

# WELCOME

## GC0155

# Clarification of Fault Ride Through Technical Requirements

Meeting 7

19 January 2023

Online Meeting via Teams

**nationalgrid**ESO

# Agenda

Topics to be discussed	Lead
Welcome	Chair
Review of Actions Log	Chair
<ul style="list-style-type: none"><li>18: ESO Update re engagements with manufacturers</li></ul>	BA
Temporary Overvoltage Requirements	JF/BA
Review of Timeline	Chair
Terms of Reference	Chair
<ul style="list-style-type: none"><li>Progress Check</li></ul>	
AOB & Next Steps	Chair



## Members / Alternates & Observers

Role	Name	Representing
Chair	Banke John-Okwesa	Code Administrator (ESO)
Technical Secretary	Ruth Roberts	Code Administrator (ESO)
Proposer	Terry Baldwin	NGESO
Workgroup Member	Alan Mason	Oceanwinds
Workgroup Member	Alan Creighton	Northern Powergrid
Workgroup Member	Alastair Frew	Drax Power Station
Observer	Andrew Larkins	Sygensys
Workgroup Member	Andrew Vaudin	EDF
Workgroup Member	Bieshoy Awad	NGESO
Observer	David Griffiths	RWE Generation UK, RWE Renewables
Observer	Fiona Williams	NGESO
Workgroup Member	Forooz Ghassemi	NGET
Workgroup Member	Frank Martin	Siemens
Workgroup Member	Fraser Norris	SSE
Workgroup Member	Garth Graham	SSE Generation
Workgroup Member	Isaac Gutierrez	Scottish Power
Workgroup Member	John Fradley	ESO
Observer	Mike Kay	Independent
Workgroup Member	Nicola Barberis Negra	Orsted
Observer	Owen Curran	Siemens
Workgroup Member	Priyanka Mohapatra	Scottish Power
Workgroup Member	Ryan Tumilty	SSE
Workgroup Member	Sean Gauton	Uniper Energy
Workgroup Member	Tim Ellingham	RWE Generation UK, RWE Renewables
Workgroup Member (Alternate)	Julie Richmond	Scottish Power
Workgroup Member (Alternate)	Martin Aten	Uniper
Workgroup Member (Alternate)	Sridhar Sahukari	Orsted
Workgroup Member (Alternate)	Tobias Siepker	Siemens
Authority Representative	Shilen Shah	Ofgem



# Timeline

**Banke John-Okwesa – ESO Code Administrator**



# Current Timeline for GC0155

Milestone	Date	Milestone	Date
Proposal Presented to Panel	16 December 2021	Workgroup 9 – Finalise solution(s) and legal text, agree that Terms of Reference have been met, Review Workgroup Report and hold Workgroup Vote	14 March 2023
Workgroup 1 – Understand / discuss proposal and solution, note the scope and identify any possible alternative solutions, agree timeline and review terms of reference, agree next steps.	10 February 2022	Workgroup Report issued to Panel	22 March 2023
Workgroup 2 – Refresher: review and agree timeline and Terms of Reference, Review/Develop solution(s) and legal text, identify/assess possible alternatives.	07 June 2022	Panel sign off that Workgroup Report has met its Terms of Reference	30 March 2023
Workgroup 3 – Develop Solution(s), review of legal text and alternatives	05 July 2022	Code Administrator Consultation	07 April 2023 – 07 May 2023
Workgroup 4 – ESO to present plan and next steps re Definition of Overvoltage Requirements following a Fault, agree on the proposed plan	25 July 2022	Draft Final Modification Report (DFMR) issued to Panel	17 May 2023
Workgroup 5 – Review / assess on-going work on Overvoltage requirements	23 August 2022	Panel undertake DFMR recommendation vote	25 May 2023
Workgroup 6 – Review / assess ongoing work on Overvoltage requirements; consider HVRT findings	07 September 2022	Final Modification Report issued to Panel to check votes recorded correctly (5 working days)	29 May 2023 – 02 June 2023
<del>Workgroup 7 – Finalise Overvoltage requirements, consider / finalise alternatives, draft consultations questions</del>	<del>23 November 2022</del>	Final Modification Report issued to Ofgem	06 June 2023
Workgroup 7 – Review of ESO findings, look through of draft legal text, consideration of alternatives, draft consultation questions	19 January 2023	Ofgem decision	TBC
Workgroup Consultation (15 Working Days)	30 January 2023 – 17 February 2023	Implementation Date	10 working days after Ofgem decision
Workgroup 8 (Post Workgroup Consultation) – Review / assess Workgroup consultation responses and Workgroup Report.	28 February 2023		

