demand plus computed losses (load flow) using the applicable NETS SQSS criteria (Economy or Security) as required for the scenarios under study as agreed by the JPC.
- 3.3.10 NGENSO, shall run the GB Models to find out if the cases are convergent. If convergence is not achieved, the Parties will meet to agree additions to the Models to help achieve convergence. This may include the addition of proposed Transmission System changes, supported by PLDs, which, although not yet Confirmed Network Reinforcements are known to be required to address particular problems in the models.
- 3.3.11 To facilitate conversion from Digsilent PowerFactory to PSSE, NGENSO shall ensure that all terminals and busbars in England and Wales have unique identifiers (Serial Numbers). A spreadsheet containing these terminals and busbars together with their respective unique identifiers shall form part of the release notes.

- 3.3.12 The JCP Modelling Group shall agree on the format and the contents of all model release notes before exchanging models. These release notes will include information to assist in model validation. This may include scenario data within the model and power flows across agreed boundaries among other things.
- 3.3.13 NGENSO shall issue the convergent GB Models to the TOs. NGENSO shall ensure that all model entries and PLDs are supported by entries in the Master Lookup Table to allow for conversion between model formats.
- 3.3.14 The Parties will exchange models in the formats specified in Appendix B
- 3.3.15 The Parties shall undertake consistency checking in accordance with the process set out in section 3.6.

3.4 Provision of Construction Planning Assumptions

- 3.4.1 Following a Construction Application, NGENSO may provide each Affected Party with a set of Construction Planning Assumptions. This will include a Contracted Generation Ranking Order containing all connected generation or generation with signed Connection Offers at the time the new application is received. If the Construction Application is for a generation connection, the new generator will be included in the Ranking Order at an appropriate position.
- 3.4.2 NGENSO shall also provide each Affected Party with a list of changes (new connections and infrastructure) that would bring the latest GB ETYS Model into line with the Construction Planning Assumptions.
- 3.4.3 On receipt of the models, each TO shall undertake consistency checking in accordance with the process set out in 3.6.

3.5 Process for updating the Master Lookup Table

- 3.5.1 In order to facilitate data exchange between the different Parties' modelling systems, a process has been developed to translate elements between TO PSSE data and the specific format and hierarchy used by NGENSO in Power Factory using Data Lookup Tables. Some of the information that differs between the TOs and NGENSO includes the conventions for site names, circuit identifiers, transformer node names and generation identifiers.
- 3.5.2 In order for the data exchange process to function correctly, the Master Lookup Table shall be maintained by NGENSO, with complete sets of current information covering the GB Transmission System. An updated Master Lookup Table should be issued with each annual/ quarterly submission of ETYS / Investment Planning data.
- 3.5.3 Whenever equipment used in planning GB Models or TO Models are added, changed or deleted, the details held within the Master Lookup Table shall be updated as part of the initial process. All changes shall be reported to NGENSO using the forms in Appendix A. NGENSO shall acknowledge receipt and update the Master Lookup Table.
- 3.5.4 Each TO shall submit any new site location code entries for the Master Lookup Table to NGENSO, to ensure the names or identifier do not conflict with existing values. If a possible conflict is identified the proposed value must be changed to remove the conflict. The forms for submitting changes are included in Appendix A.
- 3.5.5 If NGENSO agrees with the proposed new site location code, NGENSO shall acknowledge receipt of the form, confirming that it has no objections and the changes can be included in the TO and GB Models.

- 3.5.6 If NGENSO does not agree with the new site location code, NGENSO shall respond to the TO with suggestions for an alternative form. If the TO is willing to conform to these suggestions, that TO shall re-submit the changes form, NGENSO shall acknowledge receipt and agree the changes.
- 3.5.7 If any of the Parties cannot agree on the proposed new site location codes, then the dispute resolution process will be invoked.

3.6 Consistency checking process

- 3.6.1 The JPC modelling group shall agree a set of comparisons that can be used to perform consistency checks on the GB Models. The consistency checks agreed may vary depending upon the models being studied and the timescales involved.
- 3.6.2 Parties shall each study the agreed set of comparisons and report the results for comparison. Any differences that fall outside agreed tolerances would be noted.
- 3.6.3 If the GB Models are consistent, then these are approved by all Parties for use in further planning processes such as developing the GB Investment Plan, or the GB ETYS.
- 3.6.4 If there are not consistent results from the GB Models, Parties shall investigate the inconsistency, co-ordinated by the JPC modelling group.
- 3.6.5 Where inconsistencies are found as a result of erroneous GB Model data, the correct data will be agreed and the GB Models will be updated.
- 3.6.6 Where inconsistencies are found but cannot be resolved, the issue will be discussed by the JPC and a treatment will be agreed between all Parties. This may include a relaxation of the consistency tolerances previously agreed or an agreement that further sensitivity studies are performed by all Parties as their Project Listings are formulated.

3.7 Information and Data Exchange Specification

- 3.7.1 All information and data shall be exchanged in accordance with SCHEDULE 3(Information and Data Exchange Specification) of The STC
- 3.7.2 Grid Code standard and detailed planning data shall, as specified in the Grid Code, be provided to each TO as soon as it becomes available following each update.
- 3.7.3 Connection and modification data shall be provided in accordance with STCP18-1.

Appendix A: Standard Forms

Request for addition / deletion / change to Location Code Lookup table

Field	Value	Description
Owner		Owning company short name
Full Location Name		Full long name
PSS/e Extended Name		PSS/e name
SLC Name		Site Location Code 4-6 letters
Voltage		kV (400, 275, 132, etc.)
GBSO Modelling Zone		
GBSO Generation UoS Zone		Generation Tariff Zone
GBSO Demand UoS Zone		Demand Tariff Zone
BOI Zone		Boundary of Influence Zone
Site Type		Transmission, Connection or Generation
Status		Existing, Planning, Commissioning, Review
Remarks		Additional information
Addition/deletion/change		
Submitted By		
Submitted On		
Applicable From		
Grid Reference		e.g. (033870 073040)

Shaded cells to be supplied by TO.

Request for addition / deletion / change to Circuits Lookup Table

Field	Value	Description
Owner		Owning company short name
PSS/e From		
PSS/e To		
PSS/e Circuit Number		
Type		i.e. OHL, Cable or Composite
GBSO From		
GBSO To		
GBSO Parallel circuit identifier		
GBSO Circuit Reference		
Addition/deletion/change		
Submitted By		
Submitted On		
Applicable From		
Applicable To		May be left blank

Shaded cells to be supplied by TO.

Request for addition / deletion / change to Reactive Compensation Lookup Table

Field	Value	Description
Owner		Owning company short name
PSS/e From		
PSS/e To		May be left blank
PSS/e Identifier		
GBSO From		
GBSO To		May be left blank
GBSO Reference		
GBSO Unit Number		
MVAr Generation		Provide information on range and fixed steps as appropriate
MVAr Absorption		
Compensation Type		
Connection Voltage		
Addition/deletion/change		
Submitted By		
Submitted On		
Applicable From		
Applicable To		May be left blank

Shaded cells to be supplied by TO.

Request for addition / deletion / change to Transformers Lookup Table

Field	Value	Description
Owner		Owning company short name
PSS/e Node 1		
PSS/e Node 2		
PSS/e Node 3		May be left blank
PSS/e Circuit Number		
GBSO HV Node		
GBSO LV Node		
GBSO Tertiary Node		
GBSO SGT Number		
GBSO Circuit Reference		
Addition/deletion/change		
Submitted By		
Submitted On		
Applicable From		
Applicable To		May be left blank

Shaded cells to be supplied by TO.

Request for addition / deletion / change to Generation Lookup Table

Field	Value	Description
Owner		Owning company short name
Power Station Name		Full long name
Unit Number		
Generator Unique ID (BMU_ID)		
Plant Type		Steam, CCGT etc.
GBSO SLC Name		Site location 6 Letter Code
GBSO Connection Site		6 Letter GBSO code
GBSO Generator Transformer Code		
PSS/e Extended Name		
PSS/e Generator ID		
Voltage		Terminal voltage kV
Q _{min}		Minimum reactive output MVA _r
Q _{max}		Maximum reactive output MVA _r
MVA Rating		Machine rating MVA
Addition/deletion/change		
Excitation GBSO Reference		
Excitation Scottish Reference		
Governor GBSO Reference		
Governor Scottish Reference		
Submitted By		
Submitted On		
Applicable From		
Applicable To		May be left blank

Shaded cells to be supplied by TO.

Appendix B: File Formats for Exchange Models

Digsilent PowerFactory and PSSE are off line modelling tools for power system analysis.

