

PPM Reactive Power modifications to EREC G99/NI

Distribution Code Consultation

Target Audience: All current and prospective manufacturers, developers, owners and operators of generation (and storage) of any size connecting to the distribution network.

Date published: 16 June 2023

Deadline for responses: 28 July 2023

Summary:

This Distribution Code public consultation is seeking the views from stakeholders on a proposed modification to the existing Distribution Code document Engineering Recommendation ERG99/NI.

1 Introduction

Concern has been raised by industry participants¹ that the Power Park Module (PPM) reactive power capability requirements in EREC G99/NI is unnecessarily onerous and means Northern Ireland is uncompetitive compared to its neighbouring jurisdictions in respect of the connection of renewable generation.

The modification proposed here is the first modification to G99/NI and pertains to Type C and D Power Generating Modules in respect of reactive power capability.

Included in this consultation document is Annex 1 – Proposed changes to G99/NI.

2 The Defects

The document proposed for modification is EREC G99/NI (Issue 1 – April 2019).

2.1 G99/NI Modifications

2.1.1 Title Page

The cover page will be amended to include “Amendment 1” and the effective date.

2.1.2 Amendments since publication

An item will be added summarising the significant changes that were made in this amendment.

2.1.3 Fault Ride Through

Paragraph 13.3.1.11 (a) referenced 13.5.1 only. This paragraph (13.5.1) now refers to Synchronous Power Generating Modules only. Hence, it is proposed to add a reference in paragraph 13.3.1.11 to the new paragraph 13.5.4 to encompass Power Park Modules.

2.1.4 Reactive Capability

Paragraphs 13.5.1 to 13.5.3 referred to Power Generating Modules without distinguishing between Synchronous Power Generating Modules and Power Park Modules. Hence it is proposed to amend these sections to clearly refer to Synchronous Power Generating Modules. Furthermore, clarity regarding the Power Capability requirements for Power Park Modules will be provided in paragraphs 13.5.4 to 13.5.6.

Clarification that the Reactive Power capability requirements at the Connection Point when operating at Registered Capacity as specified in paragraph 13.5.1 applies to Synchronous Power Generating Modules has been made by amending 13.5.1 to include the text “Synchronous” before “Power Generating Modules”.

Clarification that the Reactive Power capability requirements at the Connection Point when operating at an output level other than Registered Capacity as specified in paragraph 13.5.2 applies to Synchronous Power Generating Modules has been made by amending 13.5.2 to include the text “synchronous” before “Generating Units”.

¹ Report submitted to NIE Networks by Renewable Energy Systems (RES), September 2022 at the request of the Renewable NI Group

Clarification that Figure 13.6 refers to Synchronous Power Generating Modules by amending the caption to “Reactive Power capability requirements (Synchronous Power Generating Modules operating at Registered Capacity)”.

Paragraph 13.5.3 specifies the voltage limits above and below which a Synchronous Power Generating Module shall maintain the Reactive Power output and Power Factor as far as possible recognising the constraints expressed by the Generator Performance Chart. It is proposed that the voltage limits be adjusted from above 1.05 pu or below 0.95 pu to above 1.06 pu or below 0.94 pu. This is consistent with Figure 13.6 and Northern Ireland existing requirements.

Clarification that Figure 13.7 refers to Synchronous Power Generating Modules by amending the caption to “Reactive Power capability requirements (Synchronous Power Generating Modules operating below Registered Capacity)”.

The approach taken in Engineering Recommendation G99 GB, for Power Park Modules connecting below 33 kV where the specified power factor/ voltage capability is not rectangular but shaped to allow the reactive power contribution at the connection point to reduce as the voltage rises and the reactive power consumption to reduce as the voltage falls has been adopted. This should reduce the cost of the connection, especially where there is a large distance between the Power Park Module and the connection point.

Proposed addition of paragraph 13.5.4, “All Power Park Modules shall be capable of satisfying the Reactive Power capability requirements at the Connection Point as defined in Figure 13.8 when operating at Registered Capacity.” In addition, it is proposed to add Figure 13.8 which depicts the Reactive Power capability requirements for Power Park Modules operating at Registered Capacity. This is a non-rectangular requirement.

Proposed addition of paragraph 13.5.5, “At voltages above 1.06 pu, or below 0.94 pu a Power Park Module shall maintain the Reactive Power output and Power Factor as far as possible recognizing that outside of the envelope of Figure 13.8 it will be necessary for the Reactive Power and/or Power Factor to be constrained by the capability as expressed on the Generator Performance Chart.”

In respect of the requirements for Reactive Power capability when operating at below Registered Capacity it is proposed to refer to the existing requirements in the Power Park Module Setting Schedule:

- Figure 2, Minimum Reactive Capability Characteristic of the PPM at the Connection Point defines the capability of the Power Park Module when operating in voltage or reactive power control mode.
- Figure 3, Minimum Power Factor Performance Chart for Transmission and Distribution Connected PPM defines the reactive power capability requirements when operating in power factor control mode.