# Proposed Timeline (to be agreed by Workgroup)

Milestone	Date	Milestone	Date
Proposal Presented to Panel	16 December 2021	Workgroup Consultation (15 Working Days)	25 April 2023 – 25 May 2023
Workgroup 1 – Understand / discuss proposal and solution, note the scope and identify any possible alternative solutions, agree timeline and review terms of reference, agree next steps.	10 February 2022	Workgroup 11 (Post Workgroup Consultation) – Review / assess Workgroup consultation responses and Workgroup Report.	12 June 2023
Workgroup 2 – Refresher: review and agree timeline and Terms of Reference, Review/Develop solution(s) and legal text, identify/assess possible alternatives.	07 June 2022	Workgroup 12 – Finalise solution(s) and legal text, agree that Terms of Reference have been met, Review Workgroup Report and hold Workgroup Vote	04 July 2023
Workgroup 3 – Develop Solution(s), review of legal text and alternatives	05 July 2022	Workgroup Report issued to Panel	19 July 2023
Workgroup 4 – ESO to present plan and next steps re Definition of Overvoltage Requirements following a Fault, agree on the proposed plan	25 July 2022	Panel sign off that Workgroup Report has met its Terms of Reference	27 July 2023
Workgroup 5 – Review / assess on-going work on Overvoltage requirements	23 August 2022	Code Administrator Consultation	01 Aug 2023 – 01 Sept 2023
Workgroup 6 – Review / assess ongoing work on Overvoltage requirements; consider HVRT findings	07 September 2022	Draft Final Modification Report (DFMR) issued to Panel	20 Sept 2023
<del>Workgroup 7 – Finalise Overvoltage requirements, consider / finalise alternatives, draft consultations questions</del>	<del>23 November 2022</del>	Panel undertake DFMR recommendation vote	28 Sept 2023
Workgroup 7 – Review of ESO findings, look through of draft legal text, consideration of alternatives	19 January 2023	Final Modification Report issued to Panel to check votes recorded correctly (5 working days)	02 Oct 2023 – 06 Oct 2023
Workgroup 8 - Consider/review ESO updates/findings, look through of draft legal text, consideration of alternatives, draft consultation questions	28 February 2023	Final Modification Report issued to Ofgem	11 Oct 2023
Workgroup 9 - Consider ESO updates/findings look through of draft legal text, consideration of alternatives, draft consultation questions, review consultation documents	17 March 2023	Ofgem decision	TBC
Workgroup 10 – Review and finalise consultation documents	18 April 2023	Implementation Date	10 working days after Ofgem decision



# Review of Actions Log

Banke John-Okwesa – ESO Code Administrator



Action Number	Workgroup raised	Owner	Action	Comment	Due by	Status
18	WG4	BA	Reach out to manufacturers to get their views.	Update:  SG – The questions have been shared with a manufacturer; they are just awaiting confirmation on who will answer them.  OC – NDAs are needed to allow them to share detailed information with the ESO. BA to chase this up internally within the ESO (once contact details have been provided by OC).		Ongoing
21	WG5	IG/BA	To meet offline to support with providing contacts of convertor manufacturers		ASAP	Open
22	WG5	All	To provide NGESO with clear articulation with examples of the TOV issues	FG to check if NGET have any examples.  PM suggested BA contact Finley McCloud from Scottish Power Networks, as he may be able to provide this data.	ASAP	Closed
23	WG5	All	For the workgroup to share with BJO to collate any evidence or examples they have on research work on TOVs to help support NGESO work and develop the modification solution	FG to check if NGET have any examples.  PM suggested BA contact Finley McCloud from Scottish Power Networks, as he may be able to provide this data.	ASAP	Closed
25	WG4	AL	Creation of Strawman on vector shift requirements for the workgroup to review	Update: AL needs another 2 weeks to collate and share this information.		N/A Closed
26	WG6	FG/FW	Confirm how TGN 288 is included within BCA's if it is not a RES document.		ASAP	Open



# Temporary Overvoltage Requirements

John Fradley / Bieshoy Awad – ESO

# Overview

An objective of the GC0155 working group is to provide a requirement for temporary overvoltage events following a fault. This requirement will provide clarity to Users and Network Operators. It will also align England, Wales, and Scotland.

