

# BALANCING CODE NO. 3

(BC3)

## FREQUENCY CONTROL PROCESS

### CONTENTS

(This contents page does not form part of the Grid Code)

<u>Paragraph No/Title</u>	<u>Page Number</u>
BC3.1 INTRODUCTION .....	2
BC3.2 OBJECTIVE.....	2
BC3.3 SCOPE .....	2
BC3.4 MANAGING SYSTEM FREQUENCY .....	3
BC3.4.1 Statutory Requirements .....	3
BC3.4.2 Target Frequency .....	3
BC3.4.3 Electric Time .....	3
BC3.5 RESPONSE FROM GENSETS.....	3
BC3.5.1 Capability .....	3
BC3.5.2 Limited Frequency Sensitive Mode .....	3
BC3.5.3 Existing Gas Cooled Reactor Plant /Power Park Modules before 1 January 2006.....	3
BC3.5.4 Frequency Sensitive Mode .....	4
BC3.5.5 System Frequency Induced Change .....	4
BC3.6 RESPONSE TO LOW FREQUENCY.....	5
BC3.6.1 Low Frequency Relay Initiated Response From Gensets .....	5
BC3.6.2 Low Frequency Relay Initiated Response From Demand .....	5
BC3.7 RESPONSE TO HIGH FREQUENCY REQUIRED FROM SYNCHRONISED. GENSETS .....	6
BC3.7.1 Plant In Frequency Sensitive Mode Instructed To Provide High Frequency Response .....	6
BC3.7.2 Plant In Limited Frequency Sensitive Mode .....	7
BC3.7.3 Plant Operation To Below Minimum Generation .....	7
BC3.7.5 Information Update To <a href="#">NGCNGESO</a> .....	8
BC3.7.6 Existing Gas Cooled Reactor Plant /Power Park Modules Before 1 January 2006 .....	8
BC3.7.7 Externally Interconnected System Operators .....	8

BC3.1 INTRODUCTION

BC3.1.1 **BC3** sets out the procedure for **NGET-NGESO** to use in relation to **Users** to undertake **System Frequency** control. **System Frequency** will be controlled by response from **Gensets** (and **DC Converters** at **DC Converter Stations**) 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 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 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; those in Part 1 of CC.8.1 are those for which the **Connection Conditions** 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-NGESO** if so agreed. **Commercial Ancillary Services** like those **System Ancillary Services** set out in Part 2 of CC.8.1, may be agreed to be provided by **Users** and which can only be utilised by **NGET-NGESO** if so agreed.

BC3.1.3 The provision of **Frequency** control services, if any, from an **External System** via a **DC Converter Station** will be provided for in the **Ancillary Services Agreement** and/or **Bilateral Agreement** with the **DC Converter Station** 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-NGESO** to direct **System Frequency** control is intended to enable (as far as possible) **NGET-NGESO** to meet the statutory requirements of **System Frequency** control.

BC3.3 SCOPE

**BC3** applies to **NGET-NGESO** and to **Users**, which in this **BC3** means:

- (a) **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) **Network Operators**,
- (c) **DC Converter Station** owners,
- (d) other providers of **Ancillary Services**, and
- (e) **Externally Interconnected System Operators**.

## BC3.4 MANAGING SYSTEM FREQUENCY

### BC3.4.1 Statutory Requirements

When ~~NGET~~ NGESO 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 comprising of a **Power Park Module** in a **Power Station** with a **Registered Capacity** less than 50MW and those comprising of a **Power Park Module** in Scotland with a **Completion Date** before 1 July 2004) and **DC Converters** at **DC Converter Stations** when transferring **Active Power** to the **Total System**, operating in **Frequency Sensitive Mode** will be instructed by ~~NGET~~ NGESO to operate taking due account of the **Target Frequency** notified by ~~NGET~~ NGESO.

### BC3.4.2 Target Frequency

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

### BC3.4.3 Electric Time

~~NGET~~ NGESO 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~~ NGESO's reasonable discretion.

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

### BC3.5.1 Capability

Each **Genset** (except those comprising of **Power Park Modules** in a **Power Station** with a **Registered Capacity** less than 50MW and those comprising of **Power Park Modules** in Scotland with a **Completion Date** before 1 July 2004) and each **DC Converter** at a **DC Converter Station** 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 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**, BC3.1.3 also applies. In addition each **Genset** (and each **DC Converter** at a **DC Converter Station**) must at all times have the capability to operate in a **Limited Frequency Sensitive Mode** by operating so as to provide **Limited High Frequency Response**.

