DS3:
Grid Code Workstream

CONTEXT

The purpose of the Grid Codes in Ireland and Northern Ireland is to set the (minimum) standards relating to the operation and use of the Transmission System and define material technical aspects relating to the use of plant or apparatus connected to the Transmission or Distribution system. The Grid Codes are active documents that are continuously under scrutiny, review and modification. This reflects the dynamic nature of the power system where technology is continuously evolving and operating practices and procedures are updated in tandem. There is a process in place for modifying the Grid Codes via the Grid Code Review Panels. Common sections of the codes can be modified via the Joint Grid Code Review Panel. The Grid Codes have already undergone many changes to incorporate and reflect the particular technical characteristics of wind generation. In recent times, government policy has placed an emphasis on connecting renewable generation to the grid, particularly wind. Recent technical studies carried out by the TSOs and their consultants have shown that very high wind penetrations will necessitate further Grid Code changes to ensure system stability, and these changes should be harmonised as much as possible between Ireland and Northern Ireland to achieve an all-island effect. These changes will be discussed below and form a key part of the DS3 project. In addition, there is a possibility of many new technologies, such as waste-to-energy generation, marine energy, electric vehicles, and smart-grid devices that may require further changes to the Grid Code. Ireland and Northern Ireland form a single synchronous system, and it is therefore imperative that EirGrid and SONI ensure that a consistent approach is applied in both the Ireland, and Northern Ireland Grid Codes.

UPCOMING AND POTENTIAL GRID CODE MODIFICATIONS

There are several Grid Code modifications that will be required in the near future (late 2011/2012), and several others which are on the horizon but may not require actual changes until 2013 or beyond.

Windfarm Steady-State Control Modes

There have been recent changes to windfarm voltage control modes, which specify the different ways in which windfarms can control voltage in normal or steady-state operation. There may be further changes required as technology develops and as our understanding of power system operation with very high wind penetrations develops.

Dynamic Active and Reactive Power Provision – Wind farms and Conventional Plant

Currently in the Grid Code, it is not clear what wind farms should do in terms of active and reactive power response during faults. There is also some confusion about wind turbine response and wind farm response which needs to be addressed. One of the key outcomes from the recent *Facilitation of Renewables* study was that the transient stability of the power system would be degraded at very high wind penetrations. However, this can be mitigated against if wind farms act quickly to support voltage during faults, as this will have the effect of making the power system more stable. As wind farm technology develops, many different options are becoming available as to how windfarms should behave during faults. Any changes needed will be drafted and presented to the Grid Code Review Panel(s).

The dynamic response of conventional plant and embedded generation will also be reviewed, and it is expected that results from the voltage control workstream and the system studies workstream will be a key part of this review.

Rate of Change of Frequency

The Irish Grid Code currently says that conventional generators should stay connected to the system for rates of change of frequency up to 0.5Hz/s. Transmission-connected windfarms are exempt from this clause in the Grid Code. The Irish Distribution Code has a similar figure rate of change of

frequency value that applied to distribution-connected windfarms. The Northern Ireland Grid Code for transmission connected generation does not state a figure.

Studies have shown rates of change of frequency encroaching on this value and it presents a clear threat to the power system as significant amounts of generation could be lost in a situation where the system inertia was low and a rapid change of frequency was experienced. The 0.5Hz/s value is not appropriate for an island system such as Ireland and Northern Ireland, especially if a significant amount of non-synchronous generation connects to the system. This factor alone could limit the instantaneous penetration of wind power on the system. The TSOs will be proposing a change to this standard, recommending that all generation, including embedded generation, shall remain connected for rates of change of frequency higher than the current 0.5Hz/s. The final recommendation will be agreed by the TSOs and relevant stakeholders and may be up to ±4Hz/s. The TSOs will work with the DSOs to have this standard adopted across the board, and will work with industry stakeholders to understand and resolve any issues relating to the change. The agreed changes will be included in all Grid and Distribution Codes.