To gain knowledge, an RFI exercise was undertaken with OEMs to understand the impact that a temporary overvoltage has and what their operating capability is.

# Temporary Overvoltage

During FRT recovery, the voltage at the point of connection may exceed its nominal operating range (0.9 – 1.1 pu).

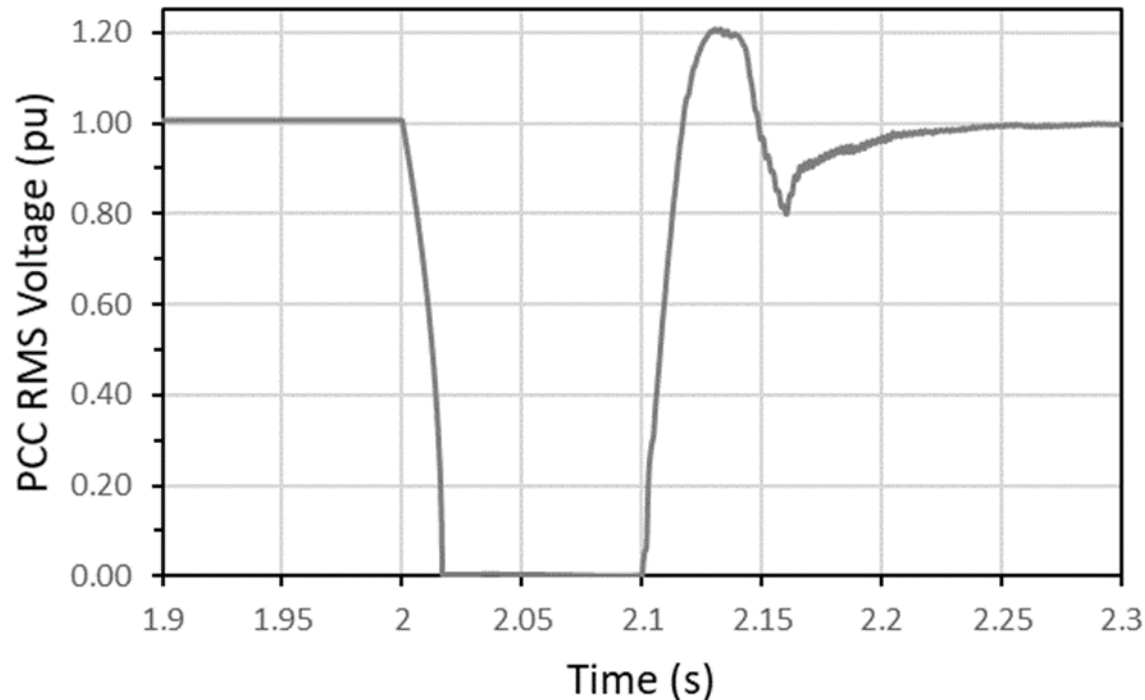


Fig 1: Example of a FRT voltage response

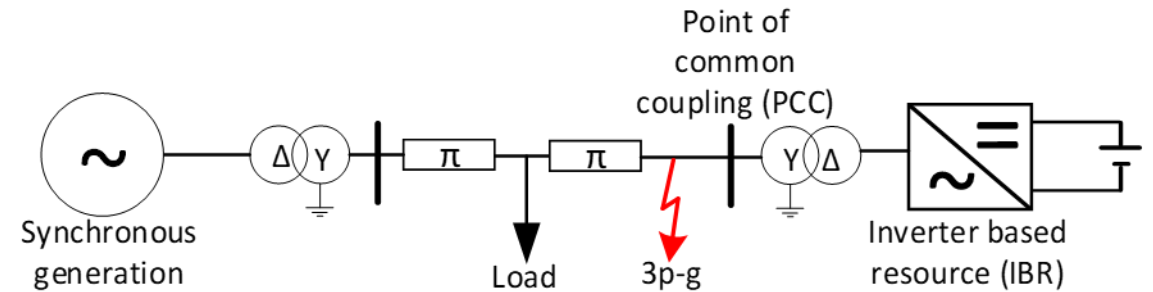


Fig 2: Example fault scenario

## Response influencing factors include:

- System strength
- Load type/response
- Compensation device operation
- IBR operating mode, control

# Existing Grid Code

- Currently, there is no upper envelope describing the acceptable temporary overvoltage thresholds that a generator is required to remain connected for.
- The addition of an upper limit will improve the security of supply.

(i) remain transiently stable and connected to the **System** without tripping of any **OTSDUW Plant and Apparatus**, or **Power Park Module** and / or any constituent **Power Park Unit**, for balanced **Supergrid Voltage** dips and associated durations on the **Onshore Transmission System** (which could be at the **Interface Point**) anywhere on or above the heavy black line shown in Figure 5b. Appendix 4A and Figures CC.A.4A.3.4 (a), (b) and (c) provide an explanation and illustrations of Figure 5b; and,

Grid code clause: CC.6.3.15.1 (2b)(i)

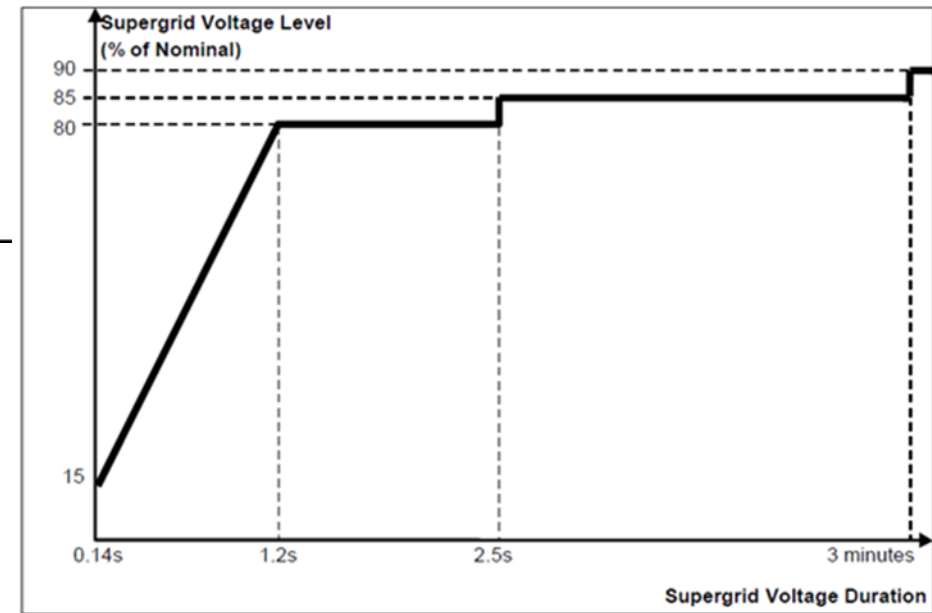


Fig 3: FRT low voltage requirement



# OEM Request For Information

Knowledge building exercise to help inform and steer the temporary overvoltage requirements.  
Split into two sections:

**Physical Impact to Equipment**

**Operating Capability**

# Physical Impact to Equipment

**Reasons for disconnection during a temporary overvoltage** (vary depending on technology):

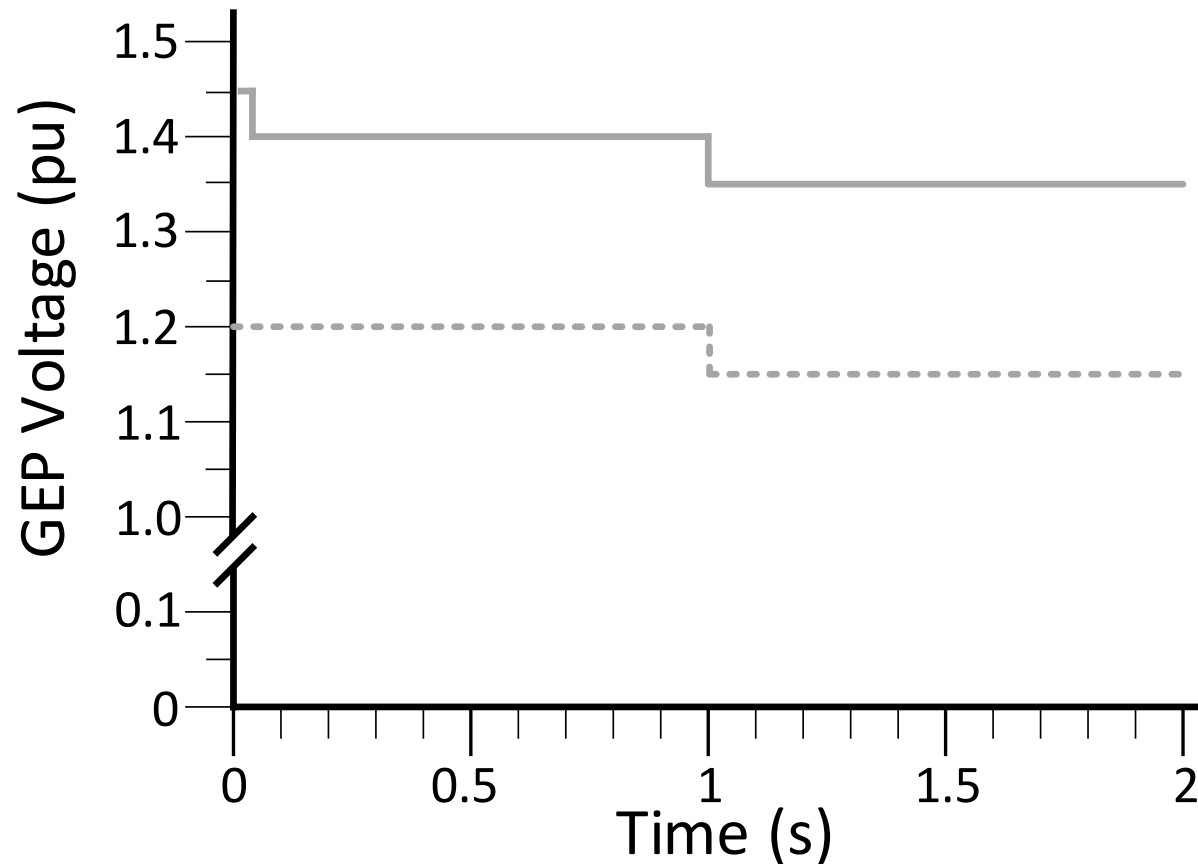
- Protection of auxiliary equipment – pumps/fans/yaw
- Protection of turbine and semiconductor components from electrical breakdown
- Prevent uncontrollable reactive current flow (thermal stress, DC link voltage)

## **HVRT Improvement:**

Through control to reduce the voltage by absorbing reactive power

# TOV Operating Capability

The following envelope was constructed based on data from OEMs.



