

## Grid Code Review Panel – Issue Assessment Proforma Protection

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### Summary

This paper reintroduces a number of protection issues which were first brought to the GCRP in 2008. The first issue 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 issue relates to the setting of Generator Back-Up Protection associated with HV Connections within CC.6.2.2.2(b). This paper proposes amendments to the Grid Code and that the issue is progressed to Industry Consultation.

### Users Impacted

#### **High**

Directly connected Generators or Directly Connected Network Operators / Non Embedded Customers, all Generators and DC Converter Station

#### **Medium**

None identified

#### **Low**

None Identified

### Description & Background

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 the 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"*.

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 Connection Agreement. This is not the intention of the wording which is effectively designed to state that if the Bilateral Connection Agreement (BCA) 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 A to this paper to address this concern.

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 “less than/greater 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.

Grid Code provision CC.6.2.2.2(b) requires the installation of Back-up Protection by all 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.

A review of CC.6.2.2.2(b) has indicated that the current wording of provisions does not provide for adequate discrimination between National Grid and Generator protection systems, where two Main Protections and one Back-up Protection have 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 are 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.

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 or 1800MW by 2014. By re-grading the settings this risk can be eliminated.

This issue was raised in 2008 and proceeded to a Workgroup. In November 2009 National Grid informed the Panel that an informal Workgroup had been established to bring transparency to fault clearance and Back-up Protection issues specified in the Grid Code. In March 2009 a survey was issued to Generators in order to identify their current arrangements used for protection.

**Proposed Solution**

It is proposed to amend CC.6.2.2.2(b) such that it provides the appropriate level of discrimination between National Grid and a Generator protection systems.

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.

The proposals will apply to all Generators and DC Converter Station owners and have been developed to minimise any retrospective compliance issues.

The proposed legal text to address the issues described above is available in Appendix A.

**Assessment against Grid Code Objectives**

*(i) to permit the development, maintenance and operation of an efficient,*

***coordinated and economical system for the transmission of electricity;***

The proposed changes permit the operation of an efficient transmission system by removing any confusion within the Grid Code requirements in facilitating the operation of protection systems so as to cause the minimum loss to the transmission system.

***(ii) to facilitate competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the national electricity transmission system being made available to persons authorised to supply or generate electricity on terms which neither prevent nor restrict competition in the supply or generation of electricity);***

The proposed changes are neutral to this objective.

***(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national***

With the clauses in the Grid Code clarified it will remove any possible confusion regarding the operation of protection systems and promote a more secure transmission system

***(iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency.***

The proposed changes are neutral to this objective.

**Impact & Assessment**

***Impact on the National Electricity Transmission System (NETS)***

The proposed changes will not have an adverse impact on the Transmission System.

***Impact on Greenhouse Gas Emissions***

The proposed changes will not have a material impact on Greenhouse Gas Emissions.

***Impact on core industry documents***

None identified at this time.

***Impact on other industry documents***

None identified at this time.

**Supporting Documentation**

Have you attached any supporting documentation YES

If Yes, please provide the title of the attachment: Appendix A

**Recommendation**

The Grid Code Review Panel is invited to:  
Progress this issue 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**. **NGET will not specify fault clearance times in the Bilateral Agreement which are less 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 the **User** from selecting fault clearance times on its **Plant and Apparatus** which are quicker than that specified in the **Bilateral Agreement** nor shall it prevent **NGET** from selecting faster fault clearance times on its own **Plant and Apparatus**.

Slower fault clearance times may be specified in accordance with the **Bilateral Agreement** for faults on the **GB Transmission System**. 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 provide **Independent 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**, the **Independent 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**.

For the avoidance of doubt, this would not preclude a **Generating Unit** (other than **Power Park Unit**), **DC Converter** or **Power Park Modules**, with a **Completion Date** before 1<sup>st</sup> January 2009 and which is connected to the **GB Transmission System** in England and Wales at 400 kV, 275 kV and 132 kV, which has two **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' **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 Independent Back-Up Protection** and **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 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**. **NGET will not specify fault clearance times in the Bilateral Agreement which are less 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 the **User** from selecting fault clearance times on its **Plant** and **Apparatus** which are quicker than that specified in the **Bilateral Agreement** nor shall it prevent **NGET** from selecting faster fault clearance times on its own **Plant** and **Apparatus**.

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