**Grid Code Modification GC0148**

**Low Frequency Demand Disconnection – Netted Demand**

**Discussion Paper for GC0148 Meeting Scheduled for 22 February 2022**

**E&R Definition**

*Netted Demand* - means the netted value of active power seen from a given point of the system, computed as (load — generation), generally expressed in kilowatts (kW) or megawatts (MW), at a given instant or averaged over any designated interval of time;

**Extract from Article 15(5) – 15(9) including commentary**

5. *Each TSO shall design the scheme for the automatic low frequency demand disconnection in accordance with the parameters for shedding load in real-time laid down in the Annex*. (This is already in place – ECC.A.5 – see Table ECC.A.5.5.1a – Similar arrangements are also in place in the CC's) *The scheme shall include the disconnection of demand at different frequencies, from a 'starting mandatory level' to a 'final mandatory level', within an implementation range whilst respecting a minimum number and maximum size of steps* (This is also in place – again also see Table ECC.A.5.5.1a). *The implementation range shall define the maximum admissible deviation of netted demand to be disconnected from the target netted demand to be disconnected at a given frequency, calculated through a linear interpolation between starting and final mandatory levels* (We are not clear what this means and it requires discussion. Does it mean we need to set that the maximum possible error at 60% reduction and then scale this back to get a pro-rata error allowance at each stage). *The implementation range shall not allow the disconnection of less netted demand than the amount of netted demand to be disconnected at the starting mandatory level* (The GB Scheme does do this and we comply). *A step cannot be considered as such if no netted demand is disconnected when this step is reached*. (Under the SHED Project the general approach is that if relay detects an exporting node it shall not be tripped). Under ECC.A.5, we already have a directional requirement which can be interlocked for forward or reverse power flow which would account for netted demand. This requirement does not apply in the CC's. See clause ECC.A.5.1.1(d) below.

**APPENDIX E5 - TECHNICAL REQUIREMENTS**
**LOW FREQUENCY RELAYS FOR THE AUTOMATIC**
**DISCONNECTION OF SUPPLIES AT LOW FREQUENCY**

ECC.A.5.1 Low Frequency Relays

ECC.A.5.1.1 The **Low Frequency Relays** to be used shall have a setting range of 47.0 to 50Hz and be suitable for operation from a nominal AC input of 63.5, 110 or 240V. The following parameters specify the requirements of approved **Low Frequency Relays**:

| | |
|---|---|
| (a) **Frequency** settings: | 47-50Hz in steps of 0.05Hz or better, preferably 0.01Hz; |
| (b) Operating time: | Relay operating time shall not be more than 150 ms; |
| (c) Voltage lock-out: | Selectable within a range of 55 to 90% of nominal voltage; |
| (d) Direction | Tripping interlock for forward or reverse power flow capable of being set in either position or off |
| (e) Facility stages: | One or two stages of **Frequency** operation; |
| (f) Output contacts: | Two output contacts per stage to be capable of repetitively making and breaking for 1000 operations: |
| (g) Accuracy: | 0.01 Hz maximum error under reference environmental and system voltage conditions.<br>0.05 Hz maximum error at 8% of total harmonic distortion **Electromagnetic Compatibility Level**. |

6. *Each TSO or DSO shall install the relays necessary for low frequency demand disconnection taking into account at least load behaviour and dispersed generation*. This clause relates to the relays. For any relay caught by the Demand Connection Code (DCC) this contains a directional element and hence where there is an exporting node this would result in generation exported to the System so should not be tripped.

7. *When implementing the scheme for the automatic low frequency demand disconnection pursuant to the notification under Article 12(2), each TSO or DSO shall:*

   *(a) avoid setting an intentional time delay in addition to the operating time of the relays and circuit breakers*; This is already catered for in ECC.A.5.1.1(b) and ECC.A.5.3.2 which states "The total operating time of the scheme, including circuit breakers operating time, shall where reasonably practicable, be less than 200 ms. For the avoidance of doubt, the replacement of plant installed prior to October 2009 will not be required in order to achieve lower total scheme operating times."

