Workshop on RfG Consultation on Parameter Selection

Northern Ireland

11 January 2018

SONI Offices Belfast

Agenda

Registration
09:00 – 09:30

Morning Session
09:30 – 12:30

- Registration & Tea/Coffee
- Background & Context
- Frequency Theme Part 1
- *Tea/Coffee Break*
- Frequency Theme Part 2
- System Restoration Theme

Lunch
12:30 – 13:30

Afternoon Session
13:30 – 4:30

- Voltage Theme Part 1
- *Tea/Coffee Break*
- Voltage Theme Part 2
- Protection Theme
- Close Out

SONI Northern Ireland Electricity Networks

Important Information about RfG

- Applicability of RfG
- Requirements are based on P_{max}
- Banding thresholds for the ‘types of generators’
- Who are the System Operators

Applicability of RfG

- RfG specifies requirements for connection & performance of generators.
- Requirements/parameters are broken down by type & in some instances sub-types
- Requirements/parameters can be generic or site specific

Applicability of RfG

- RfG **does not** apply to the following generators:
  - Existing operational generators
  - Generators whose main plant & equipment is procured* pre May 2018
  - Energy storage devices with the exception of pumped storage
- RfG **does**** apply to the following generators:
  - New i.e. those generators whose main plant & equipment is procured* post May 2018
  - Where a significant modification has been carried out to an existing unit.

** Contracts put in place*

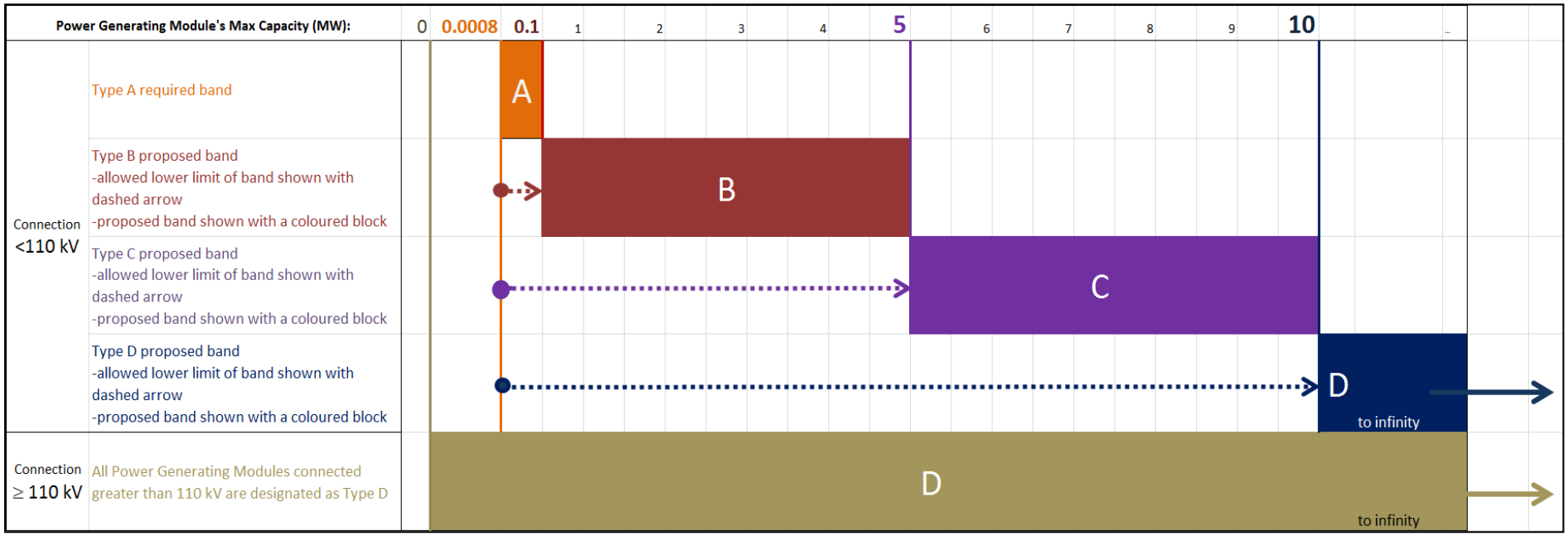
***you must comply with the requirements of RfG which comes into force in May 2019*

Requirements are Based on Pmax

- Current Grid Code requirements are applied based on Maximum Export Capacity (MEC) or Registered Capacity.
- All generation subject to the RfG will be considered based on maximum capacity:
  - 'maximum capacity' or 'P_{max}' means the maximum continuous active power which a power-generating module can produce, less any demand associated solely with facilitating the operation of that power-generating module and not fed into the network as specified in the connection agreement or as agreed between the relevant system operator and the power-generating facility owner
  - i.e. the actual installed capacity less house load.
- **This represents a <u>fundamental change</u> to how requirements are applied to generators and should be fully understood by users.**

Banding Thresholds for Types

- SONI's Minded to Position on Banding Threshold proposes the following:



Banding Thresholds for Types

- SONI's Minded to Position on Banding Threshold proposes the following:

TYPE	RANGE
Type A	800 W – 0.999˙ MW
Type B	1 MW – 4.999˙ MW
Type C	5 MW – 9.99˙ MW
Type D < 110kV	10 MW <
Type D >110kV	ALL SIZES

System Operators

- RfG requests that requirements/parameters are defined by one of three bodies
  - Transmission System Operators
  - Distribution System Operators
  - Relevant System Operators: The system operator to which a generator is connected
- Requirements in the consultation document are proposed as follows:
  - DNO as relevant DSO
  - DNO as RSO
  - TSO as relevant TSO
  - TSO as RSO

Why Are We Consulting

- Required to submit a proposal of general application for approval by the national regulator by May 2018
- For many requirements a decision has to be made nationally about the exact requirements/parameters that are applicable in their jurisdiction
- It is not a requirement of RfG to consult upon the proposals prior to submission to the National Regulator
- However the TSO & DSO have commenced a joint consultation:
  - in the interest of transparency and,
  - to ensure that the TSO & DSO have the best information available to them when submitting the proposals to UR
- Consultation opened on the 20th of December 2017 for a period of 6 weeks

What Are We Consulting On

- Four Types of requirements exist:
  - **Mandatory** means the generator must do something
  - **Non-Mandatory** means TSO & DSO can choose to apply this requirement
  - **Exhaustive** means that a requirement or specific number is given in RfG
  - **Non-Exhaustive** means an allowable range is provided & TSO/DSO must select within that range

What are we consulting on:

- TSO & DSO are consulting on non-mandatory requirements and non-exhaustive parameters.
- Seeking views on new or changed technical requirements that may or will apply to generators.

What are we not consulting on:

- Not seeking views on mandatory requirements or exhaustive parameters as they can't be changed. Further information is available in the ENTSO-E FAQ document.

What Are We Consulting On

Non-Mandatory Requirement Selection

- In the majority of cases the following assumptions are made:
  - Where the RfG requirement is an existing requirement in NI, the requirement is made mandatory in NI.
  - Where the RfG requirement is not an existing requirement in NI, the requirement is not made mandatory in NI.

What Are We Consulting On

Non-Exhaustive Parameter Selection

- There are two examples of non-exhaustive parameter selection under RfG
  - Scenario 1: RfG requests that the RSO selects the value from within a range
  - Scenario 2: RfG does not specify a range and requests that the RSO specify a value.

- In the majority of cases for Scenario 1 the following assumptions are made:
  - where the range provided in the RfG does include the existing value applied in NI, the existing value is proposed.
  - where the range provided in the RfG does not include the existing value applied in NI then the value proposed represents the minimum amount of change possible.

- In the majority of cases for Scenario 2 the following assumptions are made:
  - where the RfG does not provide a value for a non-exhaustive parameter and it is an existing parameter in NI, the existing value is proposed.
  - where the RfG does not provide a value for a non-exhaustive parameter and it is not an existing parameter in NI, a justification is given

How We Developed the Consultation

- Team of experts from the TSO & DSO
- Selection of proposed parameters was based a review of the following:
  - Grid Code,
  - Distribution Code,
  - WFPS Setting Schedule,
  - Operational, Planning & Connection Procedures & Polices,
  - Current practices
- Engagement internally in TSO & DSO
- Engagement with ENTSOE including National Link Person
- Engagement with other TSOs

How We Developed the Consultation

- Many of the requirements/parameters in the RfG exist today
- Significant work has been put into updating the Grid and Distribution Codes in recent years, especially as a result of DS3 work. It is not intended to revisit this work.
- Intention of TSO & DSO, insofar as possible, when proposing these values was as follows;
  - To keep existing requirements
  - To make minimum amount of change to existing requirements
  - Not to use this as a mechanism to make dramatic changes to existing requirements
  - Not to use this as a mechanism to align north and south existing/new requirements

How We Developed the Consultation

- Theme based approach with sub-themes
  - Frequency
  - Voltage
  - System Restoration
  - Protection
- Justification Codes
  - 1: “In line with existing”:
  - 2: “As close as possible to the existing”
  - 3: “New of Different”
  - 4: “N/A”

Responding to the Consultation

- The TSO & DSO welcome feedback on the proposals either:
  - at the workshop today
  - using the template provided online and sent to gridcode@soni.ltd.uk
- In particular we are keen to know the following:
  - Do you agree with the proposed values for each of the specific parameters as set out in this paper
  - Do you think that other parameters should have been selected for any of the parameters?
  - If yes, please explain:
    - What values you would have proposed for the specific parameters.
    - Why you proposed the value including any costs/benefits/saving you believe will materialise from your proposal.
  - Do you believe that any non-exhaustive parameters or non-mandatory requirements have been excluded from this document incorrectly
    - If yes, please detail the RfG reference

Helpful Documents for Reviewing the Consultation

- ENTSO-E non-binding implementation guidance documents IGDs to aid RfG adoption
  - 18 guidance documents are available at: https://www.entsoe.eu/news-events/announcements/announcements-archive/Pages/18-RfG-related-implementation-guidance-documents.aspx
  - Specifically the "Parameters of Non-Exhaustive Requirements" is helpful in this context, RfG is laid out in pages 7-15
  - https://www.entsoe.eu/Documents/Network%20codes%20documents/NC%20RfG/161116_IGD_General%20guidance%20on%20parameters_for%20publication.pdf?Web=1
- Requirements for Generators Network Code: articles 13-28 for parameters
  - http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0631&qid=1472462777329&from=en
- Consultation Document & Response Template
  - http://www.eirgridgroup.com/customer-and-industry/european-integration/integration/#comp_000059799323_0000007c19_05f8
- Acronyms List
  - Provided to all participants of today's workshop
  - Available online from tomorrow.

Next Steps

- Consultation closes on the 9th of February 2018
- TSO and DSO shall:
  - consider any comments received,
  - Submit a proposal to the UREGNI.
- UREGNI to review and approve proposals

Knock on Impacts of RfG Parameter Selection

- Post approval of parameters the following will need to be updated:
  - Distribution Code – approx. 2018,
  - Grid Code – approx. 2019,
  - WFPS Settings Schedule - approx. 2019,
  - G59 & G83 Engineering Recommendations – underway.

- Need to be reviewed and may need to be updated
  - Connection Agreements / Connection Offers templates,
  - Internal Processes,
  - External processes for connection, compliance testing, operational certification processes, others…
  - ETC…

Purpose of the Workshop

- We are hosting this workshop to ensure that all participants understand the basis for the consultation and the concepts in the Consultation Paper
- Additional background is available in the Consultation Paper
- This workshop gives an opportunity:
  - For participants to ask questions on the consultation
  - For the TSO/DSO to explain the justifications for any new/revised parameter proposals

Format of the Workshop

- Each theme will be covered separately
- We will step through the theme, article by article
- We will present the requirements & proposals from the consultation paper
- We will discuss the justification for the proposals in more detail
- Experts from TSO & DSO will present jointly on the relevant articles under each theme
  - Either as relevant TSO, relevant DSO or RSO

Frequency Theme

Raymond Skillen (TSO)

David Hill (DSO)

Frequency Ranges

Article 13.1 (a) (i): Frequency Ranges

- Section Number 4.1.1.1
- *A power-generating module shall be capable of remaining connected to the network and operate within the frequency ranges and time periods specified in the* table below.
- Note that only the item in bold is a non-exhaustive parameter and therefore subject to consultation. The other parameters are provided for context.