Following the approach taken in Engineering Recommendation G99 GB where a PPM comprises multiple generating units it is proposed to pro rata the reactive power requirements.

Proposed addition of paragraph 13.5.6, “When operating below Registered Capacity, all Power Park Modules, shall be capable of satisfying the Reactive Power capability requirements at the Connection Point as defined in Figure 2 and Figure 3 of the PPM Setting Schedule when the Connection Point voltage is 1.0 pu. When the Connection Point voltage is not 1.0 pu, the Reactive Power capability requirements defined in Figure 2 and Figure 3 of the PPM Setting Schedule shall be limited in accordance with those indicated by Figure 13.8. These Reactive Power limits will be reduced pro rata to the amount of plant in service”.

2.1.5 Control Modes

Paragraphs 13.8.3.1 to 13.8.3.3 referred to the control mode requirements of Power Generating Facilities without distinguishing between Synchronous Power Generating Modules and Power Park Modules. In addition, “Facility” was used interchangeably with “Module” thereby leading to an

ambiguous interpretation thereof. Hence it is proposed to amend these sections to clearly refer to Synchronous Power Generating Modules.

Furthermore, it is proposed to add paragraphs 13.8.3.4, 13.8.3.5 and 13.8.3.6 which specify the Reactive Power capabilities of Power Park Modules whilst operating in Power Factor, Voltage, and VAr control modes, respectively. These paragraphs refer to the existing Figures 2 and 3 in the Power Park Module Setting Schedule.

3 Applicable Distribution Code Objectives

The applicable Distribution Code Objectives are to:

- (a) permit the development, maintenance, and operation of an efficient, co-ordinated, and economical system for the distribution of electricity; and
- (b) facilitate competition in the generation and supply of electricity; and
- (c) efficiently discharge the obligations imposed upon distribution licensees by the distribution licences and comply with the Regulation and any relevant legally binding decision of the European Commission and/or the Agency for the Co-operation of Energy Regulators; and
- (d) specify the minimum technical, design and certain operational criteria which must be complied with by Users connected to or seeking connection with the Distribution System; and
- (e) promote efficiency in the implementation and administration of the Distribution Code.

4 Consultation Questions

- 1. Do you agree with the general intent of the proposed modification? If not, please explain your views.
- 2. If you have any detailed comments on the proposed drafting, please provide those comments in the proforma provided, or by marking up the consultation draft of G99/NI.
- 3. Do you agree that the proposed modifications satisfy the applicable Distribution Code objectives? If not, please explain your concerns.

5 Next Steps

Responses to this consultation should be sent to the Distribution Code Administrator at Dcode@nienetworks.co.uk by 1700 on 28 July 2023 on the pro-forma provided expressly for the purpose, or via any other convenient means. Responses after this date may not be considered.

For more information, please contact:

Distribution Code Administrator – Dcode@nienetworks.co.uk

Annex 1 – Proposed changes to G99/NI

The document in this Annex details the paragraphs which for which changes to G99/NI text are proposed. Significant changes are highlighted in red.

1. **Fault Ride Through**

13.3.1.11 In addition to the requirements in 13.3.1.3 to 13.3.1.10:

- (a) Each **Power Generating Module** shall be capable of satisfying the above requirements at the **Connection Point** when operating at **Registered Capacity** output and maximum leading **Power Factor** as specified in paragraph 13.5.1 and 13.5.4, as applicable.

2. **Reactive Capability**

13.5.1 All **Synchronous Power Generating Modules** shall be capable of satisfying the **Reactive Power** capability requirements at the **Connection Point** as defined in Figure 13.6 when operating at **Registered Capacity**. In some cases, for example, on large industrial sites etc where the **Synchronous Power Generating Module** is embedded in the **Generator's Installation**, the **DNO** may specify requirements that fit within the rectangular boundary defined in Figure 13.6, ie an envelope agreed between the **DNO** and the **Generator** within the rectangle of Figure 13.6. In such cases the **DNO** and **Generator** might agree a different control point, such as the **Power Generating Module's** terminals. The performance requirements of the control system including **Slope** (where applicable) shall be agreed between the **DNO** and the **Generator**. For the avoidance of doubt, where the **Generator's Installation** involves **Power Generating Modules** and demand the entire **Generator's Installation** shall be considered to be a **Power Generating Facility** and shall be capable of delivering **Reactive Power** performance at the **Connection Point**. However, where complex **Generator's Installations** involve **Power Generating Modules** and demand, the **Generator** may submit calculations to support compliance.

