

National Grid Company plc

Grid Code Review Panel

CC.6.3.3 Review Working Group

Introduction

- 1 The CC.6.3.3 Review Working Group was formed to examine the requirement included within the Grid Code for generation operation at frequencies below 49.5 Hz. The Working Group has considered the consequences arising from relaxing the existing power/frequency slope characteristic to lower slopes – the lowest requiring 75% of active power output at 47 Hz. The review has assessed the impact of the existing and the alternative slope from the point of view of increased frequency response requirements and increased customer demand disconnection.
- 2 In all, five options were considered, and discussed within the Working Group. These options were either to retain the existing CC.6.3.3 requirement or to relax the requirement in a variety of manners in the frequency range of 49.5 Hz and 47 Hz. Also, the issues arising from these options were discussed with some of the major CCGT plant manufacturers.
- 3 Research was also carried out to explore CC.6.3.3 equivalent requirements as employed by overseas electric utilities.
- 4 The Working Group met 8 times between March 2001 and April 2003, with the final meeting taking place on 7 April 2003. In this period, the Working Group produced four papers and a final report to address the Terms of Reference agreed at the Grid Code Review Panel meeting of 17 May 2001.
- 5 This paper summarises the key conclusions and recommendations of the review. The details of the review are included in the attached report.

Summary of Conclusions

- 6 The Working Group report concludes that the current Grid Code CC.6.3.3 (b) requirement should be retained for frequencies down to the relay trip setting of the first stage of automatic low frequency demand disconnection scheme (currently 48.8 Hz). This ensures that there would be:-
 - no increase in the risk of customer demand disconnection, and
 - no increase in system operating costs.

In addition, there is no benefit for relaxing the existing CC.6.3.3 requirement above 48.8 Hz because this is not seen as a major issue for CCGT plant.

- 7 Generators and CCGT manufacturers indicated that retaining the existing CC.6.3.3 requirement below 48.8 Hz on a continuous basis or for prolonged periods presents a risk of CCGT plant tripping despite the fact that CCGTs are designed to comply by overfiring. The consensus is, therefore, that there

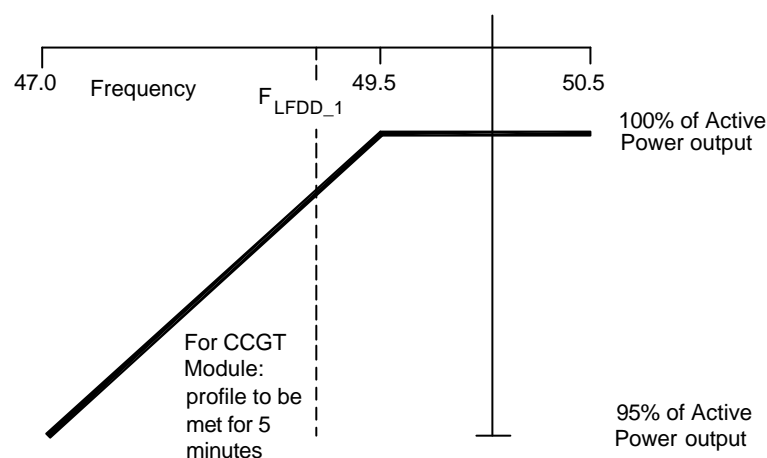
is a risk of plant tripping below 48.8 Hz, but this cannot be quantified due to the absence of any operational experience.

- 8 However, relaxing the existing CC.6.3.3 requirement for frequencies below 48.8 Hz would increase the number of stages of the low frequency demand disconnection scheme that would be activated in any major incident by a single stage. This can be considered as tripping an additional 5% to 10% of customer demand in the power island depending on the generation deficit magnitude.
- 9 In view of these severe consequences for frequencies below the relay trip setting of the automatic low frequency demand disconnection scheme, currently 48.8 Hz, and to balance the needs of generation and demand, the report concluded that the existing CC.6.3.3 requirement should be retained for a period of 5 minutes, thus allowing time for the system to stabilise through automatic system and plant control actions. Special action(s) (e.g., overfiring, water injection, or other measures) should be kept in service during the 5 minutes period. After this period of 5 minutes, if system frequency is still below 48.8Hz, a relaxation should take place for all CCGT plant so that the gas turbine power output is reduced to follow the machine's natural characteristics with reduced shaft speed in order to reduce the risk of CCGT plant tripping, and also the special action(s) should be discontinued if there is a materially increased risk of the CCGT plant tripping. The time period of 5 minutes is believed to be an adequate setting because it takes into account system operation needs and the need to minimise risks to customers.
- 10 This relaxation may require additional control/ time delay/mode switching functions to facilitate smooth transitions between modes of operation. The implementation of such facilities must not introduce new unacceptable risks.
- 11 Overall, the proposed CC.6.3.3 requirement would:
 - a) maintain the same standard of system frequency control as is now without incurring any additional system balancing cost (ultimately paid by customers).
 - b) minimise the risk of customer demand disconnection or system insecurity under emergency system conditions.

Proposed Grid Code Change

- 12 This paper proposes to amend the wording of CC.6.3.3 (b) to read as follows:-
 - CC.6.3.3 (b) maintaining its **Active Power** output at a level not lower than the figure determined by the linear relationship shown in Figure 1 for **System Frequency** changes within the range 49.5 to 47 Hz, such that if the **System Frequency** drops to 47 Hz the **Active Power** output does not decrease by more than 5%.

In the case of a **CCGT Module**, the above requirement shall be retained down to the low **Frequency** relay trip setting of 48.8Hz, or such other setting notified by **NGC** to the **User**, which will reflect the first stage of the Automatic Low **Frequency Demand Disconnection** scheme notified to **Network Operators** under OC6.6.2. For **System Frequency** below that setting, the existing requirement shall be retained for a period of 5 minutes while it remains below that setting, and special action(s) that may be required to meet this requirement shall be kept in service during this period. At the end of that 5 minutes period, if **System Frequency** remains below that setting, the special action(s) must be discontinued if there is a materially increased risk of the **Gas Turbine** tripping. The need for special action(s) is linked to the inherent **Gas Turbine Active Power** output reduction caused by reduced shaft speed due to falling **System Frequency**.



(Note: Frequency F_{LFDD_1} is the relay trip setting of the first stage of the Automatic Low **Frequency Demand Disconnection** scheme)

Figure 1

Recommendations

- 13 The Grid Code Review Panel is invited to:
 - Consider the attached report.
 - Consider and comment on the proposed Grid Code revision.
- 14 Having considered comments from the GCRP members, National Grid intends to initiate a wider industry consultation on the proposed Grid Code revision.