

The Provision and Despatch of Reactive Power

1. Introduction

This paper has been prepared for the Grid Code Review Panel following their meeting on the 29th September 2007. The paper discusses the obligation on various users to provide Reactive Power and how that Reactive Power is despatched by NGET.

2. Background

The Grid Code sets out the technical and design criteria, and performance requirements for Generating Units. Section C.C.6.3.2 states the reactive capabilities required from Synchronous Generating Units, Non-Synchronous Generating Units and Power Park Modules.

Generating units must be capable of providing System Ancillary Services which are needed for system reasons and are listed in C.C.8.1 of the Grid Code. These include the supply of Reactive Power, Frequency control, Black Start Capability and System to Generator Operational Intertripping. These System Ancillary Services are split into two groups: Part 1 lists those services that the generator is obliged to provide and Part 2 lists those services which the generator can provide if agreement is reached with National Grid. Commercial Ancillary Services are other ancillary services which a generator may provide to National Grid if agreement is reached between the relevant parties to do so. The supply of Reactive Power is a Mandatory Ancillary Service.

Section 1.3.3 of the CUSC requires all Users to enter into a Mandatory Services Agreement (MSA) which provides for payment of these System Ancillary Services. The provision relating to Commercial Ancillary Services will normally be covered in the Ancillary Services Agreement.

All Users that are party to the CUSC need to comply with sections 1, 5, 8-11 of the CUSC. Section 4 of the CUSC applies to Users who provide balancing services (including Ancillary Services) to NGET. Section 4.1.1 and 4.1.2 discuss the provision of Obligatory Reactive Power Service by Users as specified in their MSA.

The Obligatory Reactive Power Service is procured via either market agreements or default payment arrangements. Generators can participate in a tender held every six months and NGET assess the tenders in accordance with the evaluation criteria specified in the CUSC. A successful tender then becomes contractually binding. If a tender is not successful or generators do not attend a tender, they will be paid on default arrangements if they provide the service as instructed.

The call off of System Ancillary Services and the despatch of Reactive Power is described in the Grid Code, B.C.2.8.

3. Generator Obligations

Following BETTA there are a number of different agreements that Generators can enter into with NGET, as detailed within the CUSC. Detailed below are the arrangements for BELLA's, BEGA's, BMU's and Medium Embedded Power Stations.

BELLA

The Bilateral Embedded Large Licence Exempt Agreement (BELLA) is in the CUSC, Schedule 2, Exhibit 5. BELLA's were established for Large Embedded Power Stations within Scotland. They submit Physical Notifications (PN's) within the Balancing Mechanism (BM) but they do not submit Bid-Offer data, and do not pay TNUoS charges.

Section 5.1 of the BELLA states that, 'Paragraph 6.3 of the CUSC applies'. Paragraph 6.3 of the CUSC details compliance with the Grid Code and Distribution code. Therefore a BELLA needs to comply with the plant performance requirements (Reactive Power) detailed in C.C.6.3 and supply that performance as per C.C.8. As the BELLA is a CUSC party they should have an MSA which will allow for the payment of the System Ancillary Services.

As defined in section 1 of the CUSC, neither section 2 or 3 of the CUSC is applicable to a BELLA. However there are two alternative clauses which can be inserted into the BELLA stating the requirement to comply/to not comply with Balancing Codes, B.C.1 and B.C.2 of the Grid Code (detailed in section 5.2 of the BELLA). The majority of BELLA's at the start of BETTA were specified to comply with B.C.1 and B.C.2. This requires BELLA's to submit PN's and Maximum Export Level data (MEL). This ensures that NGET as system operator receives the same level of information and visibility that the Scottish transmission licensees had received to operate the system and maintain system integrity. Furthermore in principal NGET can despatch Reactive Power in accordance with B.C.2.8.

Site specific technical conditions are detailed in appendices F1 to F5 of the BELLA. Appendix F1 refers to Ancillary Services (in addition to the Mandatory Ancillary Service) and will detail those Ancillary Services if they are required by NGET and the generator has agreed to provide those services.

BEGA

The Bilateral Embedded Generation Agreement (BEGA) is in the CUSC, Schedule 2, Exhibit 2.

The BEGA is governed by and Users are bound to the CUSC. Paragraph 6.3 of the CUSC details compliance with the Grid Code and Distribution code. A BEGA needs to comply with the plant performance requirements (Reactive Power) detailed in C.C.6.3 and supply that performance as per C.C.8. As the BEGA is a CUSC party they should have an MSA which will allow for the payment of the System Ancillary Services.

Section 3 of the CUSC, 'Use of System' is applicable to a BEGA. The User agrees to pay use of system charges, defines their Transmission Entry Capacity (TEC) and can participate in the BM. As the BEGA is a BM participant and B.C.1 and B.C.2 of the Grid Code apply, NGET can despatch Ancillary Services including Reactive Power as B.C.2.8.

