The PET workstream lead and lead engineer at SP Energy Networks, Jack Haynes, has just released the results for our final live trial. The trial was conducted at our Redhouse site on the east coast of central Scotland.

The two-week live trial involved working with Greenspan Energy at one of their battery projects. The trial included the successful energisation of the SP Energy Networks distribution and transmission network assets, with multiple distributed energy resources (DERs) contributing to the distribution restoration zone (DRZ).

The goal of the final live trial at Redhouse

Our previous live trials at Chapelcross and Galloway had proven the concept of a DRZ in practice, with multiple DERs, using biomass and hydro as anchor generators respectively.

The goal of this trial was to use a non-synchronous inverter-driven battery energy storage system (BESS) as the anchor generator, a world first. The BESS had been fitted with grid-forming technology to allow it to build and maintain the power island while isolated from the main grid.

The scope of the final live trial at Redhouse

The trial involved utilising the Greenspan BESS as the anchor (used to initially energise the network), along with the Middle Balbeggie Solar Farm connected to the local Redhouse Primary Substation at 11 kV. In addition, an Aggreko 33 kV load bank was connected to the test network to simulate customer demand and allow the DERs to generate effectively.

During the live testing, the distribution and transmission networks were configured to facilitate a ‘test network’ while maintaining supply to all existing customers.

The outcomes of the testing – what was proven to work

At the end of the testing, we managed to:

- energise primary (33/11 kV) transformers (up to 24 MVA) and transmission (132/33 kV) transformers (up to 90 MVA) from the BESS operating at normal voltage levels (33 kV), with and without point on wave (POW) switching

- prove the block load pick up (BLPU) capability of the anchor generator; the amount of instantaneous demand which can be applied while maintaining the frequency above 47.5 Hz

- energise the Middle Balbeggie 11 kV cable arrays, and associated transformers, from the anchor generator

- prove stable island operation both in frequency and voltage droop control modes

- incorporate the prototype Distribution Restoration Zone Controller (DRZC) that can automate a lot of the island functions, control and monitoring.

Conclusion

With the project's transition to business as usual (BAU), the concept of providing restoration services from DERs is now becoming a reality based on the learnings from our live trials.

The live testing at Redhouse developed and proved the ability of a 'small' BESS generator to energise the 11 kV, 33 kV and 132 kV networks (including 90 MVA capacity of grid transformers).

The fundamental principle of establishing an inverter driven DRZ, with multiple DERs, has now been proven in practice. Furthermore, the incorporation of the DRZC has proved the island can be effectively automated, controlled and monitored throughout.

The PET Live Trials Part 3 report – October 2023

Please keep an eye out for part 3 of the PET live trials report due in October 2023. The report will include details of this live trial and an overview of the DRZC functionality, supporting the transition to BAU.

Partners

The four-year Distributed ReStart project is founded on a collaboration between National Grid ESO, SP Energy Networks (SPEN) and specialist energy consultancy TNEI.