# Rate of Change of Frequency (RoCoF)

## Project Six Monthly Report

30 June 2017

# Introduction

This report provides an update on the status of the RoCoF Generator Implementation Project in Northern Ireland including the DSO implementation project associated with RoCoF modification. The Utility Regulator for Northern Ireland (UR) Decision Paper on the Rate of Change of Frequency Grid Code Modification, published on May 7th, 2014, requires that generators undertake technical studies to confirm their compliance with the new RoCoF standard. This new standard is required to facilitate the increased penetration of renewables, mainly wind, on the system and is a key part of the DS3 Programme.

This project formally commenced on 21st November 2014. Each unit on the system has been categorised as high or low priority with a deadline to complete their studies by the end of May 2016, or November 2017 respectively.

There are a number of projects being carried out in parallel to the RoCoF Generator Implementation Project in Ireland as part of the overall RoCoF Implementation Project. These are the Ireland Generator Implementation Project, the TSO alternative/complementary solutions studies and the DSO implementation projects in Ireland and Northern Ireland. Progress on these projects is reported on with the overall DS3 Programme, available here on the EirGrid website.

# Background

SONI and Eirgrid have embarked upon a multi-year programme “Delivering a Secure, Sustainable Electricity System” (the DS3 programme), which is designed to ensure the power system can be operated with increasing amounts of variable non-synchronous renewable generation over the coming years. Together with the on-going work on infrastructure development and the addition of renewable generation capacity, the DS3 programme is critical to meeting the All-Island renewable electricity targets by 2020. The DS3 programme includes enhancing generation portfolio performance, developing new operational policies and system tools to efficiently use the generation portfolio to the best of its capabilities, and regularly reviewing the needs of the system as the portfolio capability evolves.

Detailed technical studies undertaken by SONI and EirGrid have indicated that, during times of high wind generation following the loss of the single largest credible contingency, RoCoF values of greater than 0.5Hz/s but no greater than 1.0Hz/s could be experienced on the island power system. In Northern Ireland in a system separation event there is a potential that RoCoF values up to 2Hz/s could be experienced. The conventional generators have stated that they do not know what the impact of a 2Hz/s RoCoF event will be and must undertake extensive studies to assess the impact.

In its decision paper URegNI approved, in principle, the proposed Grid Code modification mandating that generators withstand RoCoF events of up to 1.0Hz/s over a sliding window of 500ms. However, UR will not apply the new standard in the Grid Code until it has received confirmation from SONI that a sufficient number of generators can comply with the standard to allow SONI to safely operate the system in a manner compliant with the new RoCoF standard

# Final Approved Categorisation List

The UR RoCoF decision paper directed SONI to categorise each generating unit according to the priority in which their declaration of compliance, or submission of a derogation request, should be made in a window from 18 months to 36 months from the commencement date of the RoCoF Implementation Project.

In response to this direction, SONI wrote to UR on 7th July 2014 with a draft proposal for categorisation of generating units. SONI's draft assessment of prioritisation was based on its judgment of the relative importance of the generators and consideration of the existing and forecast run hours of individual generators during high wind scenarios as a result of generators being in merit, constrained on or having priority dispatch.

The draft categorisation list was shared and discussed with generators at a meeting in July 2014 and was also discussed during subsequent meetings between SONI and individual generators in December 2014.

Following these discussions with the generators SONI produced a modified list which was submitted to UR for approval. The agreed final categorisation list is included in Figure 1 below. A 24 month, mid priority, category is included in the ROI decision but not in the NI decision however the table below includes this period for comparison. The Capacity values in Figure 1 have been amended to better reflect the capacity of the units from a RoCoF compliance requirement perspective and the removal of an exempt unit that is now decommissioned. The categorisation of the units in NI remains unchanged from the initial submission.

As a consequence of UR decision paper which states 'The generation that will be within the scope of this decision paper will be limited to transmission connected generation and to >5MW power stations connected to the 33kV distribution network' Lisahally Power station has now been included in the RoCoF process as a 'new' unit. This unit was not included earlier in the process as it was undergoing commissioning as the process started hence the classification as a 'new' unit now. SONI have had initial discussions with Evermore energy and Burmeister & Wain Scandinavian Contractor (BWSC) and informed them of their requirements under the process. UR was informed of the SONI proposal to include Lisahally Power station in the RoCoF process. Lisahally Power station will be allowed six months to complete studies, and to undertake testing to confirm compliance to the RoCoF standard of 1 Hz/s.

| Category | Northern Ireland Units | | | |
|---|---|---|---|---|
| | **Station** | **Unit ID** | **Capacity (MW)** | **Owner** |
| **1- High Priority**<br>**18 mths** | **Kilroot** | K1 | 256 | AES |
| | | K2 | 238 | AES |
| | **Ballylumford** | B10 | 101 | AES |
| | | B31 | 245 | AES |
| | | B32 | 245 | AES |
| | **Coolkeeragh** | C30 | 425 | ESB |
| **2- Mid Priority**<br>**24 mths** | (UR decision does not reference a 24 month period) | | | |
| **3 - Low Priority**<br>**36 mths** | **Ballylumford** | BGT1 | 58 | AES |
| | | BGT2 | 58 | AES |
| | **Kilroot** | KGT1 | 29 | AES |
| | | KGT2 | 29 | AES |
| | | KGT3 | 42 | AES |
| | | KGT4 | 42 | AES |
| | **Coolkeeragh** | CGT8 | 53 | ESB |
| **4 - Exempted** | **Ballylumford** | BST4 | 144 | AES |
| | | BST5 | 147 | AES |
| **5 - New** | **Lisahally Power** | | | |
| | | LPS | 18 | Evermore |

**Figure 1 NI Generator RoCoF categorisation list**

# Project Progress

## 4.1 Background

Though one of the issues in raising the RoCoF level for the large conventional generators is the risk of losing synchronous stability during leading power factor operation the conventional generators have stated that they do not know what the full impact of a 2Hz/s RoCoF event on their plant will be. Some conventional generators have cited safety concerns (e.g. catastrophic failure of a unit) as well as the potential adverse impacts of frequent high RoCoF events on the lifetime of the plant equipment. Therefore, detailed technical studies have to be undertaken by the generators in order to determine compliance with the new RoCoF standard. Typically, plants will have to be adequately represented with their electro-mechanical limitations, such as flame stability and combustion controls, mechanical stress and transient torque on the turbine and rotor shaft, generator control and protection equipment (e.g. governor, generator, excitation system including power system stabiliser – if installed, and protection), and additional auxiliary equipment required to operate the unit such as large motors to driving, for example, cooling water pumps.

While the exact nature and scope of the studies units will have to undertake will vary, the scope of studies has been divided in to two broad sets of studies:

- Electrical dynamic simulations: The purpose of these studies is to assist SONI in assessing the impact on the transmission system of each generation unit's response to 2Hz/s over 500ms RoCoF values.
- Mechanical/Plant integrity studies: This set of studies aims to examine whether the safety or plant integrity issues previously raised by some generators are material.

The DSO has a significant amount of generation connected to the distribution system in NI, currently approximately 90% of the wind generation in NI is connected on the distribution system. There is also a significant amount of small-scale generation connected to the distribution system and both this and the wind have to be included in the RoCoF change implementation plan to allow the TSO to operate the system at higher levels of renewable generation. As such there is a DSO project as part of the RoCoF changes and as required by the URegNI RoCoF decision, an update on the DSO implementation project is to be included in this six monthly update. This is included in section 4.3 below.

## 4.2 Progress of conventional generators

The RoCoF Implementation project formally commenced on the 21st November 2014, bilateral meetings were held between the generators and SONI at the end of Q4 2014 to start the process. Each Generator was requested to provide a detailed project plan to which progress could be monitored and measured against.

This section contains the progress for Q2 of 2017, the third progress report, for the generation stations identified in the approved categorisation list. In the report all category 3 units are assumed to be on target at this stage as the focus to date has been on category 1 units and putting the relevant contracts in place to ensure the targets for these units are met.

Progress for each category 1 generator and the overall project status is assessed against the project programme using corresponding "traffic light" indicators as shown in Table 1. A summary for the progress of each Power Station is then presented.

| Overall Summary | |
|---|---|
| All generators have started the project with high priority plant generally further advanced than low priority plant.<br>As can be seen in the reports a number of units have not met the category 1 deadline. It has also been highlighted that should the studies necessitate remedial action then it may not be possible to complete the works within the time period. | |
| Overall Status |  |
| **Station/Unit** | **Progress** |
| Ballylumford B10 |  |
| Ballylumford B31 |  |
| Ballylumford B32 |  |
| Kilroot K1 |  |
| Kilroot K2 |  |
| Coolkeeragh C30 |  |
| Lisahally Power |  |

**Table 1 Project progress**

| Generator | Progress |
|---|---|
| AES Ballylumford Power station |  |

AES have engaged with the OEM for the three CCGTs at this station; studies for B31 and B32, and for B10 have been received and reviewed by SONI. Comments were returned and reports amended, and all three units entered the testing phase of the project – to be completed by the end of March 2017.

B10 was tested on March 24th, 2017 and was deemed to have passed. B31 and B32 were tested on March 22nd and 23rd, respectively, with repeat testing carried out on B31 on March 27th and 28th. Results here are of serious concern, with severe active power oscillations evident on both units in response to a test whereby a frequency injection of -0.5Hz at -1Hz/s was followed by +1Hz (net +0.5Hz) at +1Hz/s one second later. AES again engaged with the OEM; in determining the cause of these oscillations the manner in which the frequency injection was applied was deemed to be the most significant factor. A software change was implemented to correct this, and repeat testing was carried out on June 13th. Similar oscillations were again evident. This behaviour is being investigated by AES and the OEM.

A GPI has been applied since April 2017.

| Generator | Progress |
|---|---|
| AES Kilroot Power station |  |

AES have engaged with the OEM. This OEM had a significant number of requests for studies from generators on the island, which has led to a delay in submissions to AES. AES submitted an initial report and feedback was provided by SONI. The points raised are still in clarification with the OEM.

The Category 1 deadline having been missed, AES have been incurring a GPI for these units since June 2016.

| Generator | Progress |
|---|---|
| ESB Coolkeeragh Power Station |  |

The Coolkeeragh CCGT (C30) required that two studies be conducted; one for the gas turbine and generator, and one for the Steam turbine and generator. These were compiled by different providers. The reports were submitted and have been assessed by SONI. Additional information was provided, on the basis of which the reports were approved, and C30 moved into the testing phase of the project – to be completed by September 2017.

SONI are aware that this deadline may not be met due to unavailability of personnel from the OEM. ESB have been advised that a derogation, if appropriate, must be in place by the end of the testing phase.

## 4.3 Progress of DSO

| DSO | Progress |
|---|---|
| NIE Networks |  |

NIE Networks revised the completion dates of their tasks in the RoCoF work stream to Q3 2017 in line with end of the Generation studies.

The completion of the NIE Networks work is dependent on several factors: a positive outcome from academic research; agreement between NIE Networks and Health & Safety Executive Northern Ireland with regards to an acceptable increase in risk; cooperation from generators in amending Loss of Mains (LOM) protection settings and implementation of the necessary code changes.

SONI have been informed that NIE Networks do not intend to change (or enforce the change) of any of the 300MW embedded generators to the new RoCoF standard – as yet no formal written confirmation of this has been received. This represents a significant material risk to DS3, as it would pose significant challenges to moving beyond 65% SNSP.

## 4.4 Progress of Lisahally Power station

| Generator | Progress |
|---|---|
| Lisahally Power station |  |
| There has been ongoing dialogue between SONI and representatives of Lisahally Power station in relation to the RoCoF process. SONI have provided clarification where necessary and studies appear to be in progress but no report has been received. Evermore Energy are believed to be pursuing a derogation.<br><br>Evermore Energy has been incurring a GPI for this unit since 23rd January 2017. | |