

## Protection Issues

### 1. Introduction

1.1. During recent Grid Code Review Panel meetings a number of protection issues have arisen which require clarification and amendment. The first of which refers to the wording associated with CC.6.2.2.2 (a) and CC.6.2.3.1(a) and the need to provide clarification. The second relates to the setting of Generator Back-Up Protection associated with HV Connections. This paper seeks to clarify and propose new wording to address both of these issues.

### 2. CC.6.2.2.2(a) and CC.6.2.3.1 (a)

2.1. CC.6.2.2.2(a) and CC.6.2.3.1 (a) relate to the fault clearance times associated with the directly connected Generators or Directly Connected Network Operators / Non Embedded Customers respectively. The concern is that the wording of these paragraphs implies that National Grid will not specify a fault clearance time not faster than 80ms at 400kV, 100ms at 275 kV and 120ms at 132 kV and below but at the same time the Grid Code states that *"this shall not prevent the user or NGET having faster fault clearance times"*.

2.2. It is this last sentence in italics which is believed to cause confusion as it could currently imply that a faster fault clearance time could be specified in the Bilateral Agreement. This is not the intention of the wording which is effectively designed to state that if the Bilateral Agreement states a figure of 80ms at 400kV there would be nothing to stop the Generator having a faster fault clearance time than this if so required and likewise it would not prevent NGET from having a faster fault clearance time than 80ms on its own plant and apparatus. The wording has therefore been amended as shown in Appendix 1 to address this concern.

2.3. The second issue relates to the use of the term faster/slower or less than / greater than in CC.6.2.2.2 (a) and CC.6.2.3.1 (a). There has been some concern that the use of the existing terms of faster / slower are misleading and the terms greater than or less than may be more appropriate. As a result, in Appendix 1 these terms have been highlighted in yellow text. It is considered that it would be appropriate for Panel members to agree which terminology is used. If the terms Greater than or Less than are used then other sections of the Grid Code will need to be changed for consistency purposes.

#### *Way Forward*

2.4. The GCRP are invited to:

- i. Acknowledge the requirement for clarifying the existing provisions.
- ii. Agree the proposed solution which should proceed to industry consultation subject to clarification regarding the preferred legal wording.

### 3. CC.6.2.2.2(b) – Back-Up Protection

3.1. Grid Code provision CC.6.2.2.2(b) requires the installation of the Back-up Protection by Generators and National Grid. The provision provides that in the event of fault clearance times not being met by the Generator's Main Protection system (within the relevant fault clear times – CC.6.2.2.2(a)), then their Back-up Protection should be activated within a specific timeframe. The provisions specify that both National Grid's and the Generator's Back-up Protection systems should be co-ordinated to provide the appropriate level of discrimination.

3.2. A recent review of the CC.6.2.2.2(b) has indicated that the provisions (as currently written) do not provide for adequate discrimination between National Grid's and the Generator's protection systems, where two Main Protections and one Back-up Protection has been installed on the Generator's system. This is the result of inappropriate fault clearance times being specified for the Generator's protection system which is not

reflective of National Grid's fault clearance times and therefore it is not possible to coordinate the two Back-up Protections such that it provides adequate discrimination.

- 3.3. The consequences of this existing requirement means that in the event of a fault on the Generators HV connections, failure of both main protections provided by the Generator would mean that the Generators Back-Up Protection would operate within 800ms from fault inception. During this time, the Back-Up Protection on National Grid's system would operate (typically within 500ms) which could result in the loss of the entire substation and circuits remote from the substation. There is also a risk that demand and generation could be lost which in the latter case could exceed 1320MW. By re-grading the settings this risk can be eliminated.

*Proposal*

- 3.4. It is proposed to amend CC.6.2.2.2(b) such that it provides the appropriate level of discrimination between National Grid's and the Generator's protection system.
- 3.5. The amendment specifies that a Generator's Back-Up Protection, regardless of whether a Generator has one or more Main Protection, must operate with a clearance time of no slower than 300ms.
- 3.6. The proposed changes will only affect Generators connected to the Transmission System in England and Wales which currently have a protection system consisting of two Main Protections and a Back-up Protection and which have been connected to the Transmission System since 24<sup>th</sup> December 1993<sup>1</sup>.
- 3.7. Generators in Scotland with a similar system configuration will not be affected by the proposed changes as the fault clearance times specified in CC.6.2.2.2(b) provide the appropriate level of discrimination between the Generator's and relevant Transmission Owner's protection systems.
- 3.8. It is also proposed to amend the existing Grid Code definition for Back-up Protection such that it provides Users with additional clarification regarding the functionality of the protection system.
- 3.9. The associated legal text outlining the proposal may be reviewed in Appendix 2.