Negative Reserve

In Ireland and Northern Ireland, which has had limited interconnection to other power systems, the topic of negative reserve – the ability to ramp down during high frequency events – has rarely surfaced, and is not covered in the Grid Code. However, with the East-West Interconnector commissioning in 2012, and with potential for other interconnectors in the future, it is appropriate that the topic of negative reserve be discussed at this time within the context of the DS3 programme. The issue is that if large amounts of power are exported on the interconnectors, and these interconnectors trip, the surplus power could drive the frequency very high, perhaps leading to cascade tripping of generation.

Demand Side Management

Existing standards in the Grid Codes for Demand Side Units (DSUs) and Aggregated Generator Units (AGUs) need to be reviewed during 2012 based on any relevant experience of operation of these units. This is also tied in with the DSM workstream as part of the DS3 programme.

Waste-to-Energy

There are several waste-to-energy plants expected to connect to the grid in the near future. These plants' primary function is to incinerate waste, with electricity being generated from steam as a by-product. As such, they have to meet strict environmental regulations on emissions, leading to a situation where although they have the technical ability to provide operating reserve, they are precluded from doing this by the EPA because it leads to extra emissions and decreases their overall efficiency. There is quite a limited scope for waste-to-energy plants in Ireland and Northern Ireland, with a maximum of 150-200MW expected, based on the current amount of waste being sent to landfill. Because these are one-off plants, there may be a case for exempting them from the provision of operating reserve, rather than getting them to seek derogations, although this has yet to be decided. Waste-to-Energy plants are designated as 'renewable' plant under the EU rules, and thus will help achieve Ireland's target of 37% electrical energy from renewable sources by 2020. They also constitute a new fuel source, thus increasing the fuel diversity on the system.

Dynamic Model Requirements

Dynamic models are of paramount importance for both planning and operating a secure and sustainable power system. A dynamic model is usually supplied as a Laplace representation of the equipment in question. As control systems have become more complex, and new simulation packages have been introduced, there is a clear need to revise the Dynamic Model Requirements in the Grid Code for conventional plant and for wind farms. Various issues related to supplying models

to third-parties, or the use of 'black-box' type models have cropped up repeatedly in recent times. The DS3 programme will be an opportunity to bring clarity to all stakeholders on the current requirements for dynamic models. In particular, for system-level studies, dynamic models should accurately represent the aggregate behaviour of the plant at the grid connection point, including any delays and unusual control modes that can occur. More detailed models may be required for localised studies.

European Network Code

There is continuing development of a European Network Code that will be adopted by members of ENTSO-E. It is important that the current Grid Code and the new European Code are compatible, and so there is ongoing work in ensuring that the European Code is developing in line the requirements of the Ireland and Northern Ireland synchronous power system. The European Network Code is expected to be transposed into national laws mid 2012, and will comprise a minimum set of standards that all plant must adhere to.

Storage Devices

Although there are currently some energy storage devices on the Ireland and Northern Ireland power system, there is the prospect of many new storage technologies becoming available in the future for provision of a variety of different system services, such as demand-side management, balancing and frequency regulation. It is appropriate that some consideration is given to the nature of storage devices as part of the DS3 programme.

Biomass Generation

There is potential for significant amounts of biomass generation to connect to the system in the future. Biomass would be categorised as a non-variable renewable energy resource, and as such could be granted priority dispatch. Biomass plants tend to be self-dispatching, and so there is an issue about whether they could be deemed Centrally-dispatchable generation units (CDGUs), or whether they would require new Grid Code clauses to be inserted.

New Technologies

EirGrid and SONI are maintaining a watching brief on all new technologies such as Biofuels, Marine Energy, Offshore Wind, Electric Vehicles, Energy Storage Devices and Smart Devices. While there are no concrete proposals at the moment to introduce new sections of the Grid Code to deal with new technologies, EirGrid and SONI will be proactive in introducing new Grid Code clauses if they are required. EirGrid and SONI also recognise that the European Network Code may include standards on these new technologies, removing the need to introduce specific Ireland and Northern Ireland Grid Code modifications.

