

NATIONAL GRID PROTECTION APPLICATION AND SETTING AT RAILWAY SUPPLY POINTS

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PURPOSE AND SCOPE

This policy defines the protection application and setting at the interface between the National Grid electricity transmission system and railway systems.

This document shall be read in conjunction with TGN(E)212 which provides the necessary guidance on the application of the policy.

PART 1 – POLICY

1 GENERAL REQUIREMENTS

Protection requirements shall be based on the primary system configuration for railway connections. A typical primary system arrangement is given in Appendix A. Protection requirements shall also be based on plant rating as per TS 1, National Grid earthing arrangements as per TS 3.1.2, railway system earthing arrangements and the Grid Code Requirements.

Protection applied shall meet the requirements for both AT and BT modes.

Protection application policy requirements shall be met at all taps on Reactor(s) and Transformer(s).

2 PROTECTION APPLICATION

2.1 Transformer Main Protection

2.1.1 A main protection of numeric type, preferably providing two protection functions driven from a common Current Transformer (CT), shall be applied. At least one protection shall be an overall unit protection, which is responsive to both phase to phase and phase to earth faults on the transformer and its associated connections. The other protection function, applied on both HV and LV sides, shall, as a minimum, be sensitive to earth faults on HV and each LV winding (see TS 3.24.65). If a single protection relay is unable to provide the above functionality, then it is acceptable to use multiple protection relays. Note TGN(E)212 section 1.1.

2.1.2 Mechanical Protections as specified in the NGTS 3.24.8 shall be applied.

2.2 Transformer HV (400kV or 275kV) Protection

2.2.1 Instantaneous backup protection shall be applied to clear uncleared phase to phase and phase to earth faults on the HV side. Note TGN(E)212 section 1.2.1.

2.2.2 Time delayed backup protection shall be applied to clear uncleared phase to phase and phase to earth faults on the HV side. Note TGN(E)212 section 1.2.2.

2.2.3 When Copperwork Connections do not fall within the protection zones of other main protection, a separate copperwork protection shall be applied. Note TGN(E)212 section 1.2.3.

2.2.4 Circuit Breaker Fail (CBF) protection, as per NGTS 3.24.39, shall be provided for any transformer HV Circuit Breaker.

2.2.5 Ferroresonance detection protection shall be applied in accordance with PS(T)020. Where provided, the detection function shall be duplicated. Reference should also be made to TGN(E)175.

2.3 Transformer LV (25kV) Protection

2.3.1 2 stage time delayed backup protection shall be applied to clear uncleared phase to phase and phase to earth LV (25kV) faults on:

- a) The National Grid system to the first railway circuit breaker.
- b) The railway system as far as practically possible.

2.3.2 The above backup protection shall discriminate between load and fault conditions for all transformer(s) and reactor(s) taps positions.

2.4 Series Reactor Protection

2.4.1 A main protection that will clear all faults on the reactor(s), its connections and between any bushings shall be applied.

2.4.2 Mechanical Protections as specified in the NGTS 3.24.8 shall be applied.

2.5 Protection of LV Connections (including any cable sections)

2.5.1 Main protection to clear both phase to phase and phase to earth faults shall be applied. Note TGN(E)212 section 1.3.1.

2.5.2 Cable thermal overload protection to clear overload condition shall be provided. Note TGN(E)212 section 1.3.4.

2.5.3 Broken Neutral Conductor Protection to detect neutral conductor failure between the National Grid substation and the railway system shall be applied. Note TGN(E)212 section 1.3.5.

2.5.4 Single Intertripping facility to enable opening of the railway circuit breaker shall be provided. Note TGN(E)212 section 1.3.6.

3 PROTECTION SETTING

3.1 Transformer Main Protection

Note – Maximum Load is considered to be 200% transformer rating (short term).

3.1.1 Overall Differential current setting shall be set to ensure stability on all through faults and maximum load conditions over the complete transformer tapping range in accordance with the relevant manufacturer's instructions. The setting shall also ensure maximum coverage of HV and LV winding, with a minimum of 50% of LV windings coverage, under maximum load conditions.

3.1.2 HV REF current setting 10% - 60% (preferred setting 15%) of rated $I_{txhvwinding}$. The setting applied shall not exceed 60% rated $I_{txhvwinding}$ under maximum load conditions.

- 3.1.3 LV REF current setting 10% - 25% of the fault current available for earth faults at transformer LV terminals under no load conditions. The resulting setting shall not exceed 25% under maximum load conditions.

3.2 Transformer HV (400kV or 275kV) Protection

- 3.2.1 Instantaneous backup protection current setting shall be set to operate for HV faults but not LV faults.

Current setting shall be:

- a) Not less than 150% of the fault current fed from HV (under maximum fault condition with any neutral reactors shorted out) to an LV phase to phase fault.
- b) not greater than 50% of the fault current (under minimum plant condition) fed from HV to a HV phase to phase or phase to earth transformer bushings fault (whichever is the lower).

Where these criteria give a large range of possible settings, then the setting should be chosen in line with achieving greatest sensitivity.

- 3.2.2 Time delayed backup protection current setting to be applied: 230% of rated current $I_{txhvwinding}$. Note TGN(E)212 section 2.1.

TM setting, SI characteristic to IEC standard, is set to satisfy the following:

- a) to operate in a time not exceeding 0.8 s for the HV terminal faults under minimum plant conditions.
- b) not to operate before stage two overcurrent for LV faults.

Where both criteria above are not achievable then criteria (ii) shall apply.

3.3 HV (400kV or 275kV) Copperwork Protection

Copperwork protection current setting shall satisfy criteria below:

- 3.3.1 Main protection current differential setting shall be 230% rated $I_{txhvwinding}$ when the CT supervision alarm is available. Note TGN(E)212 section 2.2.1.
- 3.3.2 The current setting shall be 10% to 30% rated $I_{txhvwinding}$ when CT supervision alarm is not available. Note TGN(E)212 section 2.2.2.

The protection with settings as in 3.3.1 or 3.3.2 above must be able to detect a minimum fault infeed from the HV busbars to a HV connection fault.

3.4 HV (400kV or 275kV) Circuit Breaker Fail Protection

- 3.4.1 Current setting = 400 A at 400kV (for OIBR CBs the setting shall be 50 A), 240 A at 275kV. If the circuit has a rating of less than twice the specified setting, then the setting shall be approximately 50% of the rated current of the circuit. The CBF timing setting shall be chosen to achieve a target fault clearance time equal or less than 300 ms from the circuit breaker fail protection with a minimum allowance of 60 ms discriminating margin.

3.5 Transformer LV (25kV) Protection

To apply the 2-stage time delayed backup protection to SI, IEC characteristic, following criteria shall be met: