# **BALANCING CODE NO. 3**

(BC3)

# **FREQUENCY CONTROL PROCESS**

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# BC3.1 <u>INTRODUCTION</u>

BC3 sets out the procedure for NGET to use in relation to EU Code Users and GB Code Users to undertake System Frequency control. System Frequency will be controlled by response from Gensets (and DC Converters at DC Converter Stations and HVDC Systems) operating in Limited Frequency Sensitive Mode or Frequency Sensitive Mode, by the issuing of instructions to Gensets (and DC Converters at DC Converter Stations and HVDC Systems) and by control of Demand. The requirements for Frequency control are determined by the consequences and effectiveness of the Balancing Mechanism, and accordingly, BC3 is complementary to BC1 and BC2.

# BC3.1.2 Inter-Relationship With Ancillary Services

The provision of response (other than by operation in Limited Frequency Sensitive Mode or in accordance with BC3.7.1(c)) in order to contribute towards Frequency control, as described in BC3, by Generators or DC Converter Station owners or HVDC System Owners will be an Ancillary Service. Ancillary Services are divided into three categories, System Ancillary Services Parts 1 and 2 and Commercial Ancillary Services. System Ancillary Services, Parts 1 and 2, are those Ancillary Services listed in CC.8.1 (as applicable to GB Code Users) or ECC8.1 (as applicable to EU Code Users); those in Part 1 of CC.8.1 or Part 1 of ECC.8.1 are those for which the Connection Conditions or European Connection Conditions (as applicable) require the capability as a condition of connection and those in Part 2 are those which may be agreed to be provided by Users and which can only be utilised by NGET if so agreed. Commercial Ancillary Services like those System Ancillary Services set out in Part 2 of CC.8.1 (as applicable to GB Code Users) or Part 2 of ECC.8.1 (as applicable to EU Code Users), may be agreed to be provided by Users and which can only be utilised by NGET if so agreed.

- BC3.1.3 The provision of Frequency control services, if any, from an External System via a DC Converter Station or HVDC System will be provided for in the Ancillary Services Agreement and/or Bilateral Agreement with the DC Converter Station owner or HVDC System Owner and/or any other relevant agreements with the relevant EISO.
- BC3.1.4 The provision of Frequency control services, if any, from an Offshore Power Station connected to an Offshore Transmission System that includes a Transmission DC Converter will be facilitated (where necessary) through appropriate data signals provided to the Offshore Power Station by the Relevant Transmission Licensee in accordance with the STC.

# BC3.2 OBJECTIVE

The procedure for **NGET** to direct **System Frequency** control is intended to enable (as far as possible) **NGET** to meet the statutory requirements of **System Frequency** control.

# BC3.3 SCOPE

BC3 applies to NGET and to GB Code Users and EU Code Users, which in this BC3 means:

- (a) GB Generators with regard to their Large Power Stations (except those Large Power Stations with a Registered Capacity less than 50MW comprising of Power Park Modules),
- (b) EU Generators with regard to their Large Power Stations
- (c) Network Operators,
- (d) DC Converter Station owners and HVDC System Owners,
- (e) other providers of Ancillary Services, and
- (f) Externally Interconnected System Operators.

## BC3.4 MANAGING SYSTEM FREQUENCY

# BC3.4.1 <u>Statutory Requirements</u>

When NGET determines it is necessary (by having monitored the System Frequency), it will, as part of the procedure set out in BC2, issue instructions (including instructions for Commercial Ancillary Services) in order to seek to regulate System Frequency to meet the statutory requirements of Frequency control. Gensets (except those owned and/or operated by GB Generators comprising of a Power Park Module in a Power Station with a Registered Capacity less than 50MW and those owned and/or operated by GB Generators comprising of a Power Park Module in Scotland with a Completion Date before 1 July 2004) and DC Converters at DC Converter Stations or HVDC Systems when transferring Active Power to the Total System, operating in Frequency Sensitive Mode will be instructed by NGET to operate taking due account of the Target Frequency notified by NGET.

## BC3.4.2 Target Frequency

NGET will give 15 minutes notice of variation in Target Frequency.

#### BC3.4.3 Electric Time

**NGET** will endeavour (in so far as it is able) to control electric clock time to within plus or minus 10 seconds by specifying changes to **Target Frequency**, by accepting bids and offers in the **Balancing Mechanism**. Errors greater than plus or minus 10 seconds may be temporarily accepted at **NGET's** reasonable discretion.

# BC3.5 RESPONSE FROM GENSETS (AND DC CONVERTERS AT DC CONVERTER STATIONS AND HVDC SYSTEMS WHEN TRANSFERRING ACTIVE POWER TO THE TOTAL SYSTEM)

# BC3.5.1 Capability

Each Genset (except those owned and/or operated by GB Generators and comprising of Power Park Modules in a Power Station with a Registered Capacity less than 50MW and those owned and/or operated by GB Generators and comprising of Power Park Modules in Scotland with a Completion Date before 1 July 2004) and each DC Converter at a DC Converter Station and HVDC System must at all times have the capability to operate automatically so as to provide response to changes in Frequency in accordance with the requirements of CC.6.3.7 or ECC.6.3.7 (as applicable) in order to contribute to containing and correcting the System Frequency within the statutory requirements of Frequency control. For DC Converters at DC Converter Stations and HVDC Systems, BC3.1.3 also applies In addition each Genset (and each DC Converter at a DC Converter Station and HVDC System) must at all times have the capability to operate in a Limited Frequency Sensitive Mode.

# BC3.5.2 <u>Limited Frequency Sensitive Mode</u>

Each Synchronised Genset producing Active Power (and each DC Converter at a DC Converter Station and HVDC System) must operate at all times in a Limited Frequency Sensitive Mode (unless instructed in accordance with BC3.5.4 below to operate in Frequency Sensitive Mode). Operation in Limited Frequency Sensitive Mode must achieve the capability requirement described in CC.6.3.3 (in respect of GB Code Users) and ECC.6.3.3 (in respect of EU Code Users) and for System Frequencies up to 50.4Hz and shall be deemed not to be in contravention of CC.6.3.7 or ECC.6.3.7 (as applicable).

# BC3.5.3 (a) Existing Gas Cooled Reactor Plant

NGET will permit Existing Gas Cooled Reactor Plant other than Frequency Sensitive AGR Units to operate in Limited Frequency Sensitive Mode at all times.

(b) Power Park Modules belonging to GB Generators In Operation Before 1 January 2006

NGET will permit Power Park Modules which were in operation before 1 January 2006 and owned and/or operated by GB Generators to operate in Limited Frequency Sensitive Mode at all times. For the avoidance of doubt Power Park Modules owned and/or operated by GB Generators in England and Wales with a Completion Date on or after 1 January 2006 and Power Park Modules owned and/or operated by GB Generators in operation in Scotland after 1 January 2006 with a completion date after 1 July 2004 and in a Power Station with a Registered Capacity of 50MW or more will be required to operate in both Limited Frequency Sensitive Mode and Frequency Sensitive Mode of operation depending on System conditions. For the avoidance of doubt these requirements do not apply to EU Generators.

#### BC3.5.4 Frequency Sensitive Mode

- (a) NGET may issue an instruction to a Genset (or DC Converter at a DC Converter Station or HVDC System if agreed as described in BC3.1.3) to operate so as to provide Primary Response and/or Secondary Response and/or High Frequency Response (in the combinations agreed in the relevant Ancillary Services Agreement). When so instructed, the Genset or DC Converter at a DC Converter Station or HVDC System must operate in accordance with the instruction and will no longer be operating in Limited Frequency Sensitive Mode, but by being so instructed will be operating in Frequency Sensitive Mode.
- (b) Frequency Sensitive Mode is the generic description for a Genset (or DC Converter at a DC Converter Station or HVDC System) operating in accordance with an instruction to operate so as to provide Primary Response and/or Secondary Response and/or High Frequency Response (in the combinations agreed in the relevant Ancillary Services Agreement).
- (c) The magnitude of the response in each of those categories instructed will be in accordance with the relevant Ancillary Services Agreement with the Generator or DC Converter Station owner or HVDC System Owner.
- (d) Such instruction will continue until countermanded by **NGET** or until;
  - (i) the **Genset** is **De-Synchronised**; or
  - (ii) the **DC Converter** or **HVDC System** ceases to transfer **Active Power** to or from the **Total System** subject to the conditions of any relevant agreement relating to the operation of the **DC Converter Station** or **HVDC System**,

