Code Administrator Meeting Summary

Meeting Name: GC0155 Workgroup 6

Date: 7 September 2022

Contact Details

Chair: Banke John-Okwesa, National Grid ESO Banke.John-Okwesa@nationalgrideso.com
Proposer: Terry Baldwin, National Grid ESO Terry.Baldwin@nationalgrideso.com

Key areas of discussion

Review of Actions log

The Workgroup talked through each action in the order it had been logged, Action **20** and **24** were deemed completed and closed.

Presentation on: Fault Ride Through (FRT) Temporary Overvoltage (TOV) Requirement Withstand Voltage

- FG and BA presented slides on Fault Ride Through (FRT) Temporary Overvoltage (TOV) requirement withstand voltage, which was to be shared with the Workgroup post meeting. FG proposed that the Workgroup needed to consider two matters when setting requirements for FRT: 1) TOV withstand capability of equipment; and
  2) Power Electronic (PE) equipment performance during and after an event.
  FG highlighted that the Grid Code definition of earth fault factor[1] would also need to be considered when establishing these requirements and explained how they propose to set the expected TOV level using TGN 288[2] (which was presented at a previous Workgroup) as a starting point.

Post meeting note: The presentation slides for the FRT / TOV presentation was circulated to the Workgroup after the meeting.

- BA explained the reasons behind low voltage limits for FRT adding that a significant drop in voltage means that a Generating Unit will not be able to deliver its full output for that period. This is because the mechanical input for the Generating Unit is unlikely to change fast enough

[1] Grid Code CC.6.2.1.1 defines Earth Fault Factor for 132 kV and above in England and Wales as 1.4 pu or less and in Scotland as 1.5 pu or less.
[2] https://www.nationalgrid.com/sites/default/files/documents/TGN%28E%29_288_0.pdf

so the power imbalance will cause the rotor of a synchronous machine to accelerate, as well as a rise within the DC link voltage within a wind turbine. If this persists for a long period of time, the low voltage is likely to cause pole slipping for synchronous machines and excessive heating for the DC link chopper resistor. BA stressed that there were currently no limits on high voltages within the Grid Code and that Users were required to ride through any faults above the black line within the diagram below.

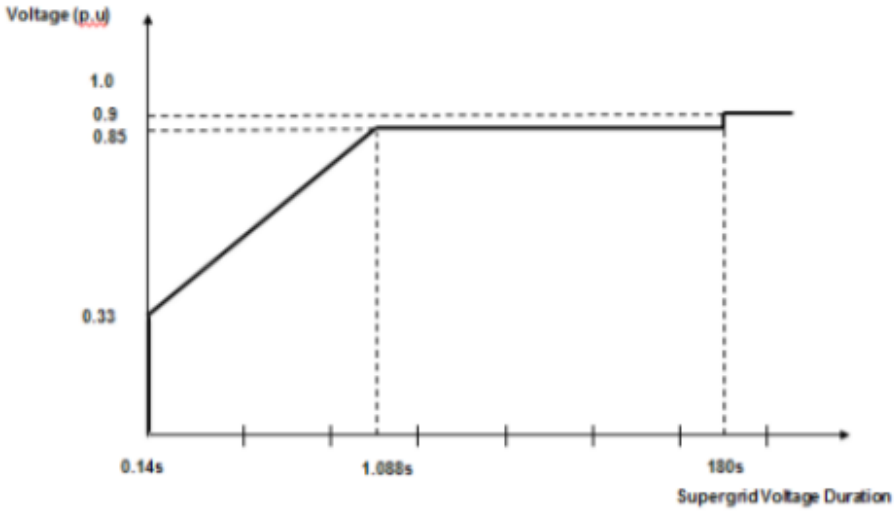

Figure 5a

This is because an increased voltage for synchronous machines enhances the synchronising torque coefficient and makes the machine less likely to pole-slip, and the PSS is also likely to deal with any issues associated with the reduced damping torque coefficient. BA also felt that the Workgroup had not clearly articulated any issues with wind turbines due to a high and extended TOV and that transmission plant were already rated and expected to ride through faults of 1.4pu (England and Wales) and 1.5pu (Scotland).

Workgroup Discussions / Feedback on ESO / NGET Proposal

- Some of the discussions held by the Workgroup include:
    - Does withstand capability also imply ride through - BA and FG clarified that the expectation is that the equipment will need to have design and performance capability to withstand and ride through faults - the problem had been categorised in two parts. The Workgroup needs to come to an agreement on Part 1 first (equipment should be chosen to withstand the upper voltage, so they will need to decide what that upper voltage should be). Before moving onto Part 2 (equipment performance during and after an event, can it ride through, and how this will be managed).
    - Challenges posed by high voltage FRT and capability at the point of connection:
        - Several Workgroup members questioned whether the ESO had carried out simulations for high voltage FRT as part of their Grid Code compliance checks before allowing parties to connect. They felt that parties should have been informed at this stage that their equipment was non-compliant, rather than allowing them to connect and then expecting them to ride though anything. BA stated that the ESO currently only carry out simulations for low voltages as there is no clear evidence of issues with high voltages. A Workgroup member

highlighted that any future simulations would also need to consider the earth fault factor.

