

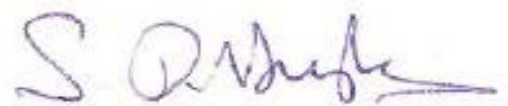
Capital Delivery Directorate

Design Handbook

**GUIDANCE ON POLICY APPLICATION
&
SETTING OF FEEDER BACKUP PROTECTION**

DH 04

Issue 2



Authorised by:

**Technical Assurance
Manager**

Date: _____

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GUIDANCE ON POLICY APPLICATION & SETTING OF FEEDER BACKUP PROTECTION

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1. PURPOSE AND SCOPE

The purpose of this handbook is to provide guidance on the feeder backup protection settings calculation for use on the National Grid 400kV and 275kV transmission system. The application and protection setting policy for the most commonly occurring electricity transmission primary arrangements within National Grid is laid down in PS (T) 010 – Issue 2.

This design handbook will ensure a consistent approach for the backup protection setting calculations. Guidance on backup protection settings for two-ended, three-ended, 'teed' transformers, transformer feeders and feeders directly connected to the LV side of an SGT is provided in this document.

2. REFERENCES

The following documentation should be read in conjunction with this design handbook.

NGTS 1
NGTS 2.24
DH28

PS(T) 010 Issue 2 February 2011 -
Application and Protection Setting Policy for the National Grid UK Transmission System

TDDR6 – Supergrid System Backup Protection – June 1988.

3. RESPONSIBILITIES

National Grid Suppliers and Consultants undertaking setting calculation work are to follow the guidance given in this design handbook. The Setting Engineer (Supplier) and Setting Engineer (Assurance) as defined in UKBP/TP107 are responsible for the calculation and correct application of appropriate relay settings to protect the power system.

It is recognised that this design handbook does not cover the backup protection setting guidance for all transmission arrangements found on National Grid's system. For any primary arrangements not covered in this document, the principles discussed may still be applicable. Advice should be sought from the National Grid Settings Engineer (Assurance) for all complex primary arrangements, as required.

4. REQUIREMENTS FOR 400kV and 275kV FEEDER BACKUP PROTECTION

The performance of backup protection is an important and critical factor in the design and operation of National Grid's transmission system. Factors such as type of fault, fault position, protection and signalling channel availability, system operating conditions, failure of secondary system to detect fault - can all result in backup protection operation.

Ability of backup protection to be able to clear a persistent fault under credible system operating conditions is of paramount importance in preventing damage and detrimental effects to the National Grid transmission system. It must be capable of responding to any credible primary system fault conditions without compromising power system security.

Also, under normal and abnormal system conditions, an incorrectly set backup overcurrent protection can result in unwanted disconnection of a large number of customers and could even lead to cascade tripping resulting in a larger disruption of supply and system split conditions.

In view of the foregoing, there is a need to ensure that a consistent approach is adopted in determining backup protection settings to perform its intended task.

4.1 REQUIREMENTS FOR PROTECTION OF TWO-ENDED FEEDERS

The guidance and protection setting requirements for 400kV and 275kV two-ended and three ended feeders are given in PS(T) 010. Clauses 3.2.10, 3.2.11, 4.2.10 and 4.2.11 apply.

The clauses provide general guidance on backup protection and stipulate the setting requirements. These ensure that the chosen backup overcurrent setting

- (a) allows circuit loading requirement to be met
- (b) provides adequate grading margin with protection at 132kV and lower voltage systems under all credible system running conditions.

4.1.1 Backup Overcurrent Setting

PS(T) 010 requires feeder backup overcurrent protection at 400kV and 275kV to comply with the following:

- (a) An overcurrent setting of 77% of the credible minimum single-end fed phase to phase fault current at the remote end of the feeder - the credible minimum fault level is defined in PS(T)010 - clause 4.1.4 refers.
- (b) An adequate grading margin with protection at 132kV and lower voltage systems under all credible system running conditions, where applicable.
- (c) Maximum circuit loading requirement is met, where possible. The existing circuit loading requirement at 400kV and 275kV is 7600A and 5200A respectively.

The above requirement in (a) ensures that the backup overcurrent is able to detect a fault under credible minimum fault conditions. The minimum fault condition considered is a single-end fed phase to phase fault at the remote end of the feeder. Given a minimum fault level scenario, backup protection setting with a factor of safety of 1.3 (i.e. when set to $1/1.3 = 0.77$ or 77%) is guaranteed to detect the minimum fault condition – the factor of safety is to allow for the CT and relay errors.

4.1.2 Backup Overcurrent Relay Characteristics

The standard inverse (SI) curve to IEC characteristics is required.

4.1.3 Backup Overcurrent Time Multiplier (TM) Setting

The required TM setting is to achieve an operating time of 1 s for a single-end fed 3-phase fault at the remote end of the feeder with a fault infeed to the feeder equivalent to 63kA at 400kV and 40kA at 275kV.

4.1.4 Backup Overcurrent Setting Calculation – An Example

Consider the transmission system in south London comprising four 275kV substations at Littlebrook, Hurst, New Cross and Wimbledon shown in Appendix 1 – Figure 1.

It is required to set the backup overcurrent protection on the Wimbledon – New Cross 2 275kV (NASAP B712) circuit at Wimbledon 275kV substation – other details are as follows:

CT ratio 1200:600:1	(Use 1200:1 tap)
Backup overcurrent relay of type	MCGG42,
Backup overcurrent relay rating	5A

The circuit parameters obtainable from the Livelink system are given in Appendix 1.