whichever is the first to occur.

- (e) NGET will not so instruct Generators in respect of Existing Gas Cooled Reactor Plant other than Frequency Sensitive AGR Units.
- (f) NGET will not so instruct GB Generators in respect of Power Park Modules:
  - (i) in Scotland in a **Power Station** with a **Completion Date** before 1 July 2004; or,
  - (ii) in a **Power Station** with a **Registered Capacity** of less than 50MW.
  - (iii) in England and Wales with a Completion Date before 1 January 2006.

# BC3.5.5 System Frequency Induced Change

A System Frequency induced change in the Active Power output of a Genset (or DC Converter at a DC Converter Station or HVDC System) which assists recovery to Target Frequency must not be countermanded by a Generator or DC Converter Station owner or HVDC System Owner except where it is done purely on safety grounds (relating to either personnel or plant) or, where necessary, to ensure the integrity of the Power Station or DC Converter Station or HVDC System.

#### BC3.6.1 Low Frequency Relay Initiated Response From Gensets And DC Converters At DC Converter Stations and HVDC Systems

- (a) NGET may utilise Gensets (and DC Converters at DC Converter Stations and HVDC Systems) with the capability of Low Frequency Relay initiated response as:
  - synchronisation and generation from standstill;
  - (ii) generation from zero generated output;
  - (iii) increase in generated output;
  - (iv) increase in DC Converter or HVDC System output to the Total System (if so agreed as described in BC3.1.3);
  - (v) decrease in DC Converter or HVDC System input from the Total System (if so agreed as described in BC3.1.3);

in establishing its requirements for Operating Reserve.

- NGET will specify within the range agreed with Generators and/or EISOs and/or (b) (i) DC Converter Station owners or HVDC System Owners (if so agreed as described in BC3.1.3), Low Frequency Relay settings to be applied to Gensets or DC Converters at DC Converter Stations or HVDC Systems pursuant to BC3.6.1 (a) and instruct the Low Frequency Relay initiated response placed in and out of service.
  - (ii) Generators and/or EISOs and/or DC Converter Station owners or HVDC System Owners (if so agreed as described in BC3.1.3) will comply with NGET instructions for Low Frequency Relay settings and Low Frequency Relay initiated response to be placed in or out of service. Generators or DC Converter Station owners or HVDC System Owners or EISOs may not alter such Low Frequency Relay settings or take Low Frequency Relay initiated response out of service without NGET's agreement (such agreement not to be unreasonably withheld or delayed), except for safety reasons.
- BC3.6.2 Low Frequency Relay Initiated Response From Demand And Other Demand Modification Arrangements (Which May Include A DC Converter Station or HVDC System When <u>Importing Active Power From The Total System</u>)
  - (a) NGET may, pursuant to an Ancillary Services Agreement, utilise Demand with the capability of Low Frequency Relay initiated Demand reduction in establishing its requirements for Frequency Control.
  - (b) (i) NGET will specify within the range agreed the Low Frequency Relay settings to be applied pursuant to BC3.6.2 (a), the amount of **Demand** reduction to be available and will instruct the Low Frequency Relay initiated response to be placed in or out of service.
    - (ii) Users will comply with NGET instructions for Low Frequency Relay settings and Low Frequency Relay initiated Demand reduction to be placed in or out of service. Users may not alter such Low Frequency Relay settings or take Low Frequency Relay initiated response out of service without NGET's agreement, except for safety reasons.
    - (iii) In the case of any such Demand which is Embedded, NGET will notify the relevant Network Operator of the location of the Demand, the amount of Demand reduction to be available, and the Low Frequency Relay settings.
  - (c) NGET may also utilise other Demand modification arrangements pursuant to an agreement for Ancillary Services, in order to contribute towards Operating Reserve.

- BC3.7 RESPONSE TO HIGH FREQUENCY REQUIRED FROM SYNCHRONISED GENSETS

  (AND DC CONVERTERS AT DC CONVERTER STATIONS AND HVDC SYSTEMS WHEN TRANSFERRING ACTIVE POWER TO THE TOTAL SYSTEM)
- BC3.7.1 Plant In Frequency Sensitive Mode Instructed To Provide High Frequency Response
  - (a) Each Synchronised Genset (or each DC Converter at a DC Converter Station or HVDC System) in respect of which the Generator or DC Converter Station owner or HVDC System Owner and/or EISO has been instructed to operate so as to provide High Frequency Response, which is producing Active Power and which is operating above the Designed Minimum Operating Level, is required to reduce Active Power output in response to an increase in System Frequency above the Target Frequency (or such other level of Frequency as may have been agreed in an Ancillary Services Agreement). The Target Frequency is normally 50.00 Hz except where modified as specified under BC3.4.2.
  - (b) (i) The rate of change of Active Power output with respect to Frequency up to 50.5 Hz shall be in accordance with the provisions of the relevant Ancillary Services Agreement with each Generator or DC Converter Station owner or HVDC System Owner. If more than one rate is provided for in the Ancillary Services Agreement NGET will instruct the rate when the instruction to operate to provide High Frequency Response is given.
    - (ii) The reduction in Active Power output by the amount provided for in the relevant Ancillary Services Agreement must be fully achieved within 10 seconds of the time of the Frequency increase and must be sustained at no lesser reduction thereafter.
    - (iii) It is accepted that the reduction in **Active Power** output may not be to below the **Designed Minimum Operating Level**.
  - (c) In addition to the High Frequency Response provided, the Genset (or DC Converter at a DC Converter Station or HVDC System) must continue to reduce Active Power output in response to an increase in System Frequency above 50.5 Hz at a minimum rate of 2 per cent of output per 0.1 Hz deviation of System Frequency above that level, such reduction to be achieved within five minutes of the rise to or above 50.5 Hz. For a Power Station with a Completion Date after 1st January 2009 this reduction in Active Power should be delivered in accordance with in (i) to (iv) below. For the avoidance of doubt, the provision of this reduction in Active Power output is not an Ancillary Service.
    - (i) The reduction in **Active Power** output must be continuously and linearly proportional as far as practical, to the excess of **Frequency** above 50.5 Hz and must be provided increasingly with time over the period specified in (iii) below.
    - (ii) As much as possible of the proportional reduction in **Active Power** output must result from the frequency control device (or speed governor) action and must be achieved within 10 seconds of the time of the **Frequency** increase above 50.5 Hz.
    - (iii) The residue of the proportional reduction in Active Power output which results from automatic action of the Genset (or DC Converter at a DC Converter Station or HVDC System) output control devices other than the frequency control devices (or speed governors) must be achieved within 3 minutes from the time of the Frequency increase above 50.5 Hz.
    - (iv) Any further residue of the proportional reduction which results from non-automatic action initiated by the **Generator** or **DC Converter Station** owner or **HVDC System Owner** shall be initiated within 2 minutes, and achieved within 5 minutes, of the time of the **Frequency** increase above 50.5 Hz.

# BC3.7.2 Plant In Limited Frequency Sensitive Mode

# BC.3.7.2.1 Plant in Limited Frequency Sensitive Mode applicable to GB Code Users

The following requirements are applicable to **GB Code Users** in respect of **Plant** operating in **Limited Frequency Sensitive Mode**. For the avoidance of doubt, these requirements do not apply to **EU Generators** and **HVDC System Owners** for whom the requirements of BC.3.7.2.2 apply.

- (a) Each Synchronised Genset (or DC Converter at a DC Converter Station) operating in a Limited Frequency Sensitive Mode which is producing Active Power is also required to reduce Active Power output in response to System Frequency when this rises above 50.4 Hz. In the case of DC Converters at DC Converter Stations, the provisions of BC3.7.7 are also applicable. For the avoidance of doubt, the provision of this reduction in Active Power output is not an Ancillary Service. Such provision is known as "Limited High Frequency Response".
- (b) (i) The rate of change of **Active Power** output must be at a minimum rate of 2 per cent of output per 0.1 Hz deviation of **System Frequency** above 50.4 Hz.
  - (ii) The reduction in **Active Power** output must be continuously and linearly proportional, as far as is practicable, to the excess of **Frequency** above 50.4 Hz and must be provided increasingly with time over the period specified in (iii) below.
  - (iii) As much as possible of the proportional reduction in **Active Power** output must result from the frequency control device (or speed governor) action and must be achieved within 10 seconds of the time of the **Frequency** increase above 50.4 Hz.
  - (iv) The residue of the proportional reduction in Active Power output which results from automatic action of the Genset (or DC Converter at a DC Converter Station) output control devices other than the frequency control devices (or speed governors) must be achieved within 3 minutes from the time of the Frequency increase above 50.4 Hz.
  - (v) Any further residue of the proportional reduction which results from non-automatic action initiated by the **Generator** or **DC Converter Station** owner shall be initiated within 2 minutes, and achieved within 5 minutes, of the time of the **Frequency** increase above 50.4 Hz.
- (c) Each GB Code User in respect of a Genset (or DC Converter at a DC Converter Station) which is providing Limited High Frequency Response in accordance with this BC3.7.2 must continue to provide it until the Frequency has returned to or below 50.4 Hz or until otherwise instructed by NGET.
- BC.3.7.2.2 Plant in Limited Frequency Sensitive Mode applicable to EU Code Users

**EU Code Users** in respect of **Gensets** and **HVDC Systems** are required to operate in **Limited Frequency Sensitive Mode** at all times unless instructed by **NGET** to operate in **Frequency Senstive Mode**. Where **EU Code Users Gensets** and **HVDC Systems** are required to operate in **Limited Frequency Senstive Mode** then the requirements of ECC.6.3.7.1 and ECC.6.3.7.2 shall apply. For the avoidance of doubt, the requirements defined in BC.3.7.2.1 do not apply to **New Generators** and **HVDC System Owners**.

# BC3.7.3 Plant Operation To Below Minimum Generation or Minimum Stable Operating Level

- (a) As stated in CC.A.3.2 and ECC.A.3.2, steady state operation below Minimum Generation or the Minimum Stable Operating Level or the Minimum Active Power Transmission Capacity is not expected but if System operating conditions cause operation below the Minimum Generation or Minimum Stable Operating Level or the Minimum Active Power Transmission Capacity which gives rise to operational difficulties for the Genset (or DC Converter at a DC Converter Station or HVDC System) then NGET should not, upon request, unreasonably withhold issuing a Bid-Offer Acceptance to return the Power Generating Module and/or Generating Unit and/or CCGT Module and/or Power Park Module or DC Converter or HVDC System to an output not less than the Minimum Generation or the Minimum Stable Operating Level or the Minimum Active Power Transmission Capacity. In the case of a DC Converter or HVDC System not participating in the Balancing Mechanism, then NGET will, upon request, attempt to return the DC Converter or HVDC System to an output not less than Minimum Generation or Minimum Stable Operating Level or the Minimum Active Power Transmission Capacity or to zero transfer or to reverse the transfer of Active Power.
- (b) It is possible that a Synchronised Genset (or a DC Converter at a DC Converter Station or HVDC System) which responded as required under BC3.7.1 or BC3.7.2 to an excess of System Frequency, as therein described, will (if the output reduction is large or if the Genset (or a DC Converter at a DC Converter Station or HVDC System) output has reduced to below the Designed Minimum Operating Level or Minimum Regulating Level or the Minimum Active Power Transmission Capacity trip after a time.
- (c) All reasonable efforts should in the event be made by the Generator or DC Converter Station owner or HVDC System Owner to avoid such tripping, provided that the System Frequency is below 52Hz.
- (d) If the System Frequency is at or above 52Hz, the requirement to make all reasonable efforts to avoid tripping does not apply and the Generator or DC Converter Station owner or HVDC System Owner is required to take action to protect the Power Generating Modules and/or Generating Units and/or Power Park Modules or DC Converters or HVDC Systems as specified in CC.6.3.13 or ECC.6.3.13.1.
- (e) In the event of the System Frequency becoming stable above 50.5Hz, after all Genset and DC Converter and HVDC System action as specified in BC3.7.1 and BC3.7.2 has taken place, NGET will issue appropriate Bid-Offer Acceptances and/or Ancillary Service instructions, which may include Emergency Instructions under BC2 to trip Gensets (or, in the case of DC Converters at DC Converter Stations or HVDC Systems, to stop or reverse the transfer of Active Power) so that the Frequency returns to below 50.5Hz and ultimately to Target Frequency.
- (f) If the System Frequency has become stable above 52 Hz, after all Genset and DC Converter or HVDC System action as specified in BC3.7.1 and BC3.7.2 has taken place, NGET will issue Emergency Instructions under BC2 to trip appropriate Gensets (or in the case of DC Converters at DC Converter Stations or HVDC Systems to stop or reverse the transfer of Active Power) to bring the System Frequency to below 52Hz and follow this with appropriate Bid-Offer Acceptances or Ancillary Service instructions or further Emergency Instructions under BC2 to return the System Frequency to below 50.5 Hz and ultimately to Target Frequency.
- BC3.7.4 The **Generator** or **DC Converter Station** owner or **HVDC System Owner** will not be in breach of any of the provisions of BC2 by following the provisions of BC3.7.1, BC3.7.2 or BC3.7.3.

# BC3.7.5 <u>Information Update To NGET</u>

In order that **NGET** can deal with the emergency conditions effectively, it needs as much up to date information as possible and accordingly **NGET** must be informed of the action taken in accordance with BC3.7.1(c) and BC3.7.2 as soon as possible and in any event within 7 minutes of the rise in **System Frequency**, directly by telephone from the **Control Point** for the **Power Station** or **DC Converter Station** or **HVDC System**.

# BC3.7.6 (a) Existing Gas Cooled Reactor Plant

For the avoidance of doubt, **Generating Units** within **Existing Gas Cooled Reactor Plant** are required to comply with the applicable provisions of this BC3.7 (which, for the avoidance of doubt, other than for **Frequency Sensitive AGR Units**, do not include BC3.7.1).

# (b) Power Park Modules In Operation Before 1 January 2006.

For the avoidance of doubt, **GB Generators** who own and/or operate **Power Park Modules** which are in operation before 1 January 2006 (irrespective of their **Completion Date**) are required to comply with the applicable provisions of this BC3.7 (which, for the avoidance of doubt do not include BC3.7.1).

# BC3.7.7 Externally Interconnected System Operators

NGET will use reasonable endeavours to ensure that, if System Frequency rises above 50.4Hz, and an Externally Interconnected System Operator (in its role as operator of the External System) is transferring power into the National Electricity Transmission System from its External System, the amount of power transferred in to the National Electricity Transmission System from the System of that Externally Interconnected System Operator is reduced at a rate equivalent to (or greater than) that which applies for Synchronised Gensets operating in Limited Frequency Sensitive Mode which are producing Active Power. This will be done either by utilising existing arrangements which are designed to achieve this, or by issuing Emergency Instructions under BC2.

< END OF BALANCING CODE 3 >