

SMALL EMBEDDED GENERATION LOSS RISK ON SYSTEM HIGH FREQUENCY EXCURSIONS

Paper by National Grid

Summary

1. There is a risk to the security of the total GB power system caused by the possible simultaneous tripping of an unknown amount of Small embedded generation plant under a system high frequency excursion. Such plant is not subject to the GB Grid Code requirement of continuous operation up to 52 Hz and may have been set to meet the 50.5 Hz trip requirement of ER G59/1.
2. This paper seeks help from the DNOs to provide information to NGET on the amount of such generation and its high frequency trip settings. This information will allow NGET to quantify, assess and manage the current level of risk to the security of the GB system should a frequency excursion above 50.5 Hz occur.

Background

3. Small embedded generating stations in GB are not required to meet the GB Grid Code requirement of continuous operation up to 52 Hz. Small power stations correspond to less than 50 MW, less than 30 MW and less than 10 MW in capacity in NGET's, SPT's and SHETL's Transmission Areas, respectively. ER G59/1 recommends stations at or below 5 MW in capacity to be disconnected from the system at 50.5 Hz.
4. For installed plant capacity between the above Small thresholds and 5MW, ER G75/1 applies but there is uncertainty on what the requirement is and what high frequency trip setting has been implemented. This uncertainty means that the 50.5Hz trip setting of ER G59/1 may have been used on such plant.
5. This concern/issue was raised at the GCRP September 2004 meeting (Paper 04/23 refers), the Technical Steering Group and DCRP. It was acknowledged then that this could be an important issue but there was no adequate driver for a change to the Distribution Code and/or the Engineering Recommendation setting.
6. Since then, a DCRPG59 WG was established with one objective, among others, to review the ER G59/1 and ER G75/1 documents. The above concern has been taken into consideration by this WG in order to minimize the future risk to the total system that may be caused by the growth of Small embedded generation.
7. There is no issue on the low frequency trip setting since ER G59/1 requirement is 47 Hz and this aligns with the GB Grid Code.

Key Issue

8. Should a frequency excursion above 50.5 Hz occur, the amount of Small embedded generation that could trip at or just above 50.5 Hz is not known to NGET. The impact on the security of the total system under such condition could be significant if the volume of plant disconnected is large. Excessive generation disconnection could lead to very low frequency conditions and cause automatic demand disconnection nationally by low frequency relays under the Low Frequency Demand Disconnection of Grid Code OC.6.6. This is a major concern to NGET and industry stakeholders.

Preliminary Review of Data from the ENA

9. Based upon the March 2007 ENA report entitled "Distribution Generation Connection Activity in the UK Distribution Networks", the installed capacity of 5 MW and below plant could total up to 1.7 GW. The maximum simultaneous loss on a 50.5 Hz trip is unknown.

10. For Small plant that is above 5 MW in capacity, the total installed capacity based on the ENA report is roughly estimated at 4.1 GW. It is not known whether some or all of this plant has a high frequency trip setting of 50.5 Hz. The amount of maximum simultaneous loss is unknown.

Information required from the DNOs

11. This preliminary review was discussed at the DCRPG59 WG and indicated the need for better information to quantify the level of system risk. It is recognized that some of the plant that make up the estimated 5.8 GW installed capacity, and in particular plant above 5 MW capacity may be fully or partially excluded by NGET from the risk assessment depending on:

- a) whether their high frequency setting used is above 50.5 Hz (e.g. 51, 51.5 or 52 Hz)
- b) its mode of operation (see Appendix)

The ENA has no direct information to assess the volume of Small plant associated with (a) and (b) above.

12. To allow NGET to quantify and manage any present risk to the security of the total system, the following information is sought from the DNOs:

- a. Small plant above 5 MW capacity
 - i. Confirm the amount of such plant
 - ii. Confirm the high frequency trip setting and time delay
 - iii. Estimate the maximum simultaneous loss
- b. Small plant at or below 5 MW capacity
 - i. Confirm the amount of maximum simultaneous loss at 50.5 Hz trip setting

Conclusions

13. There is presently a risk to the security of the total system due to the unknown amount of small embedded generation plant that may trip at 50.5 Hz, caused by adopting the recommended setting of ER G59/1.
14. In order to manage this risk, it needs to be quantified. Therefore, information on the amount of plant and its frequency trip settings will be sought from the DNOs who are best placed to provide this information.

Recommendations

15. The GCRP is invited to:
- a) note NGET's concern on possible system insecurity under what should be secured system high frequency excursion events
 - b) agree that the DNOs shall provide the information on Small embedded generation to allow NGET to quantify and manage any present system risk
 - c) Note that the information is suggested to be provided over the next six months
 - d) discuss the paper and agree way forward

Appendix A – Some possible modes of operation of small embedded generation plant

The risk to the total system from small embedded generation plant tripping during a secured high frequency event on the total system depends on:

- a. the amount of such plant
- b. its high frequency trip setting
- c. its mode of operation

Some modes of operation are:

Standby generation

Some plants are designed for standby generation purposes and are not allowed to operate continuously in parallel with the network. The ENA has no data on this generation.

Generation with export capability and critical in-house demand

Some stations are designed to run in parallel with the system whilst supplying in-house demand and exporting to the host network. Some of these stations are installed with the key objective of maintaining reliable supply to some critical in-house or possibly non-interruptible demands.

Should any problem in the external network be detected (including the high frequency trip protection), the in-house electrical power system is disconnected from the external network and the generation continues to operate and supply the in-house demand.

With this mode of operation, the generation loss to the total system would equate to the export level at the time of the event. The impact of stations with this operating mode will reduce the impact on the system. Some of these sites could have export limit and this could be a way of identifying the maximum loss risk from this category of sites.

Sites not designed for exporting

Some sites could be designed to run in parallel with the system but not designed for exporting. For those sites, the tripping of the in-house generators could transfer the in-house load to the system.