*Transition and Implementing Issues*

- 3.10. Should the proposed changes be approved by the Authority, it is recommended that the changes be applied to all Generators irrespective of when connected. Given the possible implication on the GB Transmission System regarding security of supply and potential loss of demand at a number of sites, National Grid believes it is important that all protection systems provide the appropriate level of discrimination. It is National Grid's belief that the proposed changes will only necessitate changes to the protection setting however National Grid would welcome input from relevant Users regarding the materiality of the proposals.
- 3.11. In the event of changes being approved by the Authority, National Grid recommends that there be a transitional period such that it allows the affected Generators sufficient time to make the relevant changes to their protection systems. To minimise impact on the operational activities of the Generators it is proposed that a sufficiently long transitional period is allowed; such that the changes to the protection systems could be undertaken as part of the Generators on-going maintenance programme as such the legal text will be reflective of a proposed transitional date of 1<sup>st</sup> January 2012.

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<sup>1</sup> Implementation date of relevant Grid Code provisions which introduced a Back-Up Protection fault clearance time of up to 800ms where two Main Protections were installed by the Generator (England and Wales only).

*Way Forward*

3.12. The GCRP are invited to:

- i. Acknowledge the requirement for having effective protection systems.
- ii. Note that the current Grid Code wording does not accurately provide (in all circumstances) the appropriate level of discrimination between the relevant parties' protection systems.
- iii. Agree the proposed solution, and agree to a transitional phase for the incorporation of the proposed changes.
- iv. Agree that the proposal should proceed to industry consultation

## **Appendix 1 – Proposed Legal Text for CC.6.2.2.2(a) and CC.6.2.3.1(a)**

### *Proposed Changes to Connection Conditions 6.2.2.2(a) and*

#### CC.2.2.2.2

(a) The fault clearance times for faults on the **Generator's** or **DC Converter Station** owner's equipment directly connected to the **GB Transmission System** and for faults on the **GB Transmission System** directly connected to the **Generator** or **DC Converter Station** owner's equipment, from fault inception to the circuit breaker arc extinction, shall be set out in accordance with the **Bilateral Agreement**. **NGET will not specify fault clearance times in the Bilateral Agreement which are faster/less than:** ~~The times specified in accordance with the Bilateral Agreement shall not be faster than:~~

- (i) 80mS at 400kV
- (ii) 100mS at 275kV
- (iii) 120mS at 132kV and below

but this shall not prevent ~~the a-User~~ **from selecting fault clearance times on its Plant and Apparatus which are faster/less than that specified in the Bilateral Agreement nor shall it prevent or NGET from selecting having faster/lower faster fault clearance times on its own Plant and Apparatus.**

**Slower/Greater** fault clearance times may be specified in accordance with the **Bilateral Agreement** for faults on the **GB Transmission System**. **Slower/Greater** fault clearance times for faults on the **Generator** or **DC Converter Station** owner's equipment may be agreed in accordance with the terms of the **Bilateral Agreement** but only if **System** requirements, in **NGET's** view, permit. The probability that the fault clearance times stated in accordance with the **Bilateral Agreement** will be exceeded by any given fault, must be less than 2%.

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CC.6.2.3 **Requirements at Connection Points relating to Network Operators and Non-Embedded Customers**

CC.6.2.3.1 **Protection Arrangements for Network Operators and Non-Embedded Customers**

CC.6.2.3.1.1 **Protection of Network Operator and Non-Embedded Customers User Systems** directly supplied from the **GB Transmission System**, must meet the minimum requirements referred to below:

#### Fault Clearance Times

(a) The fault clearance times for faults on **Network Operator** and **Non-Embedded Customer** equipment directly connected to the **GB Transmission System**, and for faults on the **GB Transmission System** directly connected to the **Network Operator's** or **Non-Embedded Customer's** equipment, from fault inception to the circuit breaker arc extinction, shall be set out in accordance with each **Bilateral Agreement**. ~~The times specified in accordance with the Bilateral Agreement shall not be faster than:~~ **NGET will not specify fault clearance times in the Bilateral Agreement which are faster/less than:**