C.1 NGESO Models

NGESO, acting as SO, will send GB Models to all TOs and the OFTOs in one of the following formats as agreed in advance:

- Digsilent PowerFactory .pfd
- PSSE .raw, .seq and .dyr
- Other format as agreed in advance with TOs and OFTOs.

C2 TOs and OFTO Models

TOs and OFTOs shall send TO Models to NGESO, acting as SO, in one of the following formats as agreed in advance:

- Digsilent PowerFactory .pfd
- PSSE .raw and .seq
- Other format as agreed in advance with NGESO acting as SO.

Appendix C: Criteria to determine Boundary of Influence

- With a view of assessing any requirements to change the Boundary of Influence, the JPC will determine the year and planning background to be studied. The JPC shall determine the year and planning background based on the JPC's opinion that the selected year and planning background are likely to have the most widespread influence.
- The JPC shall determine specified nodes to both (a) add additional generation and (b) test the effect of additional generation in accordance with section 3.2. An additional generator shall be added to each specified node in turn and the changes at the other specified nodes will be recorded. The size of each generator will be proportional to the transmission voltage to which it is connecting; a 1320 MW generator at 400 kV, 900 MW at 275 kV and 450 MW at 132 kV.
- At the specified nodes, the difference between the existing fault levels and the switchgear rating shall be measured. At the specified nodes the increase in fault level will be measured after the addition of a new generator at each of the other specified nodes. Where the new generator increases system fault levels by more than 50% of the difference at any of the other specified nodes, the site of the new generator shall be considered to be inside the Boundary of Influence.
- The thermal capacity of the interconnecting circuits profoundly affect the thermal capacity of neighbouring TOs' Transmission Systems, and the capacity of key internal boundaries. Hence all nodes in the SHETL area shall either be deemed to be within the SHETL Boundary of Influence to SPT, or shall be recognised that a Construction Application at these nodes would otherwise materially affect SPT's Transmission System and that NGENSO should therefore send SPT relevant parts of Construction Planning Assumptions under Section D Part Two, paragraph 3.2 of the STC. Outages of some boundary circuits and near-boundary circuits, typically including Outages on those circuits to the south of the boundary, will be modelled to measure the impact of new generators at the specified nodes to the south of a TO-TO boundary. Changes in thermal loading will be apparent on each interconnecting circuit. Changes of less than 5% in MW flows on the interconnecting circuits will not be regarded as having a significant impact. Otherwise the site of the generator shall be considered to be within the Boundary of Influence.
- Voltage impacts tend to be local, and are thus likely to fall within any Boundary of Influence defined by the above two more significant parameters of Thermal Capacity and fault levels. To confirm this, voltage will be measured during the initial studies to assess fault level and thermal impact.
- The additional generators will be set to maximum MVar export at each of the specified nodes. The changes in Transmission System voltage will be recorded at the other specified nodes. Subject to agreement by the Parties, and assuming that the voltage effects are more localised than thermal or fault level effects as expected, the voltage assessment will then NOT form part of the enduring process to determine the Boundary of Influence.
- The JPC may agree a different set of specified nodes at which generators of the sizes specified above may be placed in turn. These additional generators may be either synchronous or non-synchronous.
- The TOs will agree that the impact of stability on agreed specified generating units within the TOs' Transmission Areas will be measured. The impact of stability shall be measured by considering the decrement of transfer capability between the SHETL and SPT Transmission Areas, and between the SPT and NGET Transmission Areas as a result of stability considerations. A decrement of capability of less than 5% of the boundary value will not be considered as having a significant impact.

Appendix D: Abbreviations and Definitions

Abbreviations

TO	Transmission Owner
SO	System Operator
SHE Transmission	Scottish Hydro-Electric Transmission Ltd.
SP	Scottish Power Transmission Ltd
GB SQSS	GB Security and Quality of Supply Standards
ETYS	Electricity Ten Year Statement
OFTO	Offshore Transmission Owner

Definitions

STC definitions used:

Transmission System
Construction Planning Assumptions
GB Transmission System
NGESO
NGET
Electricity Ten Year Statement
Electricity Ten Year Statement
Transmission Owner
Transmission Investment Plan

CUSC definitions used:

Connection Offer

Definition used from other STCPs:

Joint Planning Committee (JPC) - STCP 16-1
Investment Planning Study Guidelines – STCP 16-1
ETYS Study Guidelines – STCP 20-1