Grid Code
Modification Proposal Form

Email to gridcode@eirgrid.com

Title of Modification Proposal:

Clarification of PPM FRT Requirements in PPM1.4.2 (c): Reactive current response during voltage dip

MPID (EirGrid Use Only):

Date:	04 November 2019		
Company Name:	EirGrid		
Applicant Name:	Ahmad Tahboub		
Email Address:	Ahmad.tahboub@eirgrid.com	**Tel:**	+353 (0)1 677 0897
Grid Code Version:	8		
Grid Code Section(s) Impacted by Modification Proposal:	PPM1.4.2(c)		

Modification Proposal Justification:

Several years ago, as part of the DS3 programme, the Grid Code requirements for windfarms were updated. This was done in order to support the move to higher wind limits (SNSP levels). As experience in testing and operating windfarms has grown, a general concern has emerged in the Wind Industry that the DS3 Grid Code modification around what response is expected from windfarms during and after a fault is not sufficiently clear. Over the past year, EirGrid and the Wind Industry (through IWEA) have had extensive discussions about how the Grid Code requirements could be made clearer. This particular modification concerns how much reactive current a windfarm should provide during a fault.

PPM1.4.2(a) currently states: “During Transmission System Voltage Dips, the Controllable PPM shall provide Active Power in proportion to retained Voltage, and provide reactive current as set out in PPM1.4.2(c)”. PPM1.4.2(c) states that the reactive current should be at least proportional to the voltage dip. Taken together, these two statements may be seen as contradictory, as it may not be possible for a windfarm to provide both requirements, depending on pre-fault P and Q operating points.

The main aim of the Fault Ride Through requirements in the Grid Code is to ensure that when a fault occurs, a large active power (MW) imbalance is not experienced by the system, which could be the case if windfarms did not maintain their MW output as best as they can. On the other hand, injection of reactive power (MVArs) will help the voltage to recover back towards its nominal value (e.g. 110kV) or whatever the pre-fault voltage was. This functionality helps to maintain transient stability of the system during periods of high wind.

The proposed modification replaces the requirement for the reactive current to be “at least proportional to voltage dip”, with the maximization (or otherwise) of the total PPM current injection with priority for active current.

For less onerous faults, the reactive current injection required to increase the voltage at the point of common coupling (connection point) back to nominal voltage may be less than the maximum possible injection. In such a case, if the windfarm were to inject maximum reactive current, it could create a high voltage issue.

Taking all of the above into account, we propose the following requirement for reactive current during a fault, given active power proportionality:

$$I_{q\ target\ fault-on}[pu] = min\begin{cases} \sqrt[2]{1-\left(I_{active\ pre-fault}[pu]\right)^2} \\ I_q\ to\ control\ V_{PCC}\ to\ nominal\ [pu] \end{cases}$$

The PPM does not have to contribute current in excess of the reference current. The reference current is the maximum total current at the connection point, based on nominal voltage, and a power factor of 0.95.

The reference current is calculated as:

$$I_{ref}[kA] = \frac{Registered\ Capacity\ [MW]}{0.95\ \times V_{nominal}[kV] \times \sqrt{3}}$$

A glossary entry for reference current is also proposed – see below.

Red-line Version of Impacted Grid Code Section(s) - show proposed changes to text:
Deleted text in ~~strike-through red font~~ and new text highlighted in blue font

During and after faults, priority shall always be given to the Active Power response as defined in PPM1.4.2(a) and PPM1.4.2(b). The reactive current response of the Controllable PPM shall attempt to control the Voltage back towards the nominal Voltage, *~~and should be at least proportional to the Voltage Dip~~. up to the Reference Current Rating of the Controllable PPM as required*. The reactive current response shall be supplied within the rating of the Controllable PPM, with a Rise Time no greater than 100ms and a Settling Time no greater than 300ms. *The **Reference Current Rating** is calculated as per the formula below:*

$$I_{ref}[kA] = \frac{\textbf{Registered Capacity}\ [MW]}{0.95\ \times V_{nominal}[kV] \times \sqrt{3}}$$

For the avoidance of doubt, the Controllable PPM may provide this reactive response directly from individual Generation Units, or other additional dynamic reactive devices on the site, or a combination of both.

Glossary Entry:
Reference Current Rating: *The magnitude of the total current per phase, at nominal voltage, of a **Power Park Module** when it is operating at its **Registered Capacity** and at a **Power Factor** of 0.95, as measured at its **Connection Point**.*

Green-line Version of Impacted Grid Code Section(s) - show proposed final text:

During and after faults, priority shall always be given to the **Active Power** response as defined in PPM1.4.2(a) and PPM1.4.2(b). The reactive current response of the **Controllable PPM** shall attempt to control the **Voltage** back towards the nominal **Voltage** up to the **Reference Current Rating** of the **Controllable PPM** as required. The reactive current response shall be supplied within the rating of the **Controllable PPM**, with a **Rise Time** of no greater than 100ms and a Settling Time of no greater than 300ms. The **Reference Current Rating** is calculated as per the formula below:

$$I_{ref}[kA] = \frac{\textbf{Registered Capacity}\ [MW]}{0.95\ \times V_{nominal}[kV] \times \sqrt{3}}$$

For the avoidance of doubt, the **Controllable PPM** may provide this reactive response directly from individual **Generation Units**, or other additional dynamic reactive devices on the site, or a combination of both.

GLOSSARY:
Reference Current Rating: The magnitude of the total current per phase, at nominal voltage, of a **Power Park Module** when it is operating at its **Registered Capacity** and at a **Power Factor** of 0.95, as measured at its **Connection Point**.