13.5.2 At **Active Power** output levels other than **Registered Capacity** all **synchronous Generating Units** shall be capable of satisfying the **Reactive Power** capability requirements at the **Connection Point** as defined in Figure 13.7 when operating below **Registered Capacity**, taking the auxiliary supplies and the **Active Power** and **Reactive Power** losses of the **Power Generating Module** transformer or **Station Transformer** into account. These **Reactive Power** limits will be reduced pro rata to the amount of plant in service.

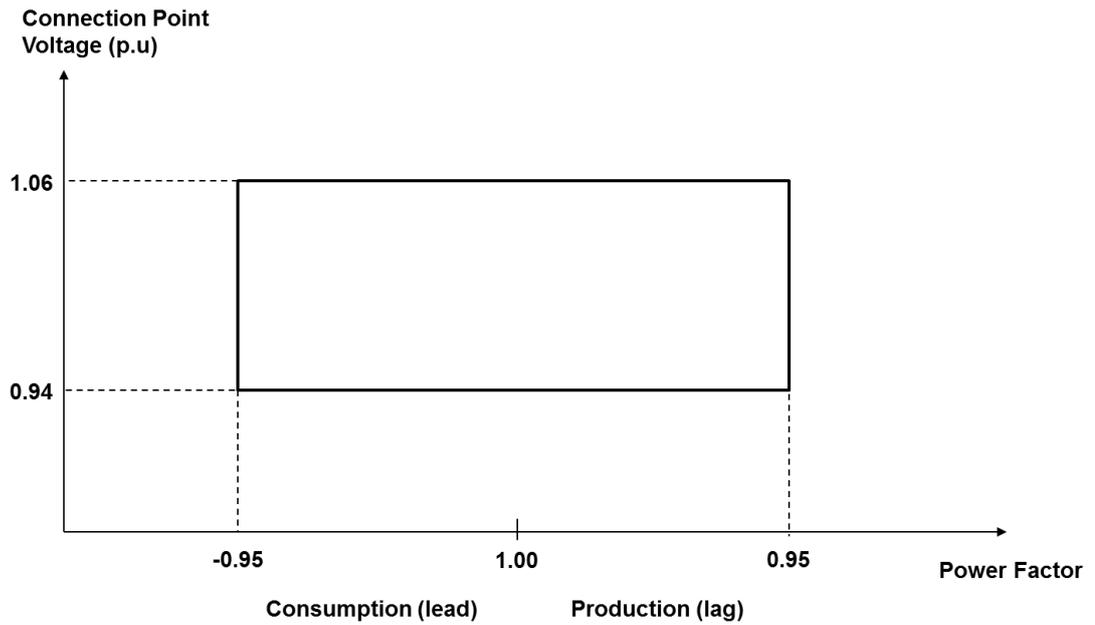


Figure 13.6 Reactive Power capability requirements (**Synchronous Power Generating Modules operating at Registered Capacity**)

13.5.3 At voltages above 1.06 pu, or below 0.94 pu a **Synchronous Power Generating Module** shall maintain the **Reactive Power** output and **Power Factor** as far as possible recognizing that outside of the envelope of Figure 13.6 it will be necessary for the **Reactive Power** and/or **Power Factor** to be constrained by the capability as expressed on the **Generator Performance Chart**.

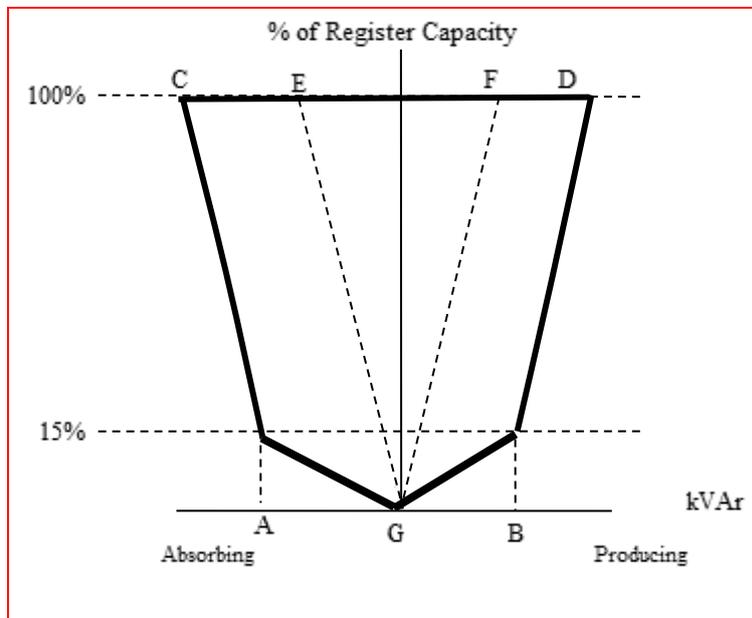


Figure 13.7 Reactive Power capability requirements (**Synchronous Power Generating Modules operating below Registered Capacity**)

13.5.4 All **Power Park Modules** shall be capable of satisfying the **Reactive Power** capability requirements at the **Connection Point** as defined in Figure 13.8 when operating at **Registered Capacity**.