### BC3.5.2 Limited Frequency Sensitive Mode

Each **Synchronised Genset** producing **Active Power** (and each **DC Converter** at a **DC Converter Station**) 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 for **System Frequencies** up to 50.4Hz and shall be deemed not to be in contravention of CC.6.3.7.

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

~~NGET~~ NGESO 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 In Operation Before 1 January 2006

~~NGET-NGESO~~ will permit **Power Park Modules** in operation before 1 January 2006 to operate in **Limited Frequency Sensitive Mode** at all times. For the avoidance of doubt **Power Park Modules** in England and Wales with a **Completion Date** on or after 1 January 2006 and **Power Park Modules** 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.

BC3.5.4

Frequency Sensitive Mode

- (a) ~~NGET-NGESO~~ may issue an instruction to a **Genset** (or **DC Converter** at a **DC Converter Station** 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** 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**) 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.
- (d) Such instruction will continue until countermanded by ~~NGET-NGESO~~ or until;
- (i) the **Genset** is **De-Synchronised**; or
  - (ii) the **DC Converter** 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**,
- whichever is the first to occur.
- (e) ~~NGET-NGESO~~ will not so instruct **Generators** in respect of **Existing Gas Cooled Reactor Plant** other than **Frequency Sensitive AGR Units**.
- (f) ~~NGET-NGESO~~ will not so instruct **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**) which assists recovery to **Target Frequency** must not be countermanded by a **Generator** or **DC Converter Station** 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**.

BC3.6 RESPONSE TO LOW FREQUENCY

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

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

in establishing its requirements for **Operating Reserve**.

- (b) (i) **NGET-NGESO** will specify within the range agreed with **Generators** and/or **EISOs** and/or **DC Converter Station** 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** 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 (if so agreed as described in BC3.1.3) will comply with **NGET-NGESO** 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 **EISOs** may not alter such **Low Frequency Relay** settings or take **Low Frequency Relay** initiated response out of service without **NGET's-NGESO'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 When Importing Active Power From The Total System)

- (a) **NGET-NGESO** 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-NGESO** 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-NGESO** 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-NGESO's** agreement, except for safety reasons.
- (iii) In the case of any such **Demand** which is **Embedded**, **NGET-NGESO** 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-NGESO** 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 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**) in respect of which the **Generator** or **DC Converter Station** 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. If more than one rate is provided for in the **Ancillary Services Agreement** [NGET-NGESO](#) 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**) 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**) 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 shall be initiated within 2 minutes, and achieved within 5 minutes, of the time of the **Frequency** increase above 50.5 Hz.



- (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 **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-NGESO](#).

- (a) As stated in CC.A.3.2, steady state operation below **Minimum Generation** is not expected but if **System** operating conditions cause operation below **Minimum Generation** which give rise to operational difficulties for the **Genset** (or **DC Converter** at a **DC Converter Station**) then [NGET-NGESO](#) should not, upon request, unreasonably withhold issuing a **Bid-Offer Acceptance** to return the **Generating Unit** or **CCGT Module** or **Power Park Module** or **DC Converter** to an output not less than **Minimum Generation**. In the case of a **DC Converter** not participating in the **Balancing Mechanism**, then [NGET-NGESO](#) will, upon request, attempt to return the **DC Converter** to an output not less than **Minimum Generation** 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**) 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**) output has reduced to below the **Designed Minimum Operating Level**) trip after a time.
- (c) All reasonable efforts should in the event be made by the **Generator** or **DC Converter Station** 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 is required to take action to protect the **Generating Units, Power Park Modules** or **DC Converters** as specified in CC.6.3.13.
- (e) In the event of the **System Frequency** becoming stable above 50.5Hz, after all **Genset** and **DC Converter** action as specified in BC3.7.1 and BC3.7.2 has taken place, **NGET-NGESO** 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**, 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** action as specified in BC3.7.1 and BC3.7.2 has taken place, **NGET-NGESO** will issue **Emergency Instructions** under **BC2** to trip appropriate **Gensets** (or in the case of **DC Converters** at **DC Converter Stations** 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 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 Information Update To **NGET-NGESO**

In order that **NGET-NGESO** can deal with the emergency conditions effectively, it needs as much up to date information as possible and accordingly **NGET-NGESO** 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**.

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, **Power Park Modules** in operation (irrespective of their **Completion Dates**) before 1 January 2006 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-NGESO** 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 >