Article 13.1 (a) (i): Frequency Ranges

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Frequency Ranges	47,5 Hz-48,5 Hz for 90 minutes	Mandatory	13.1.a.(i)	A, B, C, D PGMs and Offshore PPMs	N/A
Frequency Ranges	48,5 Hz-49,0 Hz for a time to be specified by each TSO, but not less than 90 minutes	90 Minutes	13.1.a.(i)	A, B, C, D PGMs and Offshore PPMs	2
Frequency Ranges	49,0 Hz-51,0 Hz for an unlimited time	Mandatory	13.1.a.(i)	A, B, C, D PGMs and Offshore PPMs	N/A
Frequency Ranges	51,0 Hz-51,5 Hz for 90 minutes	Mandatory	13.1.a.(i)	A, B, C, D PGMs and Offshore PPMs	N/A

Table 1 Frequency Withstand Time Periods

Article 13.1 (a) (i): Frequency Ranges

- The current Grid code requirement is **60 minutes in the 48.5Hz – 49Hz** frequency range, SONI has proposed a value closest to the current Grid code requirement a **value of 90minutes**
- This proposal delivers a **consistent technical requirement** for generators to remain connected for a period of 90minutes outside the frequency range of 49 – 51Hz where unlimited operation is required.
- Generators are required to remain connected between the frequency range **47Hz to 52 Hz,** the time requirements vary depending on the frequency

Rate of Change of Frequency

Article 13.1 (b): RoCoF

- Section Number 4.1.2.1

- *With regard to the rate of change of frequency withstand capability, a power-generating module shall be capable of staying connected to the network and operate at rates of change of frequency up to a value specified by the relevant TSO, unless disconnection was triggered by rate-of-change-of-frequency-type loss of mains protection. The relevant system operator, in coordination with the relevant TSO, shall specify this rate-of-change-of-frequency-type loss of mains protection*.

Article 13.1 (b): RoCoF

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
The maximum RoCoF for which the Power Generating Module (PGM) shall stay connected	Not Specified	1 Hz/s over 500ms window	13.1.b	A, B, C and D PGMs and Offshore PPMs	1
The proposal for loss of mains protection	Not Specified	1 Hz/Sec with a 500ms delay.	13.1.b	A, B, C and D and Offshore PPMs	1

Table 2 Rate-of-change-of-frequency-type loss of mains protection & withstand capability

Active Power Control

Article 13.4.a: Admissible reduction from maximum output with falling frequency

- Section Number 4.1.3.1

- *The relevant TSO shall specify admissible active power reduction from maximum output with falling frequency in its control area as a rate of reduction falling within the boundaries, illustrated by the full lines* in Figure 1 below.

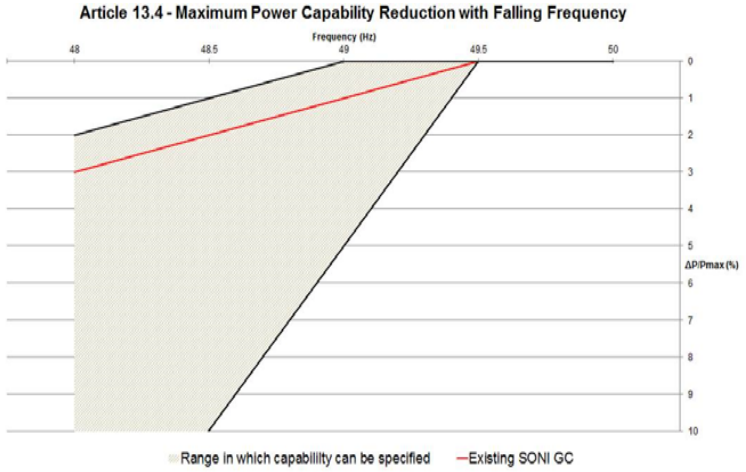
Article 13.4.a: Admissible reduction from maximum output with falling frequency

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Applicable Types	Justification Code
Admissible active power reduction from maximum output with falling frequency	below 49 Hz falling by a reduction rate of 2% of the maximum capacity at 50 Hz per 1 Hz frequency drop **or** Below 49.5 Hz falling by a reduction rate of 10% of the maximum capacity at 50 Hz per 1 Hz frequency drop.	below 49 Hz falling by a reduction rate of 2% of the maximum capacity at 50 Hz per 1 Hz frequency drop	13.4 (a)	A, B, C and D PGMs and Offshore PPMs	3

Table 3 Admissible active power reduction from maximum output with falling frequency

Article 13.4.a: Admissible reduction from maximum output with falling frequency

- As the system frequency decreases, it is essential that any **reduction in generation output is minimised**, in order to prevent the frequency from falling any further.
- The proposal is to allow a **maximum decrease in generation output of 2% when the frequency is falling below 49Hz,** were as the current Grid Code permits a proportional reduction in generation output from 49.5Hz.
- This proposal marginally increases the requirement on PGMs. However by increasing the requirement here, we are able to lessen any further reduction in the system frequency. This allows time for frequency response measures to be activated, system frequency stabilisation and ultimately will improve security of supply.



Article 13.5: Admissible reduction from maximum output with falling frequency taking Account of Technical Capabilities of PGMs

- Section Number 4.1.3.2

- *The admissible active power reduction from maximum output shall: (a) clearly specify the ambient conditions applicable; (b) take account of the technical capabilities of power-generating modules.*

Article 13.5: Admissible reduction from maximum output with falling frequency taking Account of Technical Capabilities of PGMs

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Ambient Conditions	Not Specified	10°C, 70% relative humidity and 1013 hPa for gas fired turbine generators	13.5	Gas-fired SPGMs (A, B, C and D).	3

Table 4 Admissible active power reduction from maximum output

Article 13.5: Admissible reduction from maximum output with falling frequency taking Account of Technical Capabilities of PGMs

- The RfG allows the TSO to specify the applicable ambient conditions it is proposed to use **10°C, 70 % relative humidity and 1013 hPa.** The ENTSO-E guidance document for national implementation for network codes on grid connection (Implementation Guidelines Documents) highlights that the need for this requirement is driven by the characteristics of gas fired generation units. Other generation units should not require a reduction with falling frequency. For this reason it is proposed to limit the application of this clause to gas fired generation units.

Article 13.6: Remote operation of facility to cease active power output

- Section Number 4.1.3.3

- *The power-generating module shall be equipped with a logic interface (input port) in order to cease active power output within five seconds following an instruction being received at the input port. The relevant system operator shall have the right to specify requirements for equipment to make this facility operable remotely.*

Article 13.6: Remote operation of facility to cease active power output

Requirement	Requirement in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Specify requirements for equipment to make this facility operable remotely for Type A	A right to specify	Maintain the right to specify for Type A only in due time for plant design (c/f Art 14 (2) (b) for Type B	13.6	A PGMs	3

Table 5 Specify requirements for equipment to make this facility operable remotely for Type A

Article 13.6: Remote operation of facility to cease active power output

- The RFG allows the RSO to specify requirements for equipment to enable the generator to cease active power output within 5 seconds and to operate remotely.
- The TSO and DSO reserve the right to make this requirement mandatory for Type A PGMs. As the generation portfolio on the Power System changes it may be necessary for these units to cease active power output in order to maintain system security or safety.
- The proposal is to maintain the right to specify the requirement for remote control equipment but to advise on a case by case basis, as necessary, taking into consideration that the specific requirements will be dependent on the plant design and compatibility requirements. The intention of the phrase, 'in due time for plant design' is intended to mean during the connection offer phase.

Article 13.6: Remote operation of facility to cease active power output

In summary:

- Article 13.6 requires the generator to be able to cease active power via an input port
- Article also gives the RSO the right to specify requirements to make the facility remotely operable
- RSO is maintaining the right to specify these requirements in due time for plant design

Article 13.7: Automatic connection to the network

- Section Number 4.1.3.4

- *The relevant TSO shall specify the conditions under which a power-generating module is capable of connecting automatically to the network. Those conditions shall include:*
  a. *frequency ranges within which an automatic connection is admissible, and a corresponding delay time; and*
  b. *maximum admissible gradient of increase in active power output.*

  Automatic connection is allowed unless specified otherwise by the relevant system operator in coordination with the relevant TSO.

Article 13.7: Automatic connection to the network

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
(i) Frequency Ranges and Time Delay	Non-specific	47 Hz to 50.2 Hz with a three minute delay	13.7	A, B, and C PGMs	3 1
(ii) Maximum admissible gradient of increase in power	Non-specific	10% of Pmax per minute	13.7	A, B and C PGMs	3
(iii) Allowing automatic connection	A right to not allow	Allow automatic connection for Type A & B Do not allow automatic connection for Type C	13.7	A, B and C PGMs	1

Table 6 Conditions under which a PGMs is capable of connecting automatically to the network

Article 13.7: Automatic connection to the network

- The frequency ranges differ from the existing settings today and are highlighted with a ‘3’ to indicate this. The time delay is an existing requirement and is highlighted with a ‘1’ above to indicate this.
- The RfG allows the relevant system operator to specify the conditions under which a power-generating module is capable of connecting automatically to the network. SONI currently does not use automatic connection and would specify that it is **not allowed in Northern Ireland for Type C PGMs.** However Engineering Recommendations **G59 & G83 settings allow PGMs of sizes Type A and Type B** to automatically connect once the frequency is within normal operating ranges. This right will be retained under the RfG.
- The TSO would not wish to compromise system frequency stability by permitting Types A and B generator to connect automatically when the system frequency is above 50.2Hz since this action could cause high frequency instability. However, we would permit generation to **automatically connect within the range 47 – 50.2Hz.**
- The maximum admissible gradient of **increase is 10% of Pmax per minute**, this value is chosen to facilitate stable network conditions during the automatic connection process.

Article 14.2.b: Remote operation of power output

- Section Number 4.1.3.5

- *Type B PGMs shall fulfil the following requirements in relation to frequency stability:*

  (a) to control active power output, the power-generating module shall be equipped with an interface (input port) in order to be able to reduce active power output following an instruction at the input port; and

  (b) the relevant system operator shall have the right to specify the requirements for further equipment to allow active power output to be remotely operated.

Article 14.2.b: Remote operation of power output

Requirement	Requirement in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Right to specify the requirements for further equipment to allow active power output to be remotely operated	To specify or not to specify	RSO to specify for Type B generators; in due time for plant design.	14.2 (b)	B PGMs	3

Table 7 Remote operation of Power Output

Article 14.2.b: Remote operation of power output

- Article 14.2.a requires the generator to be able to reduce active power via an input port
- Article 14.2.b gives the RSO the right to specify requirements to make the facility remotely operable
- RSO is maintaining the right to specify these requirements in due time for plant design

Article 15.2.a: Achieving Active Power Set points

- Section Number 4.1.3.6

- *power-generating modules shall fulfil the following requirements relating to frequency stability:*
  - *a. with regard to active power controllability and control range, the power-generating module control system shall be capable of adjusting an active power set point in line with instructions given to the power-generating facility owner by the RSO or the relevant TSO.*
- *The relevant system operator or the relevant TSO shall establish the period within which the adjusted active power set point must be reached. The relevant TSO shall specify a tolerance (subject to the availability of the prime mover resource) applying to the new set point and the time within which it must be reached;*

Article 15.2.a: Achieving Active Power Set points

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
The <u>period</u> within which the adjusted active power setpoint must be reached	No range provided	*PPM controllable generation* The Active power set point and the time to achieve this is determined by the TSO , however following shut down a PPM must commence active power export within 90secs WFPS setting schedule 6.11 (WFSS section 6.1, Wind following ramp rate 5MW per minute) *SPGM dispatchable generation* Active power set point and time to achieve the set point is given via TSO dispatch instructions in accordance with SDC2. Minimum ramp rates and start-up times specified in CC.S1.3.7 & CC.S1.2.3.4 (Grid code CC.S1.1.3.7 (b) & (c) ramping up and de-loading at rate of at least 3% of MCR)	15.2 (a)	C and D PGMs	1
Tolerance (subject to the availability of the prime mover resource) applying to the new setpoint and the time within which it must be reached	No Range Provided	*PPM controllable generation* Active power output to be within 3% of set point (based on RC)Time to achieve set point within ±10 seconds of target time.`(See WFPS Setting Schedule 6.1) *SPGM dispatchable generation* Tolerance bands for dispatch instructions is specified in OC11 Part B	15.2 (a)	C and D PGMs	1

Table 8: Achieving Active Power Set-points

Frequency Modes

Frequency Modes Explanation

- Limited Frequency Sensitive Mode Over Frequency (LFSM-O)
- Limited Frequency Sensitive Mode Under Frequency (LFSM-U)
- Frequency Sensitive Mode (FSM)

RfG Frequency Control Mode	Equivalent Grid Code Frequency Control Mode for PPMs	Equivalent Grid Code Frequency Control Mode for SPGM
LFSM-O	Emergency Action Mode	Not applicable in Northern Ireland today
LFSM-U	Not applicable in Northern Ireland today	Not applicable in Northern Ireland today
FSM Normal	% Curtailed Mode	Free Governor Action
FSM Frequency Step Change	Same as above	Operating Reserves

Article 13.2.a: LFSM-O Parameter Selection

- Section Number 4.1.4.2

- *With regard to the limited frequency sensitive mode — over frequency (LFSM-O), the following shall apply, as determined by the relevant TSO for its control area in coordination with the TSOs of the same synchronous area to ensure minimal impacts on neighboring areas:*
  a. *the power-generating module shall be capable of activating the provision of active power frequency response at a frequency threshold and droop settings specified by the relevant TSO*;

Article 13.2.a: LFSM-O Parameter Selection

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Frequency threshold	Between 50.2- 50.5 Hz	50.2 Hz	13.2(a)	A, B, C and D PGMs & offshore PPMs	2
Droop settings	Between 2-12 %	Machines should be capable of operating in the range 2-12%. The default setting is 4%	13.2(a)	A, B, C and D PGMs & offshore PPMs	2

Table 9: LFSM-O Parameter Selection

Article 13.2.a: LFSM-O Parameter Selection

Frequency Threshold

In SONI SPGM's do not operate in LFSM-O for the provision of FCR; these generators operate in FSM mode. LFSM-O is exclusively used in NI by PPM's operating in emergency action mode and resource following mode. The current threshold specified in the **WFPS setting schedule is 50.15Hz**, the proposal is to adopt the minimum permissible threshold **value in RFG of 50.2Hz.**

Droop Settings

The SONI Grid Code requires a droop setting for PPM's of between 2 - 20% (CC.S2.1.5.2 & CC.S2.2.5.2) and gas turbines are required to operate on a 4% droop (CC.S1.1.5.2 & CC.S1.2.4.2).The proposal is to adopt the RFG frequency droop range of **between 2 - 12%**. The existing Grid Code requirement for Gas turbines lies within this range and aligns with the default droop setting used across the island of Ireland which is 4%.

Note PPM's operating in LFSM-O will adjust the droop slightly to account for the larger dead bands and ensure the overall droop response of the PPM corresponds to 4%

Article 13.2.b: LFSM-O: Automatic disconnection and reconnection

- Section Number 4.1.4.3

- *instead of the capability referred to in paragraph (a), the relevant TSO may choose to allow within its control area automatic disconnection and reconnection of power-generating modules of Type A at randomised frequencies, ideally uniformly distributed, above a frequency threshold, as determined by the relevant TSO where it is able to demonstrate to the relevant regulatory authority, and with the cooperation of power-generating facility owners, that this has a limited cross-border impact and maintains the same level of operational security in all system states;*

Article 13.2.b: LFSM-O: Automatic disconnection and reconnection

Requirement	Requirement in RfG	Consultation Proposal	Article Number	Applicable Type	Justification Code
Automatic disconnection and reconnection of PGMs	Allow or do not allow	Do not allow	13.2 (b)	A PGMs	3

Table 10: LFSM-O Automatic Disconnection & Reconnection

Article 13.2.b: LFSM-O: Automatic disconnection and reconnection

- SONI has chosen to not allow generators to disconnect or reconnect automatically to the system to provide LFSM-O. Rather Type A PGM's are required to have the capability specified in Para (a) section 4.1.4.2

Article 13.2.f: LFSM-O: Actions at minimum regulating level

- Section Number 4.1.4.4

- *The relevant TSO may require that upon reaching minimum regulating level, the power-generating module be capable of either:*
  - *i. continuing operation at this level; or*
  - *ii. further decreasing active power output;*

Article 13.2.f: LFSM-O: Actions at minimum regulating level

Requirement	Requirement in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Actions in LFSM-O upon reaching minimum regulating level,	Choose between (i) continuing operation at this level; or (ii) further decreasing active power output	(i) continuing operation at this level;	13.2 (f)	A, B, C and D PGMs & offshore PPMs	1

Table 11: LFSM-O Actions at Minimum Regulating Level

Article 15.2.c: LFSM-U Parameter Selection

- Section Number 4.1.4.5

- *the power generating module shall be capable of activating the provision of active power frequency response at a frequency threshold and with a droop specified by the relevant TSO in coordination with the TSOs of the same synchronous area as follows:*

  – the frequency threshold specified by the TSO shall be between 49.8 Hz and 49.5 Hz inclusive;

  – the droop settings specified by the TSO shall be in the range 2 – 12%.

Article 15.2.c: LFSM-U Parameter Selection

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Frequency threshold	between 49.8 Hz and 49.5 Hz inclusive	49.5 Hz	15.2 (c)	C and D PGMs & offshore PPMs	3
Droop settings	2-12%	Default is 4% unless otherwise specified by the TSO on a site specific basis	15.2 (c)	C and D PGMs & offshore PPMs	3

Table 12 LFSM-U Frequency Threshold & Droop Settings

Article 15.2.c: LFSM-U Parameter Selection

- LFSM-U is not currently used as a mode of frequency response in Northern Ireland. However looking to the future the introduction of new market conditions or system services may require LFSM_U for the provision of frequency restoration reserve (FRR), it is for this reason the above parameters for LFSM-U are specified

Article 15.2.d.(i) and (ii): FSM Parameter Selection

- Section Number 4.1.4.6

i. *The power-generating module shall be capable of providing active power frequency response in accordance with the parameters specified by each relevant TSO within the ranges shown in Table 4* (as given in the RfG*). In specifying those parameters, the relevant TSO shall take account of the following facts:*
   - *In case of over frequency, the active power frequency response is limited by the minimum regulating level,*
   - *In case of under frequency, the active power frequency response is limited by maximum capacity,*
   - *The actual delivery of active power frequency response depends on the operating and ambient conditions of the power-generating module when this response is triggered, in particular limitations on operation near maximum capacity at low frequencies according to paragraphs 4 and 5 of Article 13 and available primary energy sources;*

ii. *The frequency response dead band of frequency deviation and droop must be able to be reselected repeatedly;*

Article 15.2.d.(i) and (ii): FSM Parameter Selection

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Active Power Range (ΔP/Pmax)	1.5-10%	Not proposing a value at this time See note below	15.2 (d) (i) and (ii)	C and D PGMs & offshore PPMs	1
Frequency Response Insensitivity (Δf)	10-30 mHz	15mHz*	15.2 (d) (i) and (ii)	C and D PGMs & offshore PPMs	3
Frequency Response Insensitivity (Δf/f)	0.02-0.06%	0.03%	15.2 (d) (i) and (ii)	C and D PGMs & offshore PPMs	3
Frequency Response Deadband	0-500mHz	+/-15mHz*	15.2 (d) (i) and (ii)	C and D PGMs& offshore PPMs	3
Droop	2-12%	Depends on gen type – default is 4%	15.2 (d) (i) and (ii)	C and D PGMs & offshore PPMs	1

Table 13 FSM Parameter Selection

Article 15.2.d.(i) and (ii): FSM Parameter Selection

- *Active Power Range*

  The TSO have consulted with the ENTSO-E Frequency Expert Group in relation to FSM. ENTSO-E have confirmed that this parameter was **included in the above table as an error** and as such will not be specified as part of this consultation. For this reason we are not proposing a value for active power range in Table 13.

  Frequency Response Insensitivity and Frequency Response Deadband

  The current version of the Grid Code does not specify requirements for Frequency Response insensitivity. It only specifies the Frequency Response Deadband. It is proposed to retain the current Grid Code requirement of 15 mHz by setting a **maximum absolute value of 15 mHz** for both the Frequency Response Insensitivity and Frequency Response Deadband.

  *In addition to the individual requirements for Frequency Response Insensitivity (ΔF) and Frequency Response Deadband and as per Annex V of the System Operating Guidelines (SOGL), the maximum combined effect of Frequency Response Insensitivity and Frequency Response **Deadband cannot exceed a value of +/-15mHz**.

Article 15.2.d.(iii): FSM: Step Change in Frequency

- Section Number 4.1.4.7

- *In the event of a frequency step change, the power-generating module shall be capable of activating full active power frequency response, at or above the full line shown in Figure 6* (as given in the RfG) *in accordance with the parameters specified by each TSO (which shall aim at avoiding active power oscillations for the power-generating module) within the ranges given in Table 5* (as given in the RfG) *. The combination of choice of the parameters specified by the TSO shall take possible technology-dependent limitations into account;*

Article 15.2.d.(iii): FSM: Step Change in Frequency

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Active power range	1.5-10%	10%	15.2 (d) (iii)	C and D PGMs & offshore PPMs	3
Admissible initial time delay for activation of active power frequency response for PGMs	*2s*	*2s*	*15.2 (d) (iii)*	*C and D PGMs & offshore PPMs*	*N/A*
Admissible initial time delay for activation of active power frequency response for PPMs	Less than 2 seconds	0s No time delays other than those inherent in the design of the frequency response system	15.2 (d) (iii)	C and D PGMs & offshore PPMs	3
Maximum admissible choice of full activation time	30 seconds	5 seconds	15.2 (d) (iii)	C and D PGMs & offshore PPMs	3
Capability relating to the duration of provision of full active power frequency response	15-30 minutes	20	15.2 (d) (v)	C and D PGMs & offshore PPMs	3

Table 14 Activating full active power frequency response

Article 15.2.d.(iii): FSM: Step Change in Frequency

- Active Power Range

SPGM

In SONI this is specified during the connection process at a **full activation time of 5 seconds** this is comparable with the existing requirements specified to generation during the connection process.

PPMs

The current requirements in the SONI WFPS Setting Schedule requires a minimum of 60% of expected MW Output change value based on droop characteristic within 5 seconds and 100% of expected MW Output change value based on droop characteristic within 15 seconds. This requirement is core to the achievement of a 40% RES-E target and the ability to operate the system at System Non Synchronous Penetration (SNSP) levels up to 75%. The RfG range in Table 14 only allows us to specify a value for the change in power output relative to the Active Power output at the moment the frequency threshold was reached (or the maximum capacity as defined by the TSO) between 1.5-10% i.e. it does not allow us to specify the levels that currently exist in the Grid Code. However to lose the capability provided for in today's Grid Code would be very damaging to the success of the DS3 program and ultimately to the integration of high levels of renewable energy into the power system.

We do not believe that the regulations intentionally undermine this capability and therefore we are going to **investigate options to retain todays Grid Code requirements for PPMs.**

For the avoidance of doubt, in this consultation we have reflected the permissible ranges in the RfG but respondents should understand that it is our intention to retain the Grid Code requirements for PPMs, in addition to the RfG requirements.

Article 15.2.d.(iii): FSM: Step Change in Frequency

- *Admissible initial time delay for activation of active power frequency response for PPMs*

The current version of the SONI WFPS Setting Schedule stated in section 6.5:

The TSO deems Fast acting with regards to Frequency Control response as being:

No time delays, such as moving average frequency filters, other than those necessarily inherent in the design of the Controllable WFPS shall be introduced.

- *Maximum admissible choice of full activation time*

The choice of full activation time is **5 seconds** in line with the existing requirements.

- *Capability relating to duration of provision of full active power frequency response*

The Frequency Containment Reserves must remain in place until such time that the Frequency replacement reserves are available. In the case of Ireland, the FCR equates to the POR, SOR, TOR1 and TOR2 under the Grid Code. The existing Grid Code Replacement Reserves must be made available from **20 minutes to four hours after the event.**

Additional Requirements Not Invoking

Additional Non-Mandatory Frequency Requirements

Requirement	Requirement in RfG	Consultation Proposal	Article Number	Type Applicability
Shorter initial FSM response delay for PGMs without inertia	Not specified	Not Mandatory – can be agreed on a case by case basis with System Services Contracts	15.2.d(iv)	Type A, B, C and D PGMs and offshore PPMs
Synthetic inertia capability for PPM	Not Specified	Not Mandatory – can be agreed on a case by case basis with System Services Contracts	21(2)	C and D PPMs

Table 15 - Areas with non-mandatory requirements detailed in the RfG

Q&A

System Restoration Theme

Miriam Ryan (TSO)

Article 15.5.c.(iii) Operation following tripping to house load

- Section Number 4.3.1

- *A power-generating module with a minimum re-synchronisation time greater than 15 minutes after its disconnection from any external power supply must be designed to trip to houseload from any operating point in its P-Q-capability diagram. In this case, the identification of houseload operation must not be based solely on the system operator's switchgear position signals. Power-generating modules shall be capable of continuing operation following tripping to houseload, irrespective of any auxiliary connection to the external network. The minimum operation time shall be specified by the relevant system operator in coordination with the relevant TSO, taking into consideration the specific characteristics of prime mover technology*

Article 15.5.c.(iii) Operation following tripping to house load

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Operation Following Tripping to House Load	Not Specified	4 hours	15.5.c.iii	C and D PGMs and offshore PPMs with a minimum re-synchronisation time greater than 15 minutes*	3

Table 42: Operation Following Tripping to House Load

Article 15.5.c.(iii) Operation following tripping to house load

- The Black Start plan requires generation units to be resynchronised within four hours. The proposal of 4 hours for operation following tripping to house load aligns with the Black Start Plan.

Q&A

Lunch

Reconvene @ 13:30

Voltage Theme

Raymond Smyth (TSO)

David Hill (DSO)

Automatic Disconnection

Article 15.3: Type C Automatic Disconnection Due to Voltage Level

- Section Number 4.2.1.1

- *With regard to voltage stability, type C power-generating modules shall be capable of automatic disconnection when voltage at the connection point reaches a minimum/maximum voltage level for a certain period of time. Table 16 specifies the voltage and duration settings.*

Article 15.3: Type C Automatic Disconnection Due to Voltage Level

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Minimum Voltage below which Module will automatic disconnect	Not specified	Specified at plant design stage	15.3	C PGMs	1
Maximum Voltage above which Module will automatic disconnect	Not specified	Specified at plant design stage	15.3	C PGMs	1

Table 16: Parameters for Automatic Disconnection

Article 15.3: Type C Automatic Disconnection Due to Voltage Level

- The DSO does not have any requirements on this article
- TSO has no specific requirements at this stage. However may see a need at a later stage and would agree any settings with DSO. Any settings would need to coordinate with ER G59 and ER G83.

Article 16.2.c: Type D Automatic Disconnection Due to Voltage Level

- Section Number 4.2.1.2

- *With regard to voltage stability, the relevant system operator in coordination with the relevant TSO shall have the right to specify voltages at the connection point at which a power-generating module is capable of automatic disconnection. The terms and settings for automatic disconnection shall be agreed between the relevant system operator and the power-generating facility owner*

Article 16.2.c: Type D Automatic Disconnection Due to Voltage Level

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Minimum Voltage below which Module will automatic disconnect	Not specified	Not Allowed	16.2.c	D PGMs	3
Maximum Voltage above which Module will automatic disconnect	Not specified	Not Allowed	16.2.c	D PGMs	3

Table 17: Type D Parameters for Automatic Disconnection

Article 16.2.c: Type D Automatic Disconnection Due to Voltage Level

- The current Grid Code does not stipulate voltage threshold which allows for automatic disconnection.
- The TSO and DNO invoke the right to prohibit the automatic
- disconnection from the transmission and distribution systems.

Reactive Power Capability for Type B PGMs

Article 17.2.a: Reactive Power capability for Type B SPGMs

- Section Number 4.2.2.1.1

- *with regard to reactive power capability, the relevant system operator shall have the right to specify the capability of a synchronous power generating module to provide reactive power;*

Article 17.2.a: Reactive Power capability for Type B SPGMs

Parameter	Requirement	Requirement in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Low Voltage	u_{min}	0.875 p.u.	0.94 p.u.	17.2 (a) & 20.2 (a)	B	1
	u_{max}	1.1 p.u.	1.1 p.u.	17.2 (a) & 20.2 (a)	B	1
	Q_{min}/P_{max} (lead)	-0.5 p.u.	-0.33 p.u.	17.2 (a) & 20.2 (a)	B	1
	Q_{max}/P_{max} (lag)	0.65 p.u.	0.203 p.u.	17.2 (a) & 20.2 (a)	B	1
Below 110kV	u_{min}	0.875 p.u.	0.94 p.u.	17.2 (a) & 20.2 (a)	B	1
	u_{max}	1.1 p.u.	1.06 p.u.	17.2 (a) & 20.2 (a)	B	1
	Q_{min}/P_{max} (lead)	-0.5 p.u.	-0.33 p.u.	17.2 (a) & 20.2 (a)	B	1
	Q_{max}/P_{max} (lag)	0.65 p.u.	0.203 p.u.	17.2 (a) & 20.2 (a)	B	1

Table 18: Right to specify reactive power capability for SPGMs

Article 17.2.a: Reactive Power capability for Type B SPGMs

- Low Voltage Generators – Voltage & Reactive ranges in line with existing D Code
- Below 110kV – Voltage & Reactive ranges in line with existing D Code

Article 20.2.a: Reactive Power Capability for Type B PPMs

- Section Number 4.2.2.1.2

- *with regard to reactive power capability, the relevant system operator shall have the right to specify the capability of a power park modules to provide reactive power;*

Article 20.2.a: Reactive Power capability for Type B PPMs

Parameter	Requirement	Requirement in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Low Voltage	u_{min}	0.875 p.u.	0.94 p.u.	17.2 (a) & 20.2 (a)	B	1
	u_{max}	1.1 p.u.	1.1 p.u.	17.2 (a) & 20.2 (a)	B	1
	Q_{min}/P_{max} (lead)	-0.5 p.u.	-0.33 p.u.	17.2 (a) & 20.2 (a)	B	1
	Q_{max}/P_{max} (lag)	0.65 p.u.	0.203 p.u.	17.2 (a) & 20.2 (a)	B	1
Below 110kV	u_{min}	0.875 p.u.	0.94 p.u.	17.2 (a) & 20.2 (a)	B	1
	u_{max}	1.1 p.u.	1.06 p.u.	17.2 (a) & 20.2 (a)	B	1
	Q_{min}/P_{max} (lead)	-0.5 p.u.	-0.33 p.u.	17.2 (a) & 20.2 (a)	B	1
	Q_{max}/P_{max} (lag)	0.65 p.u.	0.203 p.u.	17.2 (a) & 20.2 (a)	B	1

Table 19: Right to specify reactive power capability for PPMs

Article 20.2.a: Reactive Power Capability for Type B PPMs

- Low Voltage Generators – Voltage & Reactive ranges in line with existing D Code
- Below 110kV – Voltage & Reactive ranges in line with existing D Code

Reactive Power Capability at Maximum Capacity: U-Q/Pmax Profiles

Article 18.2.b.(i): SPGM: Parameters required for U-Q/Pmax Profiles

- Section Number 4.2.2.2.1

- *In relation to voltage stability, synchronous power-generating modules shall fulfil the requirements with regard to reactive power capability at maximum capacity. For that purpose a U-Q/P_{max}-profile is specified (inner envelope) within the boundaries of the fixed outer envelope of which the synchronous power-generating module shall be capable of providing reactive power at its maximum capacity (P_{max}).*

Article 18.2.b.(i): SPGM: Parameters required for U-Q/Pmax Profiles

Figure 2 represents boundaries of a U-Q/P_{max}-profile by the voltage at the connection point, expressed by the ratio of its actual value and the reference 1 p.u. value, against the ratio of the reactive power (Q) and the maximum capacity (P_{max}). The position, size and shape of the envelope are indicative. The dimensions of the inner envelope are limited by a maximum range of Q/P_{max} of 1.08 and maximum range of steady state voltage level of 0.218 p.u.

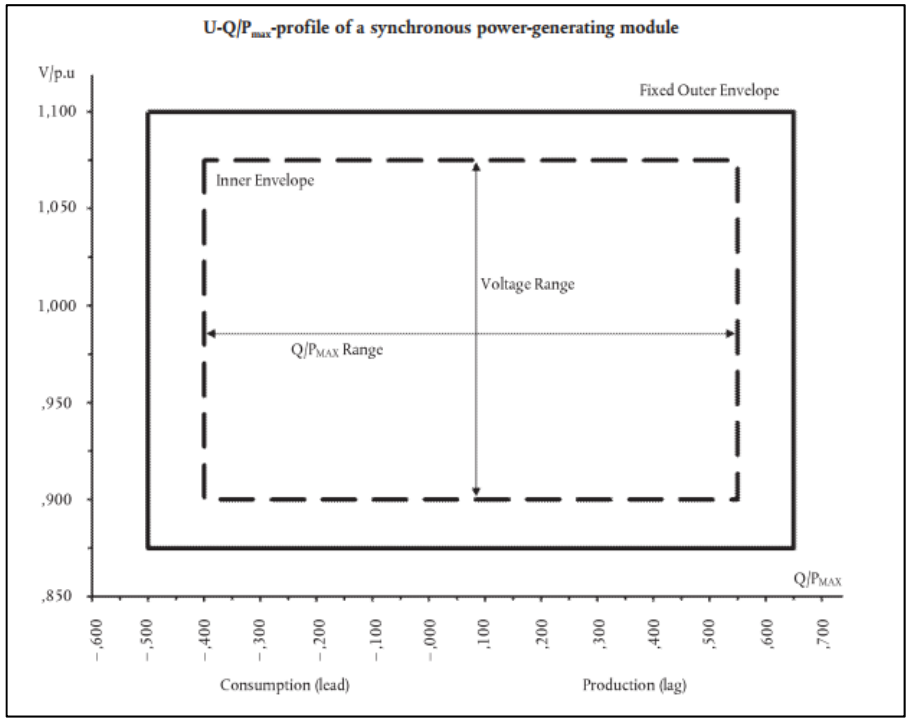


Figure 2: U-Q/P_{max}-profile for synchronous Power-Generating Modules

Article 18.2.b.(i): SPGM: Parameters required for U-Q/Pmax Profiles

SPGMs connected at a voltage level ≥ 110 kV

Connection Voltage	Parameter	Parameter in RfG (outer envelope)	Consultation Proposal (Inner Envelope)	Article Number	Type Applicability	Justification Code
110 kV	u_{min}	0.875 p.u.	0.9 p.u.	18.2.b (ii)	D SPGMs	1
	u_{max}	1.1 p.u.	1.1 p.u.			1
	Q_{min}/P_{max} (lead)	-0.5 p.u.	-0.48 p.u.			3
	Q_{max}/P_{max} (lag)	0.65 p.u.	0.6 p.u.			3
275 kV	u_{min}	0.875 p.u.	0.9 p.u.			1
	u_{max}	1.1 p.u.	1.1 p.u.			1
	Q_{min}/P_{max} (lead)	-0.5 p.u.	-0.48 p.u.			3
	Q_{max}/P_{max} (lag)	0.65 p.u.	0.6 p.u.			3
400 kV	u_{min}	0.875 p.u.	0.875 p.u.			3
	u_{max}	1.1 p.u.	1.05 p.u.			3
	Q_{min}/P_{max} (lead)	-0.5 p.u.	-0.48pu			3
	Q_{max}/P_{max} (lag)	0.65 p.u.	0.6 p.u.			3

Table 20: Definition of U-Q/Pmax-profile at Maximum Capacity for SPGMs: connection @ ≥110 kV

SONI

Northern Ireland Electricity Networks

Article 18.2.b.(i): SPGM: Parameters required for U-Q/Pmax Profiles

- The existing reactive power range in the SONI Grid Code is specified as 0.95pf leading to 0.8pf lagging, measured at the generator terminals (see CC.S1.3.2).
- This has been approximated to the connection point as range -0.48 p.u. Qmin/Pmax (lead) to 0.6 p.u. Qmax/Pmax (lag).
- There is current no 400 kV operating voltage in Northern Ireland
- The voltage range chosen for the 400 kV voltages are aligned with the Ireland Grid Code.

Article 18.2.b.(i): SPGM: Parameters required for U-Q/Pmax Profiles

SPGMs connected at a voltage level < 110 kV

Connection Voltage	Parameter	Parameter in RfG (outer envelope)	Consultation Proposal (Inner Envelope)	Article Number	Type Applicability	Justification Code
Below 110kV	u_{min}	0.875 p.u.	0.94 p.u.	18.2.b (ii)	C and D SPGMs	1
	u_{max}	1.1 p.u.	1.06 p.u.	18.2.b (ii)	C and D SPGMs	1
	Q_{min}/P_{max} (import)	-0.5 p.u.	-0.33 p.u.	18.2.b (ii)	C and D SPGMs	1
	Q_{max}/P_{max} (Export)	0.65 p.u.	0.33 p.u.	18.2.b (ii)	C and D SPGMs	1

Table 21: Definition of U-Q/Pmax-profile at Maximum Capacity for SPGMs: connection @ <110 kV

Article 18.2.b.(i): SPGM: Parameters required for U-Q/Pmax Profiles

- Below 110kV - Voltage & Reactive ranges in line with existing D Code

Article 18.2.b. (iv): SPGM: Time to Achieve Target Value within U-Q/Pmax Profile

- Section Number 4.2.2.2.2

- *the synchronous power-generating module shall be capable of moving to any operating point within its U-Q/Pmax profile in appropriate timescales to target values requested by the relevant system operator*;

Article 18.2.b. (iv): SPGM: Time to Achieve Target Value within U-Q/Pmax Profile

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Time to achieve target value	Not specified	Without undue delay but at least within 120 seconds	18.2.b (iv)	C and D SPGMs	3

Table 22: Timescales to Achieve Target Values at Maximum Capacity

Article 18.2.b. (iv): SPGM: Time to Achieve Target Value within U-Q/Pmax Profile

- The time to achieve the target value is a new parameter in the SONI Grid Code and the NIEN Distribution Code.
- The time to achieve the target value is aligned with the current requirement set out in the Ireland Grid Code in the Scheduling and Dispatch Code Appendix B (SDC2.B.8) for centrally dispatched generating units.