   (b) *minimise the disconnection of power generating modules, especially those providing inertia; and* (This is not currently done. The current scheme simply detects if the connection point is exporting but does not distinguish between Grid Forming and Non-Grid Forming plant). There may be a potential exclusion here based on point (c) below. Whether or not in future, Grid Forming plants when running are excluded from the Scheme is a consideration but the problem is that for every new connection it would mean the re-positioning of relays which would be very expensive and probably not justifiable – hence clause (c) below applies. Going forward the directional interlock on the LFDD relays achieves this but it would ne better if the scheme was implemented on 11kV feeder breakers rather than the 33kV incomers.

(c) *limit the risk that the scheme leads to power flow deviations and voltage deviations outside operational security limits*. There are two issues here i) Once the first stage of the LFDD scheme has operated at 48.8Hz, the System would already be outside operational security limits. I assume that this is therefore covered already as it will only operate once the frequency is at 48.8Hz and below and hence considered as an abnormal condition and ii) tripping of Demand must not lead to unsupportable flows on the System (I assume this is the Transmission System bearing in mind the DNO operational security limits are less clear other than under P2/6) -. *If a DSO cannot fulfil the requirements under points (b) and (c), it shall notify the TSO and propose which requirement shall apply. The TSO, in consultation with the DSO shall establish the applicable requirements based on a joint cost-benefit analysis.* We can include this wording in the legal drafting.

8. *The scheme for the automatic low frequency demand disconnection of the system defence plan may provide for netted demand disconnection based on frequency gradient provided that:*

*(a) it is activated only:*

*(i) when the frequency deviation is higher than the maximum steady state frequency deviation and the frequency gradient is higher than the one produced by the reference incident;*

*(ii) until the frequency reaches the frequency of the demand disconnection starting mandatory level;*

*(b) it complies with the Annex; and*

*(c) it is necessary and justified in order to maintain efficiently the operational security.*

This is not a mandatory requirement and therefore can be excluded from the requirement.

9. *In case the scheme for the automatic low frequency demand disconnection of the system defence plan includes netted demand disconnection based on frequency gradient, as described in paragraph 8, the TSO shall submit, within 30 days of the implementation, a report containing a detailed explanation of the rationale, implementation and impact of this measure to the national regulatory authority.*

This is not required as Art 15(8) is not mandatory.

**Summary**

**Article 15(5)**

The main issues here relate to:-

*The implementation range shall define the maximum admissible deviation of netted demand to be disconnected from the target netted demand to be disconnected at a given frequency, calculated through a linear interpolation between starting and final mandatory levels*

We are not clear what this means and it requires discussion. Does it mean we need to set that the maximum possible error at 60% reduction and then scale this back to get a pro-rata error allowance at each stage.

*The implementation range shall not allow the disconnection of less netted demand than the amount of netted demand to be disconnected at the starting mandatory level*

It is difficult to interpret what this means but I assume what the text is saying is "the amount of demand tripped over the full range of the scheme between the first stage and the last stage must not be less than that tripped by the first stage". So for us we trip 55% over stages 2 to 9, and 5% in the first stage – so we're fine. However I agree that this seems a silly requirement… so maybe there is another interpretation. Point for Workgroup Discussion.

*A step cannot be considered as such if no netted demand is disconnected when this step is reached* Based on this statement and the above response I am not sure this is relevant – again Point for Workgroup Discussion

**General Commentary**

If the above elements are addressed see below - then Articles 15(6),(7),(8) and (9) are either already addressed or are non mandatory.

As a solution going forward, if we state that any LFDD relays installed on or after 18th December 2022, are required to satisfy the additional requirements outlined above – see attached legal text – would this then discharge these obligations. Point for Workgroup Discussion.