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This contribution relates to the resilience of traditional Under Frequency Load Shedding (UFLS) schemes against changes to the generation mix, and highlights barriers to implementing 'smart' load shedding. It also discusses some more readily available solutions to improve the resilience of UFLS in the short to medium term.

As electricity demand is increasingly supplied more locally, the effectiveness of UFLS schemes becomes dependent on the demand and generation mix downstream of each UFLS relay. Much of the distributed generation (DG) commissioned in recent years is variable and unobservable, introducing uncertainty into the amount of true demand on the system at any given time and, therefore, uncertainty in the net effect that automatic load shedding may have on system frequency when activated. In GB, this effect was observed during a power system disturbance on the 9th of August 2019. During the event, the first stage of the UFLS scheme disconnected approximately 892 MW of demand. However, the net demand reduction was approx. 350 MW, indicating that approx. 550 MW of DG was disconnected by LFDD relays. In addition, as system frequency changes faster in a low inertia system, there is an increased risk that multiple stages of UFLS will be triggered before the previous stage has had enough time to operate.

Traditional UFLS relays are typically distributed throughout medium and high voltage distribution networks and isolate selected supply points to shed load. The settings of the scheme, i.e. the size of the load blocks and time delays, are fixed, making the scheme relatively inflexible. Hence the interest in 'smart' load shedding. However, many proposed improvements to traditional load shedding schemes are based on significant upgrades to network monitoring and communication systems and are unlikely to be ready for full implementation in many national power systems. They also require considerable time for proof of concept and regulatory and technical code amendments. The transition to a 'smart' UFLS scheme might still be considered a long-term goal.

Here we highlight some of the more readily available solutions that can improve the resilience of UFLS schemes in the short to medium term. Our studies at the University of Strathclyde have shown that relocating UFLS relays closer to the load (in GB, this was from 33 kV to 11 kV) and adjusting the total operating time of the scheme can result in less demand disconnection required, improving its effectiveness. In addition to these interim solutions being able to be implemented in the near term, they also use proven techniques and equipment and require minimal code updates, so are more easily adopted by network operators. The interim solutions discussed here are neither perfect, nor fully future proof. Careful selection of settings must still be made to ensure robustness of the scheme is maintained after such changes are made. For example, to mitigate the risk of over shedding of demand and ensure control of over-frequency situations.

A forward-thinking review of LFDD specification in GB is required to ensure a robust and efficient scheme is in place which offers dependability at least cost, while minimizing societal impact during triggered events in the future. It may be necessary to amend codes governing the implementation of LFDD in two stages:

- in the near-term to make LFDD more suitable for the system changes that have already occurred, considering solutions such as those discussed above;
- and then, in a second stage following the conduct of suitable research and testing, implementation of a smarter load shedding scheme to make the system more robust for the longer term.