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Q2.2.1 '*Planning HVDC transmission systems embedded into an AC interconnected network lead to a variety of challenges. Which design and technology aspects must be considered for embedded point-to-point and multi-terminal HVDC transmission systems?'*

SuperNode believe that high capacity, meshed overlay grids are the approach that needs to be adopted in considering HVDC system architectures.

I address Q2.2.1 through commenting on concerns expressed in paper C1-11097. The paper outlines that a number of conditions must be met in order to make a DC overlay grid for Europe possible, such that only a limited amount of power fail simultaneously, and this failure not exceed the defined system loss of infeed limits. This is the case for any grid type. However, with a meshed HVDC system, inherent mitigation to LSI is inherent as re-routing power through alternative in-feed routes is available.

The paper discusses the current single in-feed limits for the UK and Europe and discusses the 2019 outage of 1500MW in the UK. This particular outage occurred on a point-to-point connection. A meshed offshore, high-capacity grid would provide alternative routes to shore or re-routed power supply to the onshore grid in this case. The particular point-to-point connection was an early manifestation of offshore RES connection in the UK. If this type of issue is to be avoided as the offshore grid expands, a holistic and integrated approach needs to be considered which will result in a meshed grid architecture for the RES sources being connected. A meshed overlay and a meshed approach to RES connection is exactly the approach that is required to prevent loss of large infeed as we transition to remote energy sources. Radial and point systems need N-1 redundancy on every line, or they expose the system to infeed losses, whereas a meshed system can aggregate redundancy through different connection routes with available capacity.

Likewise, for a meshed overlay grid at a pan-European scale, capacity needs to be considered. The circuit size in an overlay grid should not be determined by the size of the grid circuits it overlays. The contingency loss of a circuit should not cause the loss of active power or inertia as the other circuits in the meshed configuration can reroute the power.

The example of the Northern Ireland grid is proposed by way of example. The 275kV ring circuit was built at an 880MVA rating over 40 years ago. The largest single infeed to the circuit ranged from 220MW to 400MW over the life of the asset. The meshed ring main with capacity allowance provides inherent redundancy.in contrast, spurs and point connections must observe LSI limits as their loss corresponds directly to an equivalent loss in active power.