

## **Grid Code Protection Obligations**

### **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.6.2.3.1.1(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.6.2.3.1.1(a)**

- 2.1. CC.6.2.2.2(a) and CC.6.2.3.1.1 (a) relate to the fault clearance times associated with directly connected Generators or Directly Connected Network Operators / Non Embedded Customers respectively. The concern is that the wording of the paragraphs implies that National Grid will not specify a fault clearance time 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 specifies a figure of 80ms at 400kV there would be nothing to stop the User having a faster fault clearance time (e.g. 79ms) should it wish to do so and likewise, it would not prevent National Grid from having a faster fault clearance time than 80ms (e.g. 79ms) on its own plant and apparatus.
- 2.3. The wording has therefore been amended as shown in Appendix A to address this concern.
- 2.4. The second issue relates to the terminology used 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 longer than or shorter than may be more appropriate. As a result National Grid proposes to amend the Grid Code such that the wording provides greater User clarity regarding the intention of the provisions thus avoiding unnecessary confusion.
- 2.5. The associated legal text outlining the proposal may be reviewed in Appendix A.

#### *Way Forward*

- 2.6. The GCRP are invited to:
- i. Acknowledge the requirement for clarifying the existing provisions.
  - ii. Agree that National Grid should proceed with an industry consultation.

### **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 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 clearance 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 (in all circumstances). This is the result of inappropriate Back-Up fault clearance times being specified for the Generator's protection system (given the potential differences in Back-Up protection design) which is not reflective of National Grid's Back-Up fault clearance times and therefore it is not possible to coordinate the two Back-Up Protections such that adequate discrimination is provided.

- 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 the infrequent infeed loss limit. 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 systems.
- 3.5. The proposal introduces a new Grid Code concept of Independent Back-up Protection which provides Generators and DC Converter Station owners with a degree of flexibility regarding the design of their protection system subject to meeting a minimum technical requirement.
- 3.6. The proposals will apply to all Generators and DC Converter Station owners and have been developed to minimise any retrospective compliance issues.
- 3.7. The associated legal text outlining the proposal may be reviewed in Appendix A.

*Way Forward*

- 3.8. 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 that the proposal should proceed to industry consultation.

## **Appendix A - Proposed Grid Code Changes**

### **CC.6.2.2.2 Generating Unit and Power Station Protection Arrangements**

#### **CC.6.2.2.2.1 Minimum Requirements**

**Protection of Generating Units** (other than **Power Park Units**), **DC Converters** or **Power Park Modules** and their connections to the **GB Transmission System** must meet the minimum requirements given below. These are necessary to reduce to a practical minimum the impact on the **GB Transmission System** of faults on circuits owned by **Generators** or **DC Converter Station** owners.

#### **CC.6.2.2.2.2 Fault Clearance Times**

- (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**. The fault clearance times specified in accordance with the **Bilateral Agreement** shall not be ~~fast~~shorter than the minimum levels specified below:

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

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

Longer~~Slower~~ fault clearance times may be specified in accordance with the **Bilateral Agreement** for faults on the **GB Transmission System**. Longer~~Slower~~ 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%.

- (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 except as specified below, provide **Independent Back-Up Protection**. **NGET** will also provide **Back-Up Protection** and these NGET and the User's **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 **Independent Back-Up Protection** provided by the **Generators** and **DC Converter Station** owners shall operate to give a fault clearance time of no longer~~slower~~ than 300 ms at the minimum infeed for normal operation for faults on the **HV Connections**. For the avoidance of

doubt, the requirement to provide an **Independent Back Up Protection** will be satisfied where the **Main Protection System** includes two or more **Main Protections** of which one is an **Independent Main Protection**. ~~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 **Main Protections** are provided 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, the **Back-Up Protection** shall operate to give a fault clearance time of no slower 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**.~~

Notwithstanding the paragraph above, a **Generating Unit** (other than **Power Park Unit**), **DC Converter** or **Power Park Module**, with a **Completion Date** before 1<sup>st</sup> January 2009 and connected to the **GB Transmission System** in England and Wales at 400 kV, 275 kV or 132 kV, may have two **Independent Main Protections** and a **Back-Up Protection**, in which the **Back Up Protection** shall operate to give a fault clearance time of no slower than 800ms at the minimum infeed for normal operation for faults on the **HV Connections**.

**Generators' and DC Converter Station owners' with Back-Up Protection or Independent 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 Station owners' Back-Up Protection or Generator or DC Converter Station owners' Independent Back-Up Protection** and the **Back-Up Protection** provided on the **GB Transmission System** and other **Users' Systems**.

- (c) When the **Generating Unit** (other than **Power Park Units**), or the **DC Converter** or **Power Park Module** is connected to the **GB Transmission System** at 400kV or 275kV, and in Scotland also at 132kV, and a circuit breaker is provided by the **Generator** or the **DC Converter Station** owner, or **NGET**, as the case may be, to interrupt fault current interchange with the **GB Transmission System**, or **Generator's System**, or **DC Converter Station owner's System**, as the case may be, circuit breaker fail **Protection** shall be provided by the **Generator** or **DC Converter Station** owner, or **NGET**, as the case may be, on this circuit breaker. In the event, following operation of a **Protection** system, of a failure to interrupt fault current by these circuit-breakers within the **Fault Current Interruption Time**, the circuit breaker fail **Protection** is required to initiate tripping of all the necessary electrically adjacent circuit-breakers so as to interrupt the fault current within the next 200 ms.
- (d) The target performance for the **System Fault Dependability Index** shall be not less than 99%. This is a measure of the ability of **Protection** to initiate successful tripping of circuit breakers which are associated with the faulty item of **Apparatus**.

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 fault clearance times specified in accordance with the **Bilateral Agreement** shall not be ~~fast~~ shorter than the minimum levels specified below:

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

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

~~Longer Slower~~ Slower fault clearance times may be specified in accordance with the **Bilateral Agreement** for faults on the **GB Transmission System**. ~~Longer Slower~~ Slower 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%.

**Proposed Changes to Connection Conditions**

**Independent Back-Up Protection** A Back-Up Protection which utilises a different type of relay and different current transformers (CTs) from the Main Protection such that it can operate autonomously in the event of any failure of the Main Protection.

**Independent Main Protection** A Protection system which comprises of two or more Main Protections in which each Main Protection utilises a different type of relay and different current transformers (CT's) such that the Main Protections can operate autonomously from each other in the event of any failure.