Appendix F1 of the BEGA lists the agreed balancing services.

Directly connected Balancing Mechanism Units (BMU's)

The Bilateral Connection Agreement (BCA) for a directly connected Power Station is in the CUSC, Schedule 2, Exhibit 1.

The BCA is governed by and Users are bound to the CUSC. Paragraph 6.3 of the CUSC details compliance with the Grid Code and Distribution code. A BMU needs to comply with the plant performance requirements (Reactive Power) detailed in C.C.6.3 and supply that performance as per C.C.8. As the BMU is a CUSC party they should have an MSA which will allow for the payment of the System Ancillary Services.

Section 2 'Connection' and section 3 'Use of System' of the CUSC is applicable to a directly connected Power Station. The User agrees to pay use of system charges, defines their Transmission Entry Capacity (TEC) and can participate in the BM. As directly connected generators are Balancing Mechanism Units (BMU), NGET can despatch Ancillary Services including Reactive Power as B.C.2.8.

Medium Embedded Generator

They have to comply with the relevant sections of the Distribution Code and will have a Distribution Agreement with the Network Operator.

D.P.C.7.5.2 states that medium Embedded Generators who are not party to the CUSC have to comply with C.C.3.3. of the Grid Code. This places an obligation on the Generator to comply with various sections of the Grid Code including C.C.6.3.2 plant performance requirements which details the Reactive Power requirements. Unless they have a Commercial Ancillary Agreement with NGET they do not have to comply with C.C.8 of the Grid Code and do not provide Mandatory Ancillary Services.

Summary Table

	BELLA	BEGA	BMU's	Medium Embedded
Reactive Capability	Full compliance with Grid Code CC 6.3.2	Full compliance with Grid Code CC 6.3.2	Full compliance with Grid Code CC 6.3.2	Full compliance with Grid Code CC 6.3.2 through the DNO (DPC 7.5)
Mandatory Services Agreement	CUSC requirement to provide Obligatory Reactive Service.	CUSC requirement to Obligatory Reactive Service.	Required to provide Obligatory Reactive Service.	Not a CUSC Party and therefore not required
Reactive Despatch by GBSO	Yes, if BELLA requires compliance with BC2	Yes in accordance with BC2	Yes in accordance with BC2	No unless a BMU
Payment for Reactive	Yes, as detailed in their MSA. Either Default Payments or tendered Market Agreements	Yes, as detailed in their MSA. Either Default Payments or tendered Market Agreements	Yes, as detailed in their MSA. Either Default Payments or tendered Market Agreements	No unless Commercial Ancillary Services Agreement applies

BELLA's – Bilateral Embedded Large Licence Exempt Agreement, (in Scotland only)

BEGA – Bilateral Embedded Generation Agreement

BMU >100MW in England & Wales, >30MW in SP area, >10MW in SSE area)

Medium Embedded (between 50-100MW in England & Wales only)

4. Despatch of Reactive Power

NGET is responsible for controlling the voltage on the GB Transmission System and the low voltage side of Grid Code Supply Points in accordance with the GB Security and Quality of Supply Standard (GBSQSS). Similarly the Distribution Network Operators (DNO's) are responsible for maintaining voltages within statutory limits on their network.

The Reactive and Active Power output from Embedded Generators can have a significant effect on the DNO's distribution system. To ensure that the despatch of Reactive or Active Power on Embedded Generation by NGET does not impair the DNO's ability to operate and control their network the DNO is obliged under B.C.1.6.1 to notify NGET of restrictions on Embedded Generation within their network. DNO's should submit to NGET each day, in respect of the following operational day, notification of;

1. Constraints on their system which NGET may need to take into account when operating the Transmission System.
2. The requirements of voltage control and MVA reserves which NG may need to take into account for system security reasons.

It is assumed that the DNO is able to impose these restrictions on the Embedded Generator through the Distribution Connection/ Use of System Agreement.

For some Embedded Generators there are standing arrangements in place for ongoing constraints imposed by the DNO.

The despatch of Reactive Power is described in BC2.8 which details the call-off of System Ancillary Service. The Users can reject an Ancillary Service instruction under the following scenario as detailed in B.C. 2.8.3 (b)

‘The issue of Ancillary Services Instructions for Reactive Power will be made with due regard to any resulting change in Active Power output. The instruction maybe rejected if it conflicts.....with the Physical Notification.’

This is particularly relevant to those Non-Synchronous Generators or Power Park Modules that in accordance with C.C.6.3 (c) or (d), only have to supply a lagging or leading Power Factor at Active Power output levels above 20% or 50% respectively of the rated MW output (with all plant in service).