

## Distribution Code Review Panel

### Meeting 63 – Thursday 8 March 2017

Paper by Secretary

#### **Rate of Change of Frequency protection changes to deal with increasing system Rate of Change of Frequency due to reduced system inertia and larger maximum loss of infeed (1800MW from 1320MW).**

#### **Emerging possible RoCoF protection compliance issue**

##### **Background**

In 2012 NGET recognised that the development of large amounts of generation, and DC interconnectors to other networks were reducing the GB system inertia. Reduced inertia results in increased system Rates of Change of Frequency (RoCoF) during large system disturbances such as the loss of a DC interconnector carrying large amounts of power, or the loss of a major generation in feed from a power station within GB. In turn these larger system RoCoF events were potentially sufficient to operate the RoCoF protection systems defined in G59. This would result in unwanted tripping of embedded generation within GB.

In order to deal with the issue a joint Grid code and Distribution code working group was set up to consider altering the RoCoF protection settings required in G59. Prior to the working groups first meeting two cross channel interconnector trips resulted in the loss of additional generation within GB on the 28<sup>th</sup> and 30<sup>th</sup> September 2012. The working group decided that initially they would target generators of 5MW or more and commissioned studies by the University of Strathclyde to determine the effects of altering the RoCoF protection on generators of 5MW or more to a range of RoCoF events.

Following public consultation it was agreed that for existing synchronous generating units and those connected for a short period after G59 was updated would be allowed to change the settings to 0.5Hz per second but that all non-synchronous machines and synchronous machines connected after the end of July 2016 would have a setting of 1Hz per second measured over 500ms. The revised RoCoF protection settings were published in G59/3-1 in August 2014.

The published setting was 1Hz/s with a time delay of 0.5s (or 0.5Hz/s for synchronous machines connected up to the 31<sup>st</sup> July 2016) The setting requirement is augmented with a note which says:

*“The required protection requirement is expressed in Hertz per second (Hz/s). The time delay should begin when the measured RoCoF exceeds the threshold expressed in Hz/s. The time delay should be reset if measured RoCoF falls below that threshold. The relay must not trip unless the measured rate remains above the threshold expressed in Hz/s continuously for 500ms. Setting the number of cycles on the relay used to calculate the RoCoF is not an acceptable implementation of the time delay since the relay would trip in less than 500ms if the system RoCoF was significantly higher than the threshold.”*

##### **Problem**

From August 2014 to July 2016 the changes required to be made were implemented at power stations of 5MW and larger across GB and no issues were raised with any relay. Since August 2016 a number of instances have come to light of DNO witnessing engineers being concerned about the setting methodology of two specific relays supplied by one manufacturer. The affected relays an identical algorithm to detect RoCoF. They have a RoCoF setting in

Hz/s and a measurement window setting in number of cycles. By adjusting these two settings the relays response to voltage phenomena on the network caused by faults etc can be modified.

The initial concern was about the relay using cycles to determine time which was a method described as unacceptable in G59/3-1. Initial thoughts were that for the critical event of a falling frequency using cycles would result in longer times to trip and that perhaps it was not a big issue. However it was not known in detail how the relay worked. Investigations by a member of the working group that developed the current G59 drafting, working with the manufacturer, has established without demur from the manufacturer that the relay is strictly non-compliant in regard to the 500ms time setting.

As part of this investigation it has been established that the errors in operating time arising from this non-compliance are not material and would not interfere with the relays' abilities to detect islands or in restraining for transmission system events. In other words the non-compliance is believed to be at a level of technical detail rather than fundamental fitness for purpose.

The relays in question are also capable of being set in either of a RoCoF mode or Vector Shift mode. In RoCoF mode the relay is technically non-compliant with the latest version of G59, but the Vector Shift mode is compliant.

These relays have been very successfully marketed and appear to comprise at least 60% of the installed base of loss of mains protection relays in GB overall (not necessarily in the >5MW population).

To be clear, as the current G59 only applies the specific timing requirement to generators >5MW, the non-compliance is related to this population rather than the population in general.

The numbers of non-compliant relays installed in contravention of G59/3-1 since 1 August 2014 is not immediately known, although it should not be hard to establish this via the DNOs.

## **Other considerations**

Dealing with non-compliant relays in the >5MW population would be most unwelcome, given the recent efforts to achieve compliance with the revised RoCoF settings.

GC0079 is also investigating the continuing suitability of Vector Shift as a loss of mains protection method. Although this work has not yet concluded it is already almost certain that new settings will be recommended. The easy option of changing non-compliant RoCoF relays to (currently) compliant Vector Shift would increase both system risk and the numbers of VS settings to change if a retrospective programme is found to be justified.

GC0079 will produce recommendations for <5MW generation and all Vector Shift protection later this year.

It is for DNOs to undertake any action appropriate to deal with non-compliance. DNOs will form a view on what the appropriate action is in due course, taking into account the extent of the non-compliance and recommendations from GC0079 later in the year.

If the DNOs believe that the optimum resolution is to continue to accept these relays on the system, this will need to be formalized by the Panel, either by promoting further changes to G59, or possibly via a Distribution Code guidance note.

## **Recommendation**

The Panel is asked to note:

- the development of this problem.
- DNOs proposed assessment of absolute numbers of non-compliances
- The likely further recommendations for Vector Shift protection settings

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- The possibility of having to promote some G59 or D Code changes to resolve the issue.

A report on this issue will be brought to the next Panel meeting.