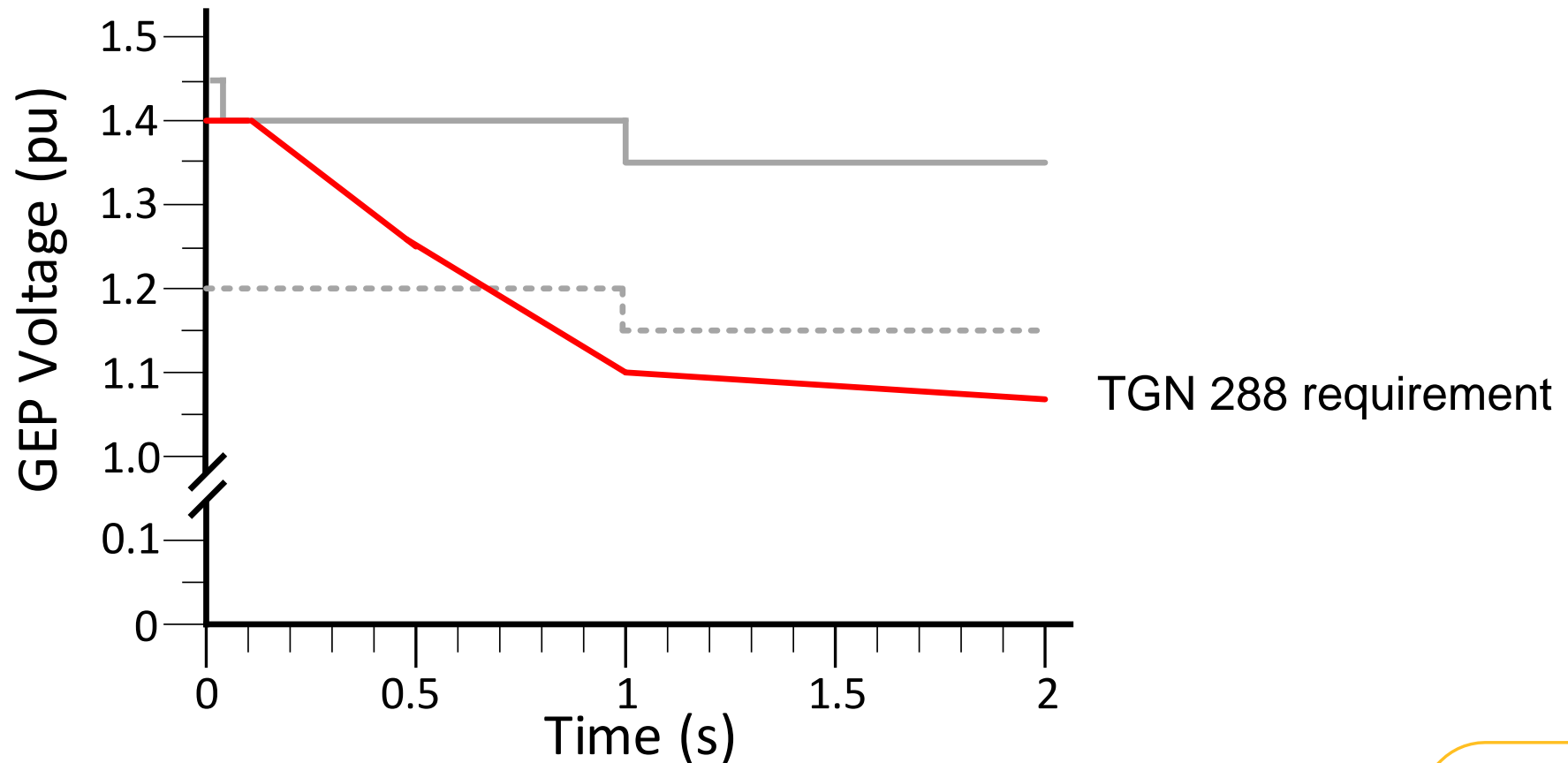
Max. HVRT capability  
provided

Min. HVRT capability  
provided

# Alignment of Grid Code to TGN 288 (Currently only for England and Wales)

Desire to align the grid code to TGN 288.