Article 21.3.b (i) and (ii) & Article 25.5: PPM: Parameters required for U-Q/Pmax Profiles

- Section Number 4.2.2.2.3

- *Power Park modules shall fulfil requirements in relation to voltage stability with regard to reactive power capability at maximum capacity. For that purpose a U-Q/P_{max}-profile (inner envelope) is specified within the boundaries of the fixed outer envelope of which the Power Park Module shall be capable of providing reactive power at its maximum capacity (P_{max}).*

Article 21.3.b (i) and (ii) & Article 25.5: PPM: Parameters required for U-Q/Pmax Profiles

Figure 3 represents boundaries of a U-Q/P_{max}-profile by the voltage at the connection point, expressed by the ratio of its actual value and the reference 1 p.u. value, against the ratio of the reactive power (Q) and the maximum capacity (P_{max}). The position, size and shape of the inner envelope are indicative.
The dimensions of the inner envelope are limited by a maximum range of Q/P_{max} of 0.66 and maximum range of steady state voltage level of 0.218 p.u.

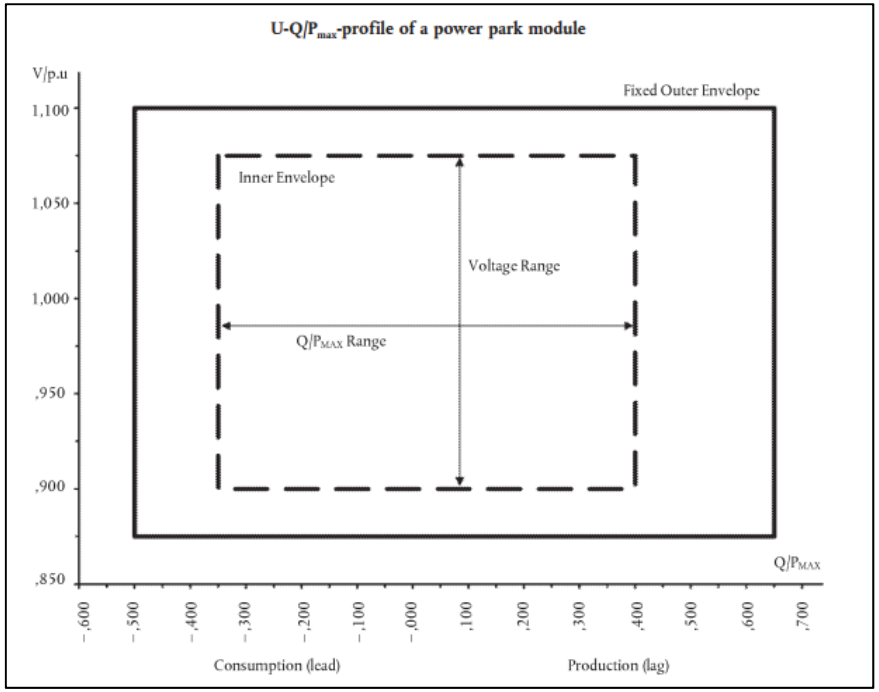


Figure 3: U-Q/P_{max}-profile for Power Park Modules

Article 21.3.b (i) and (ii) & Article 25.5: PPM: Parameters required for U-Q/Pmax Profiles

PPMs connection at a voltage level ≥ 110 kV

Connection Voltage	Parameter	Parameter in RfG (outer envelope)	Consultation Proposal (Inner Envelope)	Article Number	Type Applicability	Justification Code
110 kV	u_{min}	0.875 p.u.	0.9 p.u.	21.3.b (ii)	D PPMs & offshore PPMs	1
	u_{max}	1.1 p.u.	1.1 p.u.	21.3.b (ii)	D PPMs & offshore PPMs	1
	Q_{min}/P_{max} (lead)	-0.5 p.u.	-0.33 p.u.	21.3.b (ii)	D PPMs & offshore PPMs	1
	Q_{max}/P_{max} (lag)	0.65 p.u.	0.33 p.u.	21.3.b (ii)	D PPMs & offshore PPMs	1
275 kV	u_{min}	0.875 p.u.	0.9 p.u.	21.3.b (ii)	D PPMs & offshore PPMs	1
	u_{max}	1.1 p.u.	1.1 p.u.	21.3.b (ii)	D PPMs & offshore PPMs	1
	Q_{min}/P_{max} (lead)	-0.5 p.u.	-0.33 p.u.	21.3.b (ii)	D PPMs & offshore PPMs	1
	Q_{max}/P_{max} (lead)	0.65 p.u.	0.33 p.u.	21.3.b (ii)	D PPMs & offshore PPMs	1
400 kV	u_{min}	0.875 p.u.	0.875 p.u.	21.3.b (ii)	D PPMs & offshore PPMs	3
	u_{max}	1.1 p.u.	1.05 p.u.	21.3.b (ii)	D PPMs & offshore PPMs	3
	Q_{min}/P_{max} (lead)	-0.5 p.u.	-0.33 p.u.	21.3.b (ii)	D PPMs & offshore PPMs	1
	Q_{max}/P_{max} (lag)	0.65 p.u.	0.33 p.u.	21.3.b (ii)	D PPMs & offshore PPMs	1

Table 23: Definition of a U-Q/Pmax-profile at Maximum Capacity PPMs: connected @ ≥ 110

Article 21.3.b (i) and (ii) & Article 25.5: PPM: Parameters required for U-Q/Pmax Profiles

- The SONI Grid Code specifies a range for wind farm power stations of 0.95pf leading to 0.95pf lagging.
- This is equivalent to a range of -0.33 Qmin/Pmax (lead) to 0.33 Qmin/Pmax (lag).
- The values chosen for 400kV voltage envelope are aligned with the Ireland Grid Code.

Article 21.3.b (i) and (ii) & Article 25.5: PPM: Parameters required for U-Q/Pmax Profiles

PPMs connection at a voltage level < 110 kV

Connection Voltage	Parameter	Parameter in RfG (outer envelope)	Consultation Proposal (Inner Envelope)	Article Number	Type Applicability	Justification Code
Below 110kV	u_{min}	0.875 p.u.	0.94 p.u.	21.3.b (ii)	C and D PPM and offshore PPMs	1
	u_{max}	1.1 p.u.	1.06 p.u.	21.3.b (ii)	C and D PPM and offshore PPMs	1
	Q_{min}/P_{max} (lead)	-0.5 p.u.	-0.33 p.u.	21.3.b (ii)	C and D PPM and offshore PPMs	1
	Q_{max}/P_{max} (lag)	0.65 p.u.	0.33 p.u.	21.3.b (ii)	C and D PPM and offshore PPMs	1

Table 24: Definition of a U-Q/Pmax-profile at Maximum Capacity PPMs connected @ <110 kV

Article 21.3.b (i) and (ii) & Article 25.5: PPM: Parameters required for U-Q/Pmax Profiles

- Below 110kV - Voltage & Reactive ranges in line with existing D Code

Reactive Power Capability below Maximum Capacity: P-Q/Pmax Profiles

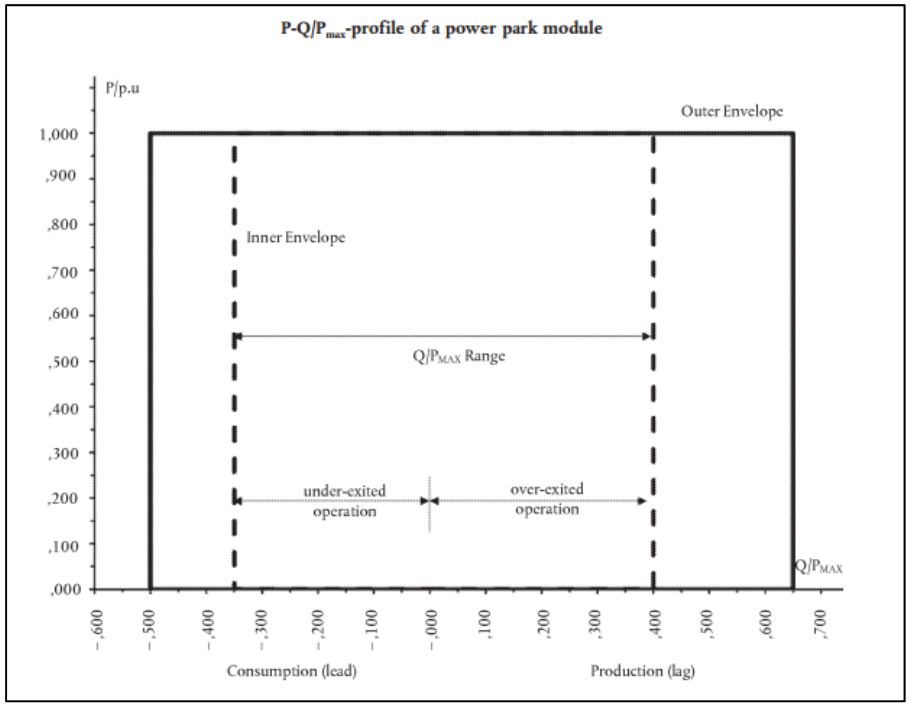
Article 21.3.c.(i), (ii) and (iv): PPM: Parameters required for P-Q/Pmax Profiles

- Section Number 4.2.2.3.1

- *Power park modules shall fulfil the following additional requirements in relation to voltage stability with regard to reactive power capability below maximum capacity. For that purpose a P- Q/P_{max}-profile is specified within the boundaries of which the power park module shall be capable of providing reactive power below maximum capacity ($P < P_{max}$).*

Article 21.3.c.(i), (ii) and (iv): PPM: Parameters required for P-Q/Pmax Profiles

The figure below represents boundaries of a P-Q/P_{max}-profile by the voltage at the connection point, expressed by the ratio of its actual value and the reference 1 p.u. value, against the ratio of the reactive power (Q) and the maximum capacity (P_{max}). The position, size and shape of the inner envelope are indicative.
The diagram represents boundaries of a P-Q/P_{max}-profile at the connection point by the fixed outer envelope.



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Article 21.3.c.(i), (ii) and (iv): PPM: Parameters required for P-Q/Pmax Profiles

PPMs connected at a voltage level ≥ 110 kV

Connection Voltage	Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
110 to 400 kV	p_{min}	0.0 p.u.	0.12 p.u.	21.3.c (ii)	D PPMs	1
	p_{max}	1.0 p.u.	1.0 p.u.	21.3.c (ii)	D PPMs	1
	Q_{min}/P_{max} (lead)	-0.5 p.u.	-0.33 p.u.	21.3.c (ii)	D PPMs	1
	Q_{max}/P_{max} (lag)	0.65 p.u.	0.33 p.u.	21.3.c (ii)	D PPMs	1

Table 25: Definition of a U-Q/Pmax-profile at Maximum Capacity PPMs connected @ ≥110 kV

Article 21.3.c.(i), (ii) and (iv): PPM: Parameters required for P-Q/Pmax Profiles

- The proposals above are consistent with the existing SONI Grid Code for Wind Farm Power Stations.

Article 21.3.c.(i), (ii) and (iv): PPM: Parameters required for P-Q/Pmax Profiles

PPMs connected at a voltage level < 110 kV

Connection Voltage	Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Below 110kV	p_{min}	0.0 p.u.	0.15 p.u.	21.3.c (ii)	C and D PPM	1
	p_{max}	1.0 p.u.	1.0 p.u.	21.3.c (ii)	C and D PPM	1
	Q_{min}/P_{max} (lead)	-0.5 p.u.	-0.33 p.u.	21.3.c (ii)	C and D PPM	1
	Q_{max}/P_{max} (lag)	0.65 p.u.	0.33 p.u.	21.3.c (ii)	C and D PPM	1

Table 26: P-Q/Pmax-profile below Maximum Capacity PPMs: connection @ <110 kV & in Topology 2

Article 21.3.c.(i), (ii) and (iv): PPM: Parameters required for P-Q/Pmax Profiles

- Below 110kV – Q/P_{max} and P_{min}/P_{max} ranges in line with existing D Code

Article 21.3.c.(iv): PPM: Time to Achieve Target Value within P-Q/Pmax Profile

- Section Number 4.2.2.3.2

- *the PPM shall be capable of moving to any operating point within its P- Q/P_{max}-profile in appropriate timescales to target values requested by the relevant system operator.*

Article 21.3.c.(iv): PPM: Time to Achieve Target Value within P-Q/Pmax Profile

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Time to achieve target value [transmission connected]	Not specified	Without delay but within 20 seconds	21.3.c.(iv)	C and D PPM	1
Time to achieve target value [distribution connected]	Not specified	Without delay but within 20 seconds	21.3.c.(iv)	C and D PPM	1

Table 27: Timescales to Achieve Target Values at Maximum Capacity

Article 21.3.c.(iv): PPM: Time to Achieve Target Value within P-Q/Pmax Profile

- This aligns with the current SONI WFPS Setting Schedule which stipulates that a change in set-point shall be implemented within 20 seconds of receipt of the appreciate signal from the TSO.