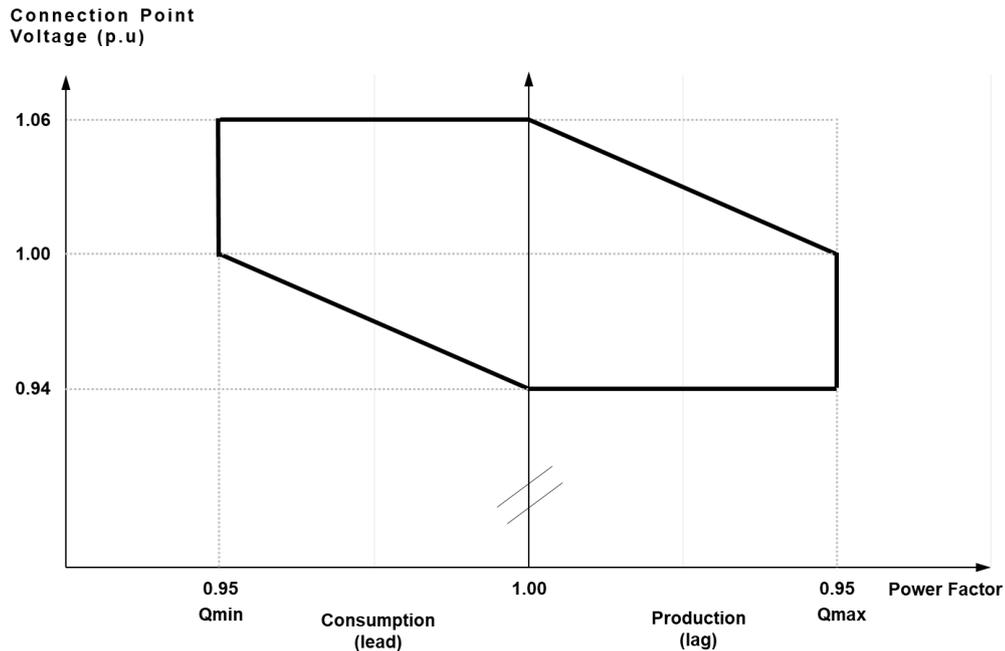


Figure 13.8 Reactive Power capability requirements (Power Park Modules operating at Registered Capacity)

13.5.5 At voltages above 1.06 pu, or below 0.94 pu a **Power Park Module** shall maintain the **Reactive Power** output and **Power Factor** as far as possible recognizing that outside of the envelope of Figure 13.8 it will be necessary for the **Reactive Power** and/or **Power Factor** to be constrained by the capability as expressed on the **Generator Performance Chart**.

13.5.6 When operating below **Registered Capacity**, all **Power Park Modules**, shall be capable of satisfying the **Reactive Power** capability requirements at the **Connection Point** as defined in Figure 2 and Figure 3 of the **PPM Setting Schedule** when the **Connection Point** voltage is 1.0 pu. When the **Connection Point** voltage is not 1.0 pu, the **Reactive Power** capability requirements defined in Figure 2 and Figure 3 of the **PPM Setting Schedule** shall be limited in accordance with those indicated by Figure 13.8. These **Reactive Power** limits will be reduced pro rata to the amount of plant in service.

3. Control Modes

13.8.3.1 Whilst the **Synchronous Power Generating Module** is operating in **Power Factor** control mode its reactive capability is described by the envelope EFG within the **Reactive Power** capability chart given in Figure 13.7.

13.8.3.2 Whilst the **Synchronous Power Generating Module** is operating in voltage control mode, the minimum reactive capability is described by the envelope ACDBG within the **Reactive Power** capability chart given in Figure 13.7.

13.8.3.3 Whilst the **Synchronous Power Generating Module** is operating in VAr Control Mode the **Power Generating Modules** shall be capable of importing or exporting VARs within the envelope described by ACDBG within the **Reactive Power** capability chart given in Figure 13.7.

13.8.3.4 Whilst the **Power Park Module** is operating in **Power Factor** control mode its reactive capability is described by the envelope within the **Power Factor** performance chart given in Figure 3 of the **PPM Setting Schedule**.

13.8.3.5 Whilst the **Power Park Module** is operating in voltage control mode, the minimum reactive capability is described by the envelope ABCDEF within the **Reactive Power** capability chart given in Figure 2 of the **PPM** Setting Schedule.

13.8.3.6 Whilst the **Power Park Module** is operating in VAr Control Mode the **Power Generating Modules** shall be capable of importing or exporting VARs within the envelope described by ABCDEF within the **Reactive Power** capability chart given in Figure 2 of the **PPM** Setting Schedule.