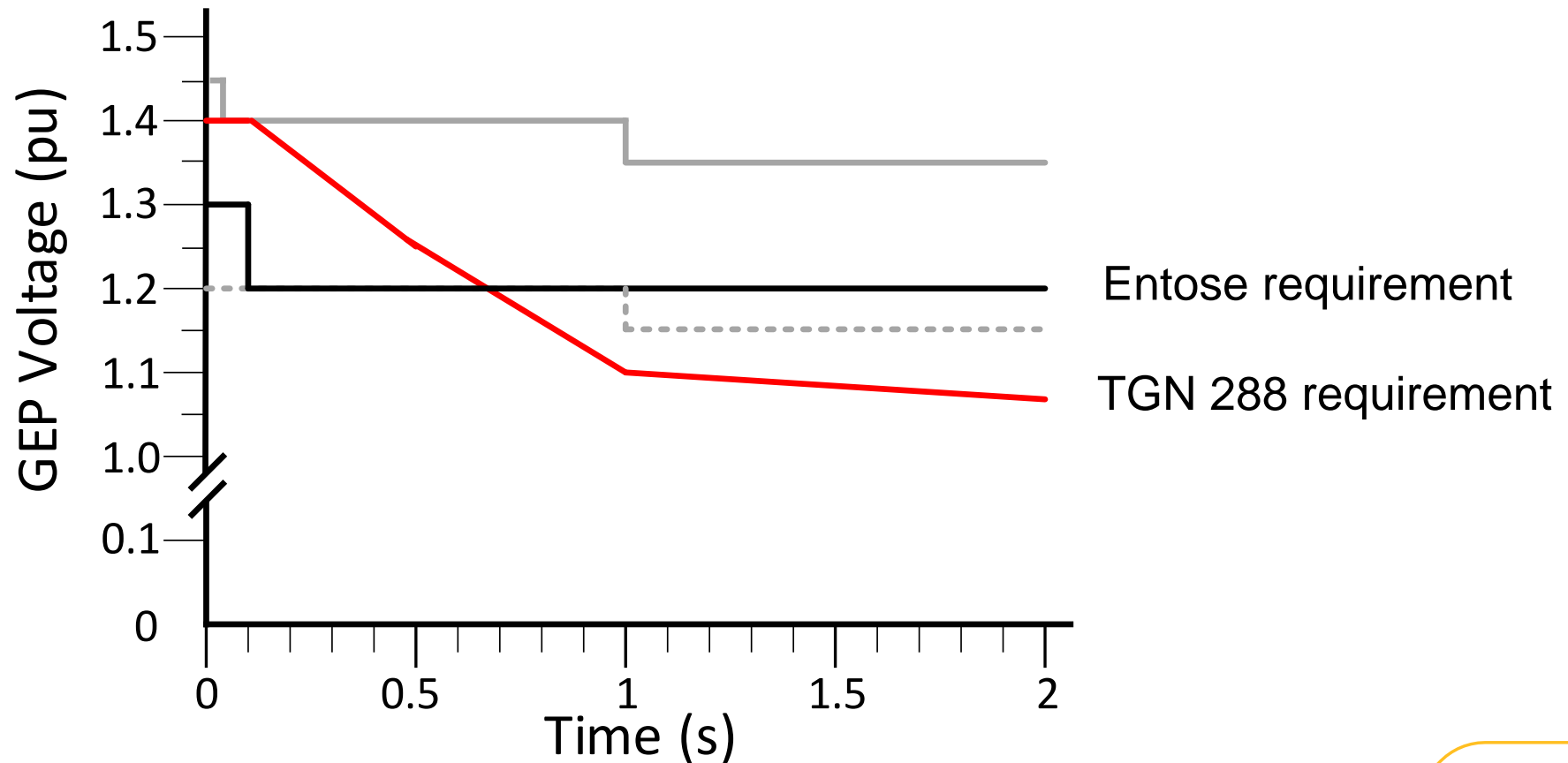
**Why:** This will reduce the uncertainty and therefore lower the risks and the associated operating costs.





# TGN vs Entsoe Requirements

As a comparison, Entsoe have proposed there own HVRT requirements.



# Implementation of Requirements

The implementation process is still to be finalised and is an on-going discussion with the following concerns raised:

- How will the gap between requirement and operation be met?
- Will the requirements apply to new and existing plant?
- How will the performance be demonstrated?
- Where will additional investment come from to help meet the requirements?
- What will the derogation criteria be?

# Terms of Reference

Banke John-Okwesa – ESO Code Administrator

# GC0155 Terms of Reference

Workgroup Term of Reference	Current status
a) Implementation and costs;	<b>To be covered depending on outcome of e(iv)</b>
b) Review draft legal text should it have been provided. If legal text is not submitted within the Grid Code Modification Proposal the Workgroup should be instructed to assist in the developing of the legal text; and	<b>In progress</b>
c) Consider whether any further Industry experts or stakeholders should be invited to participate within the Workgroup to ensure that all potentially affected stakeholders have the opportunity to be represented in the Workgroup. Demonstrate what has been done to cover this clearly in the report	Experts have been invited into meetings as and when required
d) Consider Electricity Balancing Regulation (EBR) implications	There are no EBR implications
e) Minor changes and clarifications to the existing Grid Code Fault Ride Through (FRT) requirements specifically but not limited to consideration of the following areas:  i. Clarify instances where User plant is required to trip in order to clear transmission system faults  ii. Amending requirements for generating maximum reactive current during faults where these may be unachievable for some generators  iii. Amending post-fault active power requirements to consider whether generators at low load may have greater levels of oscillation than permitted  iv. To consider clarifying and or defining requirements for over-voltage following a fault	Considered and discussed  Considered and discussed  Still in considerations. Some tweaks to be made to initial requirements  In progress.
f) Identify and address any cross code impacts on other codes especially Distribution Code (e.g. G99 requirements)	No impact on Dcode. Legal text will be drafted/sectioned in a way that there won't be impact on G99.



# AOB & Next Steps

Banke John-Okwesa – ESO Code Administrator