Supplementary Reactive Power Requirements

Article 18.2.a: SPGM: Supplementary reactive power requirements

- Section Number 4.2.2.4.1

- The *relevant system operator may specify supplementary reactive power to be provided if the connection point of a synchronous power-generating module is neither located at the high-voltage terminals of the step-up transformer to the voltage level of the connection point nor at the alternator terminals, if no step-up transformer exists. This supplementary reactive power shall compensate the reactive power demand of the high-voltage line or cable between the high-voltage terminals of the step-up transformer of the synchronous power-generating module or its alternator terminals, if no step-up transformer exists, and the connection point and shall be provided by the responsible owner of that line or cable*.

Article 18.2.a: SPGM: Supplementary reactive power requirements

Requirement	Requirement in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Right to specify supplementary reactive power requirements when the connection point is remote	To specify or not to specify	RSOs reserve the right to specify	18.2.a	Type C and D SPGMs	1

Table 28: Right to Specify Supplementary Reactive Power Requirements for SPGMs

Article 18.2.a: SPGM: Supplementary reactive power requirements

- The TSO and DSO invoke the right to specify supplementary reactive power requirements for remote connection points in order to align with the supplementary reactive power requirements.
- This is to ensure that the reactive power consumption of any cable or line connecting a generator is adequately compensated.

Article 21.3.a: PPM: Supplementary reactive power requirements

- Section Number 4.2.2.4.2

- *The relevant system operator may specify supplementary reactive power to be provided if the connection point of a power park module is neither located at the high-voltage terminals of the step-up transformer to the voltage level of the connection point nor at the convertor terminals, if no step-up transformer exists. This supplementary reactive power shall compensate the reactive power demand of the high- voltage line or cable between the high-voltage terminals of the step-up transformer of the power park module or its convertor terminals, if no step-up transformer exists, and the connection point and shall be provided by the responsible owner of that line or cable.*

Article 21.3.a: PPM: Supplementary reactive power requirements

Requirement	Requirement in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Right to specify supplementary reactive power requirements when the connection point is remote	To specify or not to specify	RSOs reserve the right to specify	21.3.a	Type C and D PPMs	1

Table 29: Right to Specify Supplementary Reactive Power Requirements for PPMs

Article 21.3.a: PPM: Supplementary reactive power requirements

- The TSO and DSO invoke the right to specify supplementary reactive power requirements for remote connection points in order to align with the supplementary reactive power requirements.
- This is to ensure that the reactive power consumption of any cable or line connecting a generator is adequately compensated such that transmission planning standards are maintained.

Reactive Power Control Modes for PPMs

Article 21.3.d.(iv)- Voltage Control Mode

- Section Number 4.2.2.5.1

- *Following a step change in voltage, the power park module shall be capable of achieving 90% of the change in reactive power output within a time t_1 and must settle at the value specified by the slope within a time t_2 with a steady-state reactive tolerance no greater than 5% of the maximum reactive power*.

Article 21.3.d.(iv)- Voltage Control Mode

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
t_1 = time within which 90% of the change in reactive power is reached	1 – 5 sec	1	21.3.d.(iv)	C and D PGMs	1
t_2 = time within which 100% of the change in reactive power is reached	5 – 60 sec	5	21.3.d.(iv)	C and D PGMs	1

Table 30: Parameters of the Voltage Control Mode

Article 21.3.d.(iv)- Voltage Control Mode

- Voltage Control performance criteria specified in the WFPS settings schedule
- Parameters specified in Table 30 align with existing requirements

Article 21.3.d (vi) - Power Factor Control Mode

- Section Number 4.2.2.6

- *For the purpose of power factor control mode, the power park module shall be capable of controlling the power factor at the connection point within the required reactive power range with a target power factor in steps no greater than 0.01.*

Article 21.3.d (vi) - Power Factor Control Mode

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Target power factor	Not specified	site-specific	21.3.d.(vi)	C and D PGMs	3
Time period to reach the set point	Not specified	5 seconds	21.3.d.(vi)	C and D PGMs	3
Tolerance	Not specified	5%	21.3.d.(vi)	C and D PGMs	3

Table 31: Parameters of the Power Factor Control Mode

Article 21.3.d (vi) - Power Factor Control Mode

- Power Factor Control performance criteria specified in the WFPS settings schedule
- Parameters specified in Table 31 align with existing requirements

Voltage Control System for SPGMs

Article 19.2.a and 19.2.b.(v): Voltage Control System

- Section Number 4.2.3.1

- *In relation to voltage stability, power-generating facility owner and the relevant system operator, in coordination with the relevant TSO, shall agree on the parameters and settings of the components of the voltage control system. The agreement shall cover the specifications and performance of an automatic voltage regulator ('AVR') with regard to steady-state voltage and transient voltage control (site-specific non-exhaustive Parameter). Further the specifications and performance of the excitation control system of an automatic voltage regulator shall include a Power System Stabilizer (PSS) function to attenuate power oscillations, among other, if the synchronous power-generating modules size is above the value proposed in Table 32.*

Article 19.2.a and 19.2.b.(v): Voltage Control System

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Power Threshold	Not specified	All Type D SPGMs	19.2.b.(v)	D SPGMs	2

Table 32: Power Threshold above which PSS Function is required

Article 19.2.a and 19.2.b.(v): Voltage Control System

- Due to the increasing complexity of the transmission system, along with the increasing levels of non-synchronous generation, it is likely the frequency and levels of oscillations will increase.
- In order manage this going forward and to maintain the security and safety of the transmission system, PSSs will be required on all type D PGMs.

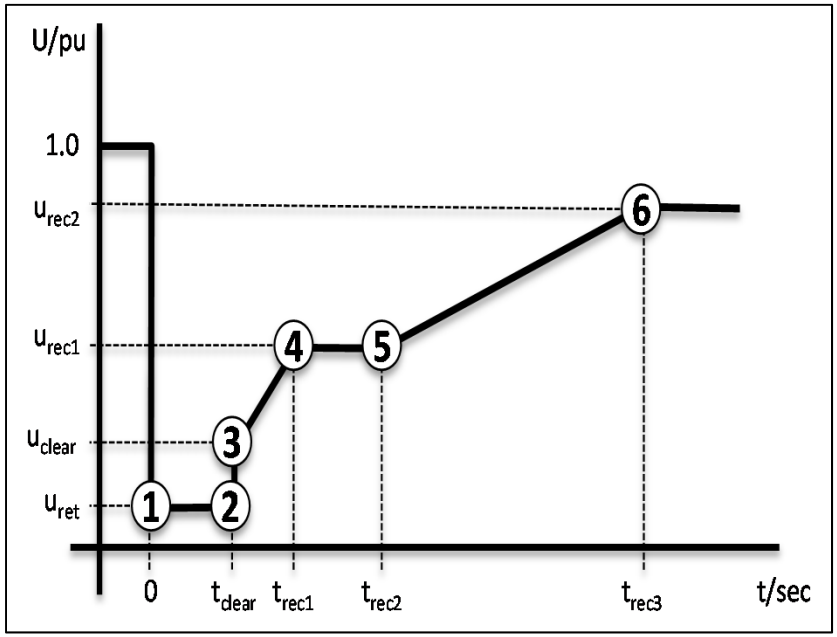
Fault Ride Through Capability

Article 14.3.a & 16.3.a: FRT Capability for PGMs connected at voltage level <110 kV

- Section Number 4.2.4.1

- *Power-generating modules shall be capable of staying connected to the network and continuing to operate stably after the power system has been disturbed by secured faults. That capability shall be in accordance with a voltage-against-time profile at the connection point for fault conditions in line with the figure below:*
- *The voltage-against-time-profile shall express a lower limit of the actual course of the phase-to-phase voltages on the network voltage level at the connection point during a symmetrical fault, as a function of time before, during and after the fault.*
- *That lower limit is specified for synchronous power-generating modules and power park modules connected below the 110 kV level in the following subsections.*

Article 14.3.a & 16.3.a: FRT Capability for PGMs connected at voltage level <110 kV



Fault Ride Through Profile of a Power-Generating Module

Article 14.3.a & 16.3.a: FRT Capability for SPGMs connected at voltage level <110 kV

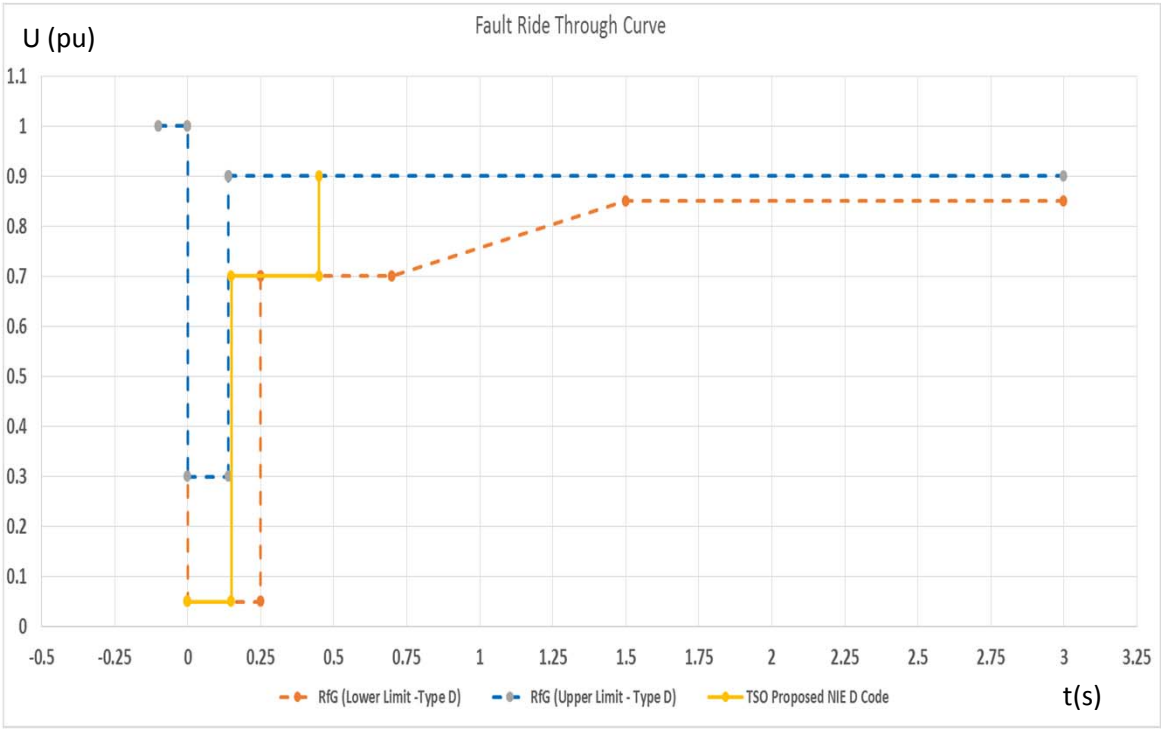
SPGMs connected at a voltage level < 110 kV

Voltage parameters (pu)			Time parameters (s)			Justification Code
Parameter	RfG Range	Proposal	Term	RfG Range	Proposal	
U_{ret}	0.05-0.3	0.05	t_{clear}	0.14-0.25	0.15	3
U_{clear}	0.7-0.9	0.7	t_{rec1}	t_{clear}	t_{clear}	3
U_{rec1}	U_{clear}	U_{clear}	t_{rec2}	t_{rec1}-0.7	0.45	3
U_{rec2}	0.85-0.9 & >=U_{clear}	0.9	t_{rec3}	t_{rec2}-1.5	t_{rec2}	3

Table 33: Definition of FRT parameters for SPGMS connected @ <110 kV

Article 14.3.a & 16.3.a: FRT Capability for SPGMs connected at voltage level <110 kV

- This is a change to the D Code and more closely reflects the capabilities of synchronous generating sets.
- The most onerous retained voltage level is chosen reflecting the radial nature of the distribution system.