- (i) 80mS at 400kV
- (ii) 100mS at 275kV
- (iii) 120mS at 132kV and below

but this shall not prevent **User** from selecting fault clearance times on its **Plant** and **Apparatus** which are **faster/less** than that specified in the **Bilateral Agreement** nor shall it prevent **NGET** from selecting **faster/lower** fault clearance times on its own **Plant** and **Apparatus**. ~~a **User** or **NGET** having a faster fault clearance time.~~

**Slower/Greater** fault clearance times may be specified in accordance with the **Bilateral Agreement** for faults on the **GB Transmission System**. **Slower/Greater** fault clearance times for faults on the **Network Operator** and **Non-Embedded Customers** equipment may be agreed in accordance with the terms of the **Bilateral Agreement** but only if **System** requirements in **NGET's** view permit. The probability that the fault clearance times stated in accordance with the **Bilateral Agreement** will be exceeded by any given fault must be less than 2%.

## **Appendix 2 – Proposed Legal Text for CC.6.2.2.2(b) (Back-up Protection)**

### *Proposed Changes to Connection Conditions 6.2.2.2(b)*

- (b) For the event that the above fault clearance times are not met as a result of failure to operate on the **Main Protection System(s)** provided, the **Generators** or **DC Converter Station** owners shall provide **Back-Up Protection**. **NGET** will also provide **Back-Up Protection** and these **Back-Up Protections** will be co-ordinated so as to provide **Discrimination**.

~~On a **Generating Unit** (other than **Power Park Units**), **DC Converter** or **Power Park Module** connected to the **GB Transmission System** where only one **Main Protection** is provided to clear faults on the **HV Connections** within the required fault clearance time, the **Back-Up Protection** provided by the **Generators** and **DC Converter Station** owners shall operate to give a fault clearance time of no slower than 300 ms at the minimum infeed for normal operation for faults on the **HV Connections**. Where two **Main Independent Protections** are provided on **Generating Units** (other than **Power Park Units**), **DC Converters** or **Power Park Modules** connected to the **GB Transmission System** at 400 kV and 275 kV where two **Independent Main Protections** are provided which are not subject to a common mode failure and on **Generating Units** (other than **Power Park Units**), **DC Converters** or **Power Park Modules** connected to the **GB Transmission System** at 132 kV and below there is no requirement for the **Generator** or **DC Converter Station** owner to provide, the **Back-Up Protection** is not a requirement. In instances where **Back-up Protection** is provided it shall operate to give a fault clearance time of no greater than 800 ms in England and Wales and 300 ms in Scotland at the minimum infeed for normal operation for faults on the **HV Connections**.~~

**Generators'** and **DC Converter Station** owners' **Back-Up Protection** will also be required to withstand, without tripping, the loading incurred during the clearance of a fault on the **GB Transmission System** by breaker fail **Protection** at 400kV or 275kV or of a fault cleared by **Back-Up Protection** where the **Generator** or **DC Converter** is connected at 132kV and below. This will permit **Discrimination** between **Generator** or **DC Converter Back-Up Protection** and **Back-Up Protection** provided on the **GB Transmission System** and other **Users' Systems**.

### *Proposed Changes to General Conditions*

#### **GC.16. Back Up Protection**

- GC.16.1** This GC.16 shall have effect until 1 January 2012, at which time this GC.16 shall cease to have any force of effect.
- GC.16.2** Notwithstanding the requirement specified in CC.6.2.2.2 (b) that the **Back-Up Protection** provided by the **Generators** and **DC Converter Station** owners shall operate to give a fault clearance time of no slower than 300ms at the minimum infeed for normal operation for faults on **HV Connections**, any **Generating Unit** (other than **Power Park Units**), **DC Converter** or **Power Park Module** connected to the **GB Transmission System** as at [date of implementation of Grid Code change] which has a fault clearance time for its **Back-Up Protection** of greater than 300ms but less than 800ms, has until 1 January 2012 to make the necessary changes to its **Back-Up Protection** in order to comply with the provisions of CC6.2.2.2 (b). Until the necessary changes have been made, such **Generators** and **DC Converter Station** owners shall ensure that their **Back-Up Protection** has a fault clearance time of no slower than 800ms. For the avoidance of doubt all fault clearance times for all such **Back-Up Protection** must be no slower than 300ms with effect on and from 1 January 2012.

*Proposed Changes to Glossary and Definitions*

**Back-Up Protection**    **Protection** equipment or system which is intended to operate when a system fault is not cleared in due time because of failure or inability of the **Main Protection** to operate or in case of failure to operate of a circuit-breaker other than the associated circuit breaker **such Protection equipment or system must have no common mode of failure with any Main Protection.**