GRID CODE REVIEW PANEL

Network Defence Against Widespread Voltage Collapse
Low voltage demand disconnection

Introduction

1 Voltage collapse is a phenomenon that can afflict transmission networks when there is insufficient reactive power generation to meet reactive power demand generally during high demand and/or power transfer levels. This imbalance could occur because of unexpected significant increases in demand, generation losses, multiple circuit trips or various combinations of these events, leading to possible widespread voltage collapse and blackout.

2 Recent blackouts in Europe and North America in 2003, and also North America in 1996 are recent examples of large-scale blackouts where voltage collapse played an important part. Many other international blackouts since the late 1970s have been caused or significantly contributed to by network voltage collapse.

3 Automatic fast low voltage demand disconnection (LVDD) is a type of special protection scheme that can act as a means of preventing or containing widespread network voltage collapse. Many network utilities in Europe, America and elsewhere have implemented such schemes as a network defence measure against widespread voltage collapse.

Background

4 The National Grid transmission system is designed and operated in accordance with the Security and Quality of Supply Standards (SQSS). The SQSS specifies credible contingencies against which the transmission system is secured against voltage collapse. However under rare, severe contingencies beyond the SQSS requirements, widespread voltage collapse could occur unless some network defence measures are in place to act as a last resort safety net against it.

5 As a prudent transmission operator, National Grid has undertaken initial studies to assess the viability of such a LVDD concept as a possible network defence measure. These studies concluded that LVDD is technically viable and can be very cost-effective in comparison with major network investments. However, detailed design technical studies would need to be done in liaison with the DNOs to ensure satisfactory design and implementation.

6 In addition, our initial analysis has raised several issues that would need to be discussed and resolved with some industry parties and Ofgem. These issues include the funding of these schemes, whether a new Grid Code obligation would need to be introduced on network operators including National Grid, and various technical and commercial risks that may be introduced by such schemes. The attached Appendix includes a very brief note on the issues that may be introduced by network defence against rare contingencies beyond the SQSS, widespread voltage collapse and LVDD schemes.

Proposals

7 National Grid proposes that the GCRP sets up a sub-group to address the issue of network defence against widespread network voltage collapse, and the technical, commercial and regulatory issues surrounding the introduction of LVDD schemes as defence measures.

8 The initial proposed terms of reference for the sub-group are:

i) Network Operators, Ofgem and other interested parties to discuss and agree whether LVDD should be introduced as defence measures against widespread network voltage collapse considering issues such as cost-effective management of network security risks and justification of investments.

ii) To discuss relevant commercial and regulatory issues e.g. the funding of LVDD schemes and whether these should be introduced as a Grid Code obligation on Network Operators, including National Grid, similar to the existing LFDD schemes under OC6.6.

iii) If agreed, to determine if LVDD should be nationwide (similar to the existing LFDD schemes), including Scotland, or just on an area basis according to vulnerability or risk.

iv) To develop proposal that could form the basis of further Grid Code changes.

Recommendations

7 Members of the Grid Code Review Panel are invited to

a. Discuss the issues raised in this paper
b. Agree to form a sub-group to discuss the proposed initial TOR and take forward the agreed ones
c. Nominate representatives to the sub-group

APPENDIX A

SQSS Planning Requirements

National Grid is not required under the SQSS to plan against severe contingencies involving multiple events. However, under its Transmission Licence, National Grid is required to plan, develop and operate a safe, secure, economic and efficient transmission system.
Investments in LVDD network defence must be justified.

International Experience

The recent blackouts in Europe and North America in 2003, and also in North America in 1996 have focussed media attention to the likelihood of similar blackouts in Britain. Many international utilities have introduced LVDD schemes. Some were installed because of planning requirements, others to guard against exceptional contingencies. Investigations into the 2003 USA blackout and the 1996 USA West Coast blackout have resulted in recommendations for utilities to install additional LVDD schemes.
There may be issues for the electricity supply industry in Britain in relation to international best practice and experience.

Probability of Widespread Network Voltage Collapse

This probability is very difficult to quantify due to lack of available historical data as well as not being amenable to practical predictions. It depends on how much generation in the area is running, power import level, reactive compensation sources, demand levels, network topology, planned and unplanned circuit outages, weather conditions, common mode failures and many others. However, it is known from actual national and international blackouts that the frequency of partial or total system blackouts is not negligible. Analysis of major international incidents appears to suggest a long-term average frequency of occurrence of about one in 50 years for a widespread blackout in a mature and developed power system. This is generally considered a reasonably good engineering judgement.

Consequences of Voltage Collapse and blackout

Voltage collapse can cause partial or widespread system blackouts. Some of the consequences may be:

- Injuries to and even fatalities on the public
- Widespread social/civil disturbances, criminal damage and chaos
- Widespread disruption to the economy
- Compensation claims against the electricity supply industry
- Etc.

Funding and Regulatory Impact

How should the LVDD schemes be funded given that they would be required to be installed within DNO networks?

Should LVDD schemes be treated similar to the existing LFDD scheme (Grid Code OC6.6) and hence be introduced as a Grid Code obligation on DNOs and National Grid?

What impact could such schemes have on DNO incentives if/when they do operate? OC6.6 precedent with the LFDD?