Article 14.3.a & 16.3.a: FRT Capability for PPMs connected at voltage level <110 kV

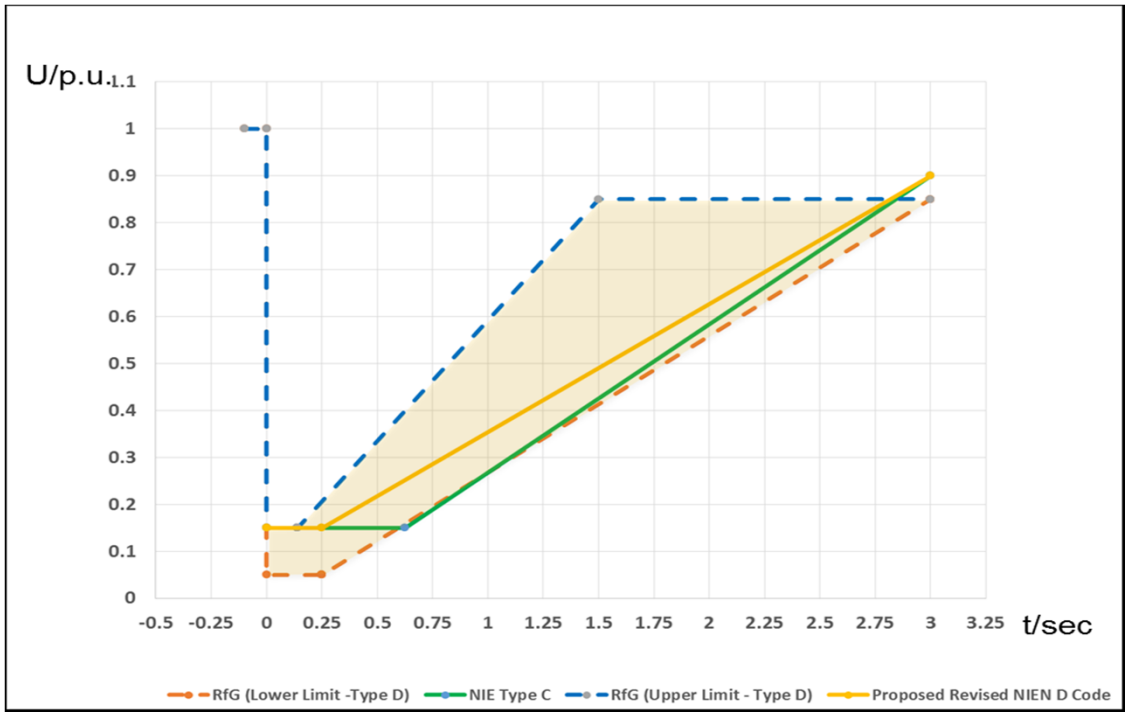
PPMs connected at a voltage level < 110 kV

Voltage parameters (pu)			Time parameters (s)			Justification Code
Parameter	RfG Range	Proposal	Parameter	RfG Range	Proposal	
U_{ret}	0.05-0.15	0.15	t_{clear}	0.14-0.25	0.25	3
U_{clear}	U_{ret} -0.15	0.15	t_{rec1}	t_{clear}	t_{clear}	3
U_{rec1}	U_{clear}	U_{clear}	t_{rec2}	t_{rec1}	t_{clear}	3
U_{rec2}	0.85	0.85	t_{rec3}	1.5-3.0	2.9	3

Table 34: Definition of FRT parameters for PPMs connected @ <110 kV

Article 14.3.a & 16.3.a: FRT Capability for PPMs connected at voltage level <110 kV

- The modifications are the minimum required to comply with the RfG.

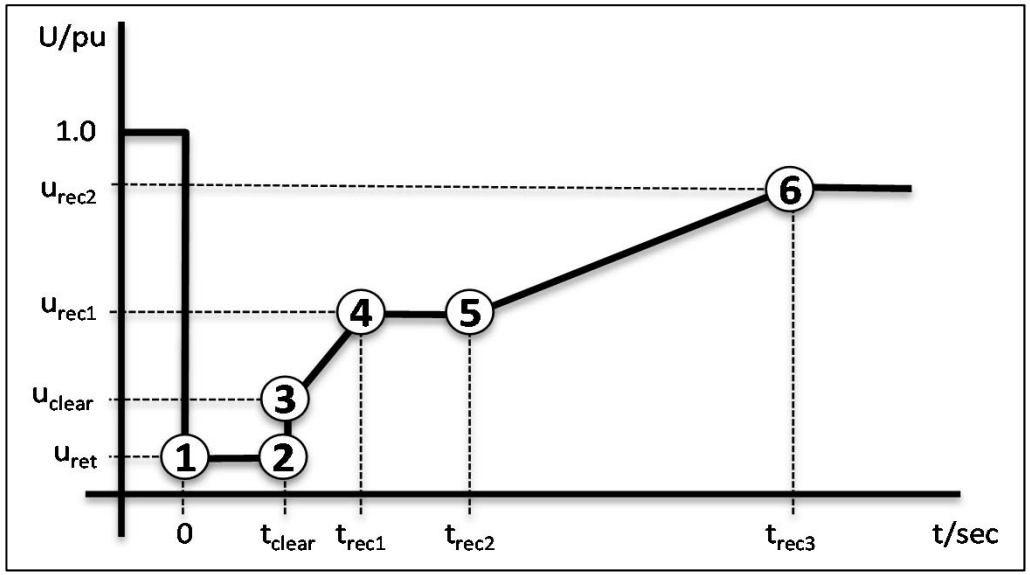


Article 16.3.a FRT Capability for PGMs connected at voltage level ≥110 kV

- Section Number 4.2.4.2

- *Power-generating modules shall be capable of staying connected to the network and continuing to operate stably after the power system has been disturbed by secured faults. That capability shall be in accordance with a voltage-against-time profile at the connection point for fault conditions in line the figure below.*
- *The voltage-against-time-profile shall express a lower limit of the actual course of the phase-to-phase voltages on the network voltage level at the connection point during a symmetrical fault, as a function of time before, during and after the fault.*
- *That lower limit is specified for synchronous power-generating modules and power park modules connected at or above the 110 kV level in the following subsections.*

Article 16.3.a FRT Capability for PGMs connected at voltage level ≥110 kV



Fault Ride Through Profile of a Power-Generating Module

Article 16.3.a FRT Capability for SPGMs connected at voltage level ≥110 kV

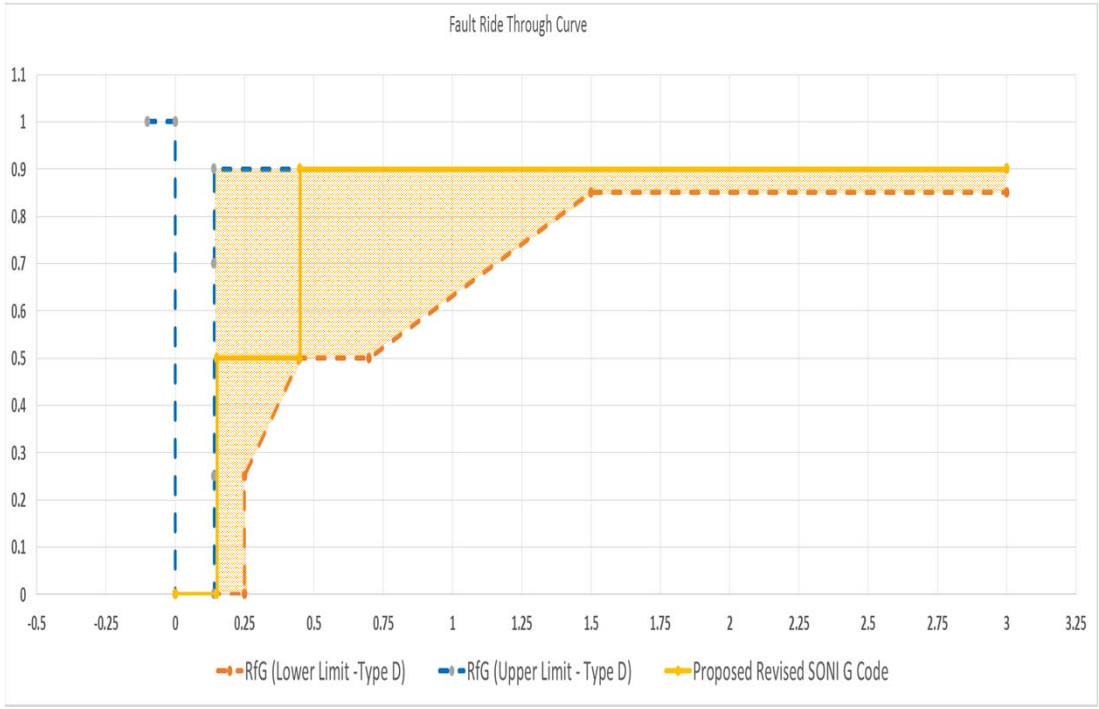
SPGMs connected at a voltage level ≥ 110 kV

Voltage parameters (pu)			Time parameters (s)			Justification Code
Parameter	RfG Range	Proposal	Term	RfG Range	Proposal	
U_{ret}	0	0	t_{clear}	0.14-0.25	0.15	3
U_{clear}	0.25	0.25	t_{rec1}	t_{clear} -0.45	t_{clear}	3
U_{rec1}	0.5-0.7	0.5	t_{rec2}	t_{rec1}-0.7	0.45	3
U_{rec2}	0.85-0.9	0.9	t_{rec3}	t_{rec2}-1.5	t_{rec2}	3

Table 35: Definition of FRT parameters for SPGMs connected @ ≥110 kV

Article 16.3.a FRT Capability for SPGMs connected at voltage level ≥110 kV

- The Grid Code does not provide fault ride through requirements for synchronous generators compliant with RfG.
- The proposal is based on the proposed modifications to the Ireland Grid Code and Distribution Code.



Article 16.3.a FRT Capability for PPMs connected at voltage level ≥110 kV

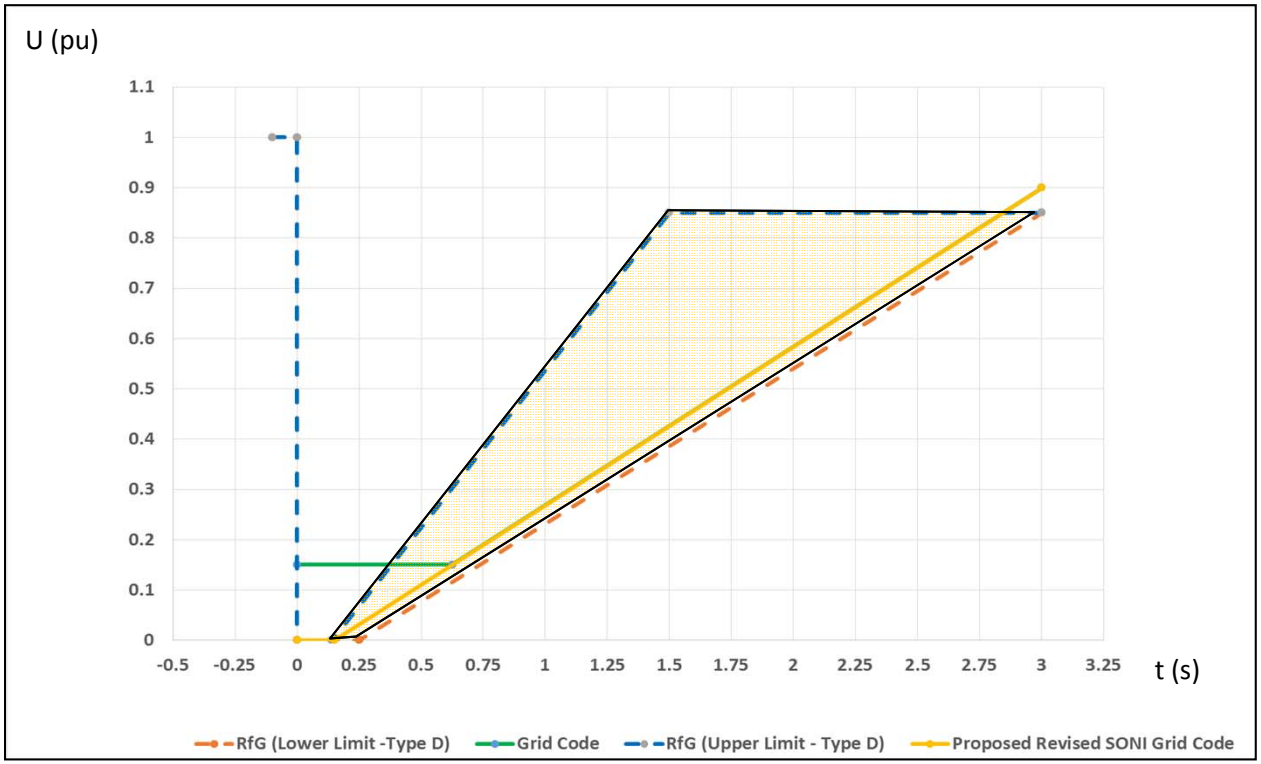
PPMs connected at a voltage level ≥ 110 kV