- Workgroup members highlighted that there was a physical limit to design constraint. Silicon convertors are more sensitive to over voltage than other devices in high voltage networks. So, to make them more robust they would need to design for that and explore the relationship between high voltage tolerance over specific periods of time.
- PM explained that during a high voltage FRT, there is a reverse power flow from the Grid to the DC link, which causes a stress on it. This can only be tuned and managed to a certain degree, beyond which there is a threat to the wind turbine which causes it to De-load. PM share an academic paper with the Workgroup on high FRT and wind turbine limitations to try and explain this further. PM stated that it is globally acknowledged that there is an upper limit, beyond which parties should be allowed to trip, and from their assessment this is currently 1.3 pu. PM and BA agreed to have a separate meeting to discuss this further.
- PM also highlighted concerns around "transient overvoltage" stating that during fault clearance through to the transient state where the voltage is recovering to its steady state value, there are significant voltage oscillations before the voltage settles back down. A Workgroup member stated that to tackle this, the ESO may need to refine the requirements of reactive current injection within that recovery time. As well as defining the minimum short circuit levels required to allow Users to connect at certain megawatt ratings.

- BA highlighted interactions with Frequency Management and explained that reactive current injection during a fault supports the system voltage and contributes towards rapid voltage recovery. This reduces the risk of further generation tripping and changes to this could increase simultaneous tripping of generation (low frequency demand disconnection). This last occurred on 9 August 2019 and had significant repercussions. The ESO would find it very difficult to manage this risk as they would either have to:
  a) Carry out further EMT simulations – which they do not have the resource or time to do.
  b) Set a low limit and procure frequency response to manage the risk – which would cost too much.

  BA advised that, on the assumption that there is an issue with high voltages the proposed next steps will be to:
  - Define a ceiling for TOV which would have to be guaranteed by design by the Transmission Owners (TO's) for the network. There would also be a requirement on generators not to cause it to exceed those values. The ESO preference is to use the limits already available within TGN 288 as the ceiling, as this is consistently used by all the TO's and should also be the minimum capability of Users' plant.
  - Review other related plant performance and FRT requirements to understand how the plant is going to respond to TOV and not exacerbate any such an event.
- A Workgroup member noted that these requirements had not been included in any previous grid compliance simulations, so they were already in a situation where it is unclear what the high voltage ride through capability of the equipment installed to date is. Therefore, the ESO may still need to procure some frequency response reserve in case there is tripping within these overvoltage limits. The Workgroup member also suggested a more pragmatic approach to address the capability of equipment installed to date and future plant installations separately.

- FG highlighted that TGN 288 was created in 2016 to address inquiries from network users on overvoltage capability of their equipment and was adopted by other TO's and became part of the Bilateral connection agreement (BCA). Prior to that there were no specific requirements other than what was in the Grid Code. FG had also shared the background report on how the TGN 288 limits were developed with the Workgroup.
- Some Workgroup members requested further clarity on TGN 288 and whether they would be phase to phase or phase to ground requirements. Several Workgroup members questioned how this had been included within BCA's especially if it was not a RES document. Also, a Workgroup member highlighted that National Grid manage several templates which are not governed by a governance process, so they can be amended without any third-party involvement, and it may have been included within these. The Workgroup member also felt that this was not the correct way to add these requirements onto Users. FG took this away as an action to get this clarified.

Timeline review

- The Chair talked through the Timeline and the Workgroup agreed to review this further at the next meeting.

Next steps

- The next workgroup meeting was initially planned for Tuesday 15 November 2022 but will now be re-scheduled for another date in November. At this meeting they will discuss TOV withstand capability of equipment and what the ceiling should be. As well as trying to obtain the views of Scottish TO's and establishing if they need to send out private questionnaires to Users to try and understand the limitations on existing plants, and what might be possible for them to do in the future.

Post meeting note: The next meeting was re-schedule to 23 November 2022 – meeting invites sent out to the Workgroup.

The following actions were noted:

Actions Log

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).		Open
20	WG5	PM	To send the material to NGESO providing details on convertor		ASAP	Complete

			manufacturer specifications			
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	Open
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	Open
24	WG5	FN	To share some technical questions for the Workgroup to deliberate and discuss		7th Sept	Complete
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.		Open
26	WG6	FG/FW	Confirm how TGN 288 is included within BCA's if it is not a RES document.		ASAP	Open

Participants

Attendees	Initials	Company	Position
Banke John-Okwesa	BJO	Code Administrator National Grid ESO	Chair
Shazia Akhtar	SA	Code Administrator National Grid ESO	Technical Secretary
Terry Baldwin	TB	National Grid ESO	Proposer & Workgroup Member
Alan Creighton	AC	Northern Powergrid	Workgroup Member
Alastair Frew	AF	Drax Power Station	Workgroup Member
Andrew Larkins	AL	Sygensys	Workgroup Member
Bieshoy Awad	BA	National Grid ESO	NGESO Rep and Workgroup Member
Forooz Ghassemi	FG	NGET	Workgroup Member
Isaac Gutierrez	IG	Scottish Power	Workgroup Member
Martin Aten	MA	Uniper	Workgroup Member
Nicola Barberis Negra	NBN	Orsted	Workgroup Member
Priyanka Mohapatra	PM	Scottish Power	Workgroup Member
Sarah Graham	SG	Oceanwinds	Workgroup Member

Tim Ellingham	TE	RWE	Workgroup Member
Fiona Williams	FW	NGESO	NGESO Rep & Observer
John Fradley	JF	National Grid ESO	Observer
Julie Richmond	JR	Scottish Power	Observer
Mike Kay	MK	Independent	Observer
Owen Curran	OC	Siemens	Observer
Xiaoyao Zhou	XZ	National Grid ESO	Observer

For further information, please contact Banke John-Okwesa.