GRID CODE DEVELOPMENT FOR DS3 PROJECT - HIGH LEVEL PLAN

Wind farm Steady-state control modes	Responsibility	Timeline
• Follow up on Grid Code changes with performance monitoring and testing	TSOs	Q1 2012
• Discuss WFPS voltage control modes with DSOs – and develop changes to Distribution Codes as necessary	TSOs	Q2 2012
• Bring any further changes to GCRPs / DCRPs and RAs as appropriate	TSOs	Q4 2012
Dynamic Active and Reactive Power Response – Wind farms and Conventional Plant		
• Decision on WFPS Reactive Power Modes in Grid Code	CER	In progress
• Draft proposal on WFPS Dynamic Reactive Power	TSOs	Q1 2012
• Agree all island position on WFPS Reactive Power	TSOs	Q1 2012
• Draft proposal for Ireland and Northern Ireland GCRPs and present	TSOs	Q2 2012
• Engagement with stakeholders	TSOs	Q2 2012
• Final proposal for Ireland and Northern Ireland GCRPs / RAs for approval	TSOs	Q3 2012
• Decision on proposals	RAs	Q4 2012
• Discuss changes with DSOs & Plan Distribution Code Change	TSOs /DSOs	Q4 2012
• DSOs to bring forward proposals for Distribution Code Change	DSOs	Q1 2013
• Decision on proposals	RAs	Q2 2013
• Draft proposals on changes to conventional/embedded generation active and reactive power response	TSOs	Q3 2013
• Bring proposals to industry / GCRPs / RAs as appropriate	TSOs	2014
Rate of Change of Frequency Ride-Through Ability		
• Bring proposal on change to ROCOF to Ireland GCRP	TSOs	Complete
• SONI to investigate how ROCOF can be implemented in NI Grid Code	SONI	In progress
• Present proposal to DS3 advisory council	TSOs	Complete
• Establish Grid Code Working Group on ROCOF	TSOs/RAs/Industry	Q1 2012
• Discuss ROCOF with industry / stakeholders and agree a common position	ROCOF WG	Q2 2012
• Bring final proposal on ROCOF to GCRP / RAs for approval	TSOs	Q3 2012
• Decision on proposals	RAs	Q4 2012
• Discuss changes with DSOs & Plan Distribution Code Changes for ROCOF relays	TSOs /DSOs	Q4 2012
• Review and Implementation of new standards	TSOs/DSOs/Industry	Q4 2013
Waste-to-Energy		
• Draft internal discussion document on different approaches	TSOs	Complete
• Bring proposal to Ireland GCRP (Grid Code modification or derogation option)	TSOs	Complete

• Decision on proposals	CER	Q1 2012
Dynamic Model Requirements		
• Look at international requirements (UK/US/Australia/Europe etc.) on dynamic models	TSOs	Q1 2012
• Review current requirements and collate ideas	TSOs	Q2 2012
• Draft Grid Code modification / discuss with relevant parties	TSOs	Q4 2012
• Bring proposal to GCRP/JGCRP, regulators	TSOs	Q1 2013
Demand-side Management		
• Bring modifications on Demand-side unit MEC to GCRP	TSOs	Q4 2011
• Review of Grid Code standards for DSU and AGU	TSOs	Q4 2012
Grid Code Development and New Technologies		
• Monitor output from DS3 Workstreams to identify further Grid Code Changes	TSOs	Quarterly Review
• Watching brief on new technologies: Marine Energy / Off-shore Wind / Smart Devices	TSOs	2012/2013/2014
• Tentative proposals for integrating new technologies into the grid	TSOs	2013
Negative Reserve		
• Carry out a review of international best practice on negative reserve	TSOs	Q2 2012
• Develop an appropriate modification to the Grid Code(s) to cover off this area	TSOs	Q4 2012
• Decision on proposals	RAs	Q2 2013
Storage Devices		
• Review of storage technologies	TSOs	Q4 2012
Biomass		
• Review of biomass technologies and characteristics	TSOs/Industry	Q3 2012
• Develop appropriate modifications to the Grid Codes to cover off this area	TSOs	Q4 2012
• Decision on proposals	RAs	Q2 2013