Voltage parameters (pu)			Time parameters (s)			Justification Code
Parameter	RfG Range	Proposal	Term	RfG Range	Proposal	
U_{ret}	0	0	t_{clear}	0.14-0.25	0.15	1
U_{clear}	U_{ret}	U_{ret}	t_{rec1}	t_{clear}	t_{clear}	
U_{rec1}	U_{clear}	U_{clear}	t_{rec2}	t_{rec1}	t_{clear}	
U_{rec2}	0.85	0.85	t_{rec3}	1.5-3.0	2.9	1

Table 36: Definition of FRT parameters for PPMs connected @ ≥ 110 kV

Article 16.3.a FRT Capability for PPMs connected at voltage level ≥110 kV

- Maintained as close as possible to existing FRT in Grid Code for WFPS
- Retained voltage requires to be reduced to zero.
- Gradient crosses the 0.85pu line at 2.9s



FRT: Fast Fault Current Injection

Article 20.2.b Fast Fault Current Injection for Symmetrical Faults

- Section Number 4.2.4.3.1

- The relevant system operator in coordination with the relevant TSO shall have the right to specify that a power park module be capable of providing fast fault current at the connection point in case of symmetrical (3-phase) faults, under the following conditions
  i. the power park module shall be capable of activating the supply of fast fault current either by:
     a. ensuring the supply of the fast fault current at the connection point, or
     b. measuring voltage deviations at the terminals of the individual units of the PPM and providing a fast fault current at the terminals of these units;
  ii. the relevant system operator in coordination with the relevant TSO shall specify:
     a. how and when a voltage deviation is to be determined as well as the end of the voltage deviation,
     b. the characteristics of the fast fault current, including the time domain for measuring the voltage deviation and fast fault current, for which current and voltage may be measured differently from the method specified in Article 2,
     c. the timing and accuracy of the fast fault current, which may include several stages during a fault and after its clearance;

Article 20.2.b Fast Fault Current Injection for Symmetrical Faults

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Voltage threshold for fast fault current injection	Not specified	During voltage dips i.e. when the voltage is below 0.9 p.u.	20.2.b	B, C and D PPMs	3
End of the voltage deviation	Not specified	Once the voltage has recovered to within normal operating voltage range	20.2.b	B, C and D PPMs	3
the characteristics of the fast fault current, including the time domain for measuring the voltage deviation and fast fault current	Not specified	Reactive current should be provided for the duration of the voltage deviation within the rating of the PPM	20.2.b	B, C and D PPMs	3
the timing and accuracy of the fast fault current, which may include several stages during a fault and after its clearance	Not specified	Rise Time no greater than 100ms and a Settling Time no greater than 300ms.	20.2.b	B, C and D PPMs	3

Table 37: Fast Fault Current Injection - Symmetrical Faults

Article 20.2.b Fast Fault Current Injection for Symmetrical Faults

- The existing Distribution Code and Grid Code are silent on the provision of fast fault current.
- The DNO and TSO invoke the right to specify that a power park module be capable of providing fast fault current at the connection point in case of symmetrical (3-phase) faults under the conditions given.
- Values are set to align with Ireland Grid Code.

Article 20.2.c Fast Fault Current Injection for Asymmetrical Faults

- Section Number 4.2.4.3.2

- *with regard to the supply of fast fault current in case of asymmetrical (1-phase or 2-phase) faults, the relevant system operator in coordination with the relevant TSO shall have the right to specify a requirement for asymmetrical current injection*

Article 20.2.c Fast Fault Current Injection for Asymmetrical Faults

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Voltage threshold for fast fault current injection	Not specified	During voltage dips i.e. when the voltage is below 0.9 p.u.	20.2.b	B, C and D PPMs	3
the characteristics of the fast fault current, including the time domain for measuring the voltage deviation and fast fault current	Not specified	Reactive current should be provided for the duration of the voltage deviation within the rating of the PPM	20.2.b	B, C and D PPMs	3
the timing and accuracy of the fast fault current, which may include several stages during a fault and after its clearance	Not specified	Rise Time no greater than 100ms and a Settling Time no greater than 300ms.	20.2.b	B, C and D PPMs	3

Table 38: Fast Fault Current Injection - Asymmetrical Faults

Article 20.2.c Fast Fault Current Injection for Asymmetrical Faults

- The existing Distribution Code and Grid Code are silent on the provision of fast fault current.
- The DNO and TSO invoke the right to specify that a power park module be capable of providing fast fault current at the connection point in case of symmetrical (3-phase) faults under the conditions given.
- Values are set to align with Ireland Grid Code.

FRT: Post Fault Active Power Recovery of PPMs

Article 20.3.a Post-Fault Active Power Recovery for PPMs

- Section Number 4.2.4.4

- *the relevant TSO shall specify the post-fault active power recovery that the power park module is capable of providing and shall specify certain parameters*

Article 20.3.a Post-Fault Active Power Recovery for PPMs

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
when the post-fault active power recovery begins, based on a voltage criterion	Not specified	u_n< 0.9 p.u.	20.3.a	B, C and D PPMs	1
maximum allowed time for active power recovery	Not specified	500ms	20.3.a	B, C and D PPMs	**1**
magnitude and accuracy for active power recovery	Not specified	90%	20.3.a	B, C and D PPMs	**1**

Table 39: Post-Fault Active Power Recovery for PPMs

Article 20.3.a Post-Fault Active Power Recovery for PPMs

- The proposal of parameters which specify the capability of post-fault active power recovery is in line with CC.S2.1.3.6 c) of the current SONI Grid Code and section 7.12.3.2. of the Distribution Code.

FRT: Prioritisation of Active/Reactive Current

Article 21.3.e Priority Given to Active or Reactive Power Contribution for PPMs

- Section Number 4.2.4.5

- *With regard to prioritising active or reactive power contribution, the relevant TSO shall specify whether active power contribution or reactive power contribution has priority during faults for which fault-ride-through capability is required. If priority is given to active power contribution, this provision has to be established no later than 150 ms from the fault inception.*

Article 21.3.e Priority Given to Active or Reactive Power Contribution for PPMs

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Prioritisation requirements during FRT	Active/Reactive	Active	21.3.e	C and D PPMs	3

Table 40: Priority given to Active or Reactive Power Contribution

Article 21.3.e Priority Given to Active or Reactive Power Contribution for PPMs

- The SONI Grid Code is silent on this requirement in respect of wind farm power stations.
- The choice of active considered a priority for the Northern Ireland transmission system and is consistent with EirGrid Grid Code.

Additional Requirements Not Invoking

Additional Non-Mandatory Voltage Requirements

Requirement	Requirement in RfG	Consultation Proposal	Article Number	Type Applicability
Simultaneous overvoltage and underfrequency or simultaneous undervoltage and overfrequency	Not specified	Not invoking at this time.	16(02)(a)(ii)	Type A, B, C and D PGMs

Table 41: List of Non-Mandatory and not invoked Requirements for Generators

Q&A

Protection Theme

Miriam Ryan (TSO)

Article 15.2.b: Manual, local measures where the automatic remote devices are out of service

- Section Number 4.4.1

- *Manual local measures shall be allowed in cases where the automatic remote control devices are out of service.*
- *The relevant system operator or the relevant TSO shall notify the regulatory authority of the time required to reach the set point together with the tolerance for the active power.*

Article 15.2.b: Manual, local measures where the automatic remote devices are out of service

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Time required to achieve setpoint when automatic remote devices are unavailable	Not Specified	1 hour	15(2)(b)	B, C and D PGMs	3

Table 43: Time required to Achieve Set point when Automatic Remote Devices are Unavailable

Article 15.2.b: Manual, local measures where the automatic remote devices are out of service

- The proposed time of one hour should allow reasonable time for the operator to reach site and to place the PGM under manual control and is in line with current blackstart plan procedures.

Article 15.6.b (i): Instrumentation: Quality of Supplies

- Section Number 4.4.2

- Power-generating facilities shall be equipped with a facility to provide fault recording and monitoring of dynamic system behaviour. This facility shall record the following parameters:
  - Voltage,
  - Active power,
  - Reactive power, and
  - Frequency
- The relevant system operator shall have the right to specify quality of supply parameters to be complied with on condition that reasonable prior notice is given.

Article 15.6.b (i): Instrumentation: Quality of Supplies

Requirement	Requirement in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Quality of supplies parameters to be recorded.	Not Specified	Site Specific	15(6)(b)(i)	C and D PGMs and offshore PPMs	1

Table 44: Quality of Supplies Parameters to be Recorded

Article 15.6.b.(iii): Dynamic System Behaviour Monitoring

- Section Number 4.4.3

- *The dynamic system behaviour monitoring shall include an oscillation trigger specified by the relevant system operator in coordination with the relevant TSO, with the purpose of detecting poorly damped power oscillations;*

Article 15.6.b.(iii): Dynamic System Behaviour Monitoring

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Oscillation trigger detecting poorly damped power oscillations.	Not Specified	Site Specific	15(6)(b)(iii)	C and D PGMs and offshore PPMs	1

Table 45: Oscillation Trigger Detecting Poorly Damped Power Oscillations

Article 15.6.c.(iii) Simulation Model Provision

- Section Number 4.4.4

- *The request by the relevant system operator referred to in point (i) shall be coordinated with the relevant TSO. It shall include:*
  - *The format in which models are provided,*
  - *The provision of documentation on a model's structure and block diagrams,*
  - *An estimate of the minimum and maximum short circuit capacity at the connection point, expressed in MVA, as an equivalent of the network.*

Article 15.6.c.(iii) Simulation Model Provision

Requirement	Requirement in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Model Provision	Not Specified	Retain the existing model provision requirements with the inclusion of min and max short circuit levels	15(6)(c)(iii)	C and D PGMs and offshore PPMs	2

Table 46: Simulation Model Provision

Article 15.6.c.(iii) Simulation Model Provision

- The existing requirements of section PC6 covers the vast majority of the requirements detailed in the RfG, apart from the provision of the min and max short circuit levels in MVA. Hence, the proposal is to extend PC6 to include the provision of the necessary min and max short circuit levels.

Article 15.6.f: Neutral-point at the network side of step transformers

- Section Number 4.4.5

- *Earthing arrangement of the neutral-point at the network side of step-up transformers shall comply with the specifications of the relevant system operator.*

Article 15.6.f: Neutral-point at the network side of step transformers

Parameter	Parameter in RfG	Consultation Proposal	Article Number	Type Applicability	Justification Code
Earthing arrangement of the neutral-point	Not Specified	Site specific - Will be specified as a part of the connection agreement	15(6)(f)	C and D PGMs and offshore PPMs	1

Table 47: Neutral-point at the Network Side of Step Transformers

Additional Non-Mandatory Protection & Instrumentation Requirements

Parameter	Parameters in RfG	Article Number	Type Applicability
Control Scheme and Settings: Agreement and coordination between the TSO, the RSO (TSO and DSO) and the power generating facility owner (PGFO)	Control schemes and settings of the control devices	14.5.a	B,C & D PGMs and offshore PPMs
Electrical Protection Schemes and settings: Agreement and coordination between the RSO and the PGFO	Protection schemes and settings	14.5.b	B,C & D PGMs and offshore PPMs
Loss of angular stability or loss of control: Agreement between PGFO and the RSO (DSO or TSO), in coordination with the TSO	Criteria to detect loss of angular stability or loss of control	15.6.a	C & D PGMs and offshore PPMs
Instrumentation: Settings of the fault recording equipment, including triggering criteria and sampling rate **Agreement between the PGFO and the RSO (DSO or TSO), in coordination with the TSO.**	Settings of the fault recording equipment, including triggering criteria and sampling rate	15.6.b(ii)	C & D PGMs and offshore PPMs
Instrumentation: Protocols for recorded data **Agreement between PGFO, the RSO and the relevant TSO**	Protocols for recorded data	15.6.b(iv)	C & D PGMs and offshore PPMs
Installation of devices for system operations and system security: Agreement between RSO or TSO and PGFO	Definition of the devices needed for system operation and system security	15.6.d	C & D PGMs and offshore PPMs
Synchronisation: Agreement between the RSO and the PGFO	Settings of the synchronisation devices	16.4	D PGMs and offshore PPMs
Angular stability under fault conditions: Agreement between TSO & PGFO	Agreement for technical capabilities of the power generating module to aid angular stability.	19.3	D SPGM

Q&A

Closeout

Marie Hayden (TSO)

In summary

- Intention of TSO & DSO, insofar as possible, when proposing these values was as follows;
  - To keep existing requirements
  - To make minimum amount of change to existing requirements
  - Not to use this as a mechanism to make dramatic changes to existing requirements
  - Not to use this as a mechanism to align north and south existing/new requirements
- Consultation closes on the 9th of February 2018
- The TSO & DSO welcome any further feedback on the proposals, using the template provided online and sent to gridcode@soni.ltd.uk

Q&A