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| Network Innovation Competition 2020 Supplementary Answer form | | |

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| Project Name | Constellation | | |
| Question number | #8 | Pro forma section | Section 10.4.2.2 |
| Question date | 27/08/20 | Answer date | 01/09/2020 |
| Question summary | (Second to last bullet on the page) Please explain the bullet on directional reactive power undervoltage protection – how does this prevent voltage collapse? | | |

## 

## Answer (please retain document formatting and do not exceed 2 pages unless otherwise agreed with Ofgem)

If there is a considerable loss in invertor based power generation, it may affect the system’s ability to recover. To ensure the power system’s stability, various grid codes[[1]](#footnote-1) have revised their requirements and therefore require that the distributed generators have to make a contribution to network support. In case of network faults, the DG unit should not be immediately disconnected from the network. Instead, as a matter of principle, generating plants connected to the network must be capable of participating in steady-state voltage control and dynamic network support. However, if the generators stay connected, it must be ensured that they do not import reactive power from the network as this may contribute further to collapse of the grid.

The directional reactive power undervoltage protection function[[2]](#footnote-2) (DQPTUV) is used at the connection for synchronous distributed generation units for detecting such situations, that is, simultaneous undervoltage and reactive power (under excited generators) and trips these generators. DQPTUV measures phase voltages and current at the network connection point. The DG is disconnected from the network with a specific time delay if all phase voltages decrease and remain at or below the specified limit and if reactive power is simultaneously consumed (that is, under-excitation operation). Within the research aspects of the project we will gather understanding of the effectiveness of DQPTUV on invertor based generation.

The protection function DQPTUV is developed considering various National Grid codes and can be integrated in the Constellation solution. For example, in the BDEW Technical Guideline “Generating Plants Connected to the Medium-Voltage Network” (June 2008 issue, Germany), it is stated that if all three phase-to-phase voltages at the grid connection point decrease and remain at and below a value of 85% of the rated and if reactive power is simultaneously consumed at the grid connection point (under-excited operation), the generating facility must be disconnected from the network with a time delay of 0.5 s.

1. Distribution Code: DC0079 Frequency Changes during Large Disturbances and their Impact on the Total System [↑](#footnote-ref-1)
2. Full description of directional reactive power undervoltage protection can be found from this document: <https://library.e.abb.com/public/70602692769a4ffa87ca027e6fb1af1d/RE_615_tech_756887_ENn.pdf> [↑](#footnote-ref-2)