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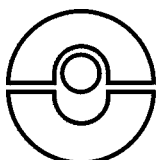
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Translation

Coordination of electrical protection sub-stations/traction units

*Coordination des protections électriques sous-station/engins moteurs
Koordination der elektrischen Schutzeinrichtungen Unterwerk/Triebfahrzeuge*



*Union Internationale des Chemins de fer
Internationaler Eisenbahnverband
International Union of Railways*

UIC



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VII - Way and Works

Application :

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All members of the International Union of Railways

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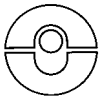
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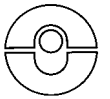
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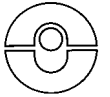
Summary

This leaflet sets out the rules for coordinating the operation of circuit breakers in substations and on board tractive units in order to ensure interoperability of motive power stock on networks equipped with different electrification systems.

Coordination is required because:

- the cut-out power of train-borne circuit breakers is limited whereas the level of short circuit currents may exceed it under some power supply voltages;
- if there is no OHL voltage, the tractive unit circuit breakers must open within a maximum pre-defined time;
- the conditions for automatic re-closing of sub-station circuit breakers must be compatible with the preceding conditions.

The leaflet specifies the limit condition of the input filter load current on tractive units under direct current power supply so that sub-station circuit breakers will not trip unnecessarily.

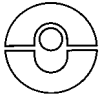


1 - Scope

This Leaflet covers sub-stations and traction units of modern, interoperable design:

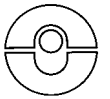
- the first part concerns interoperable traction units running under 25 kV 50 Hz and 15 kV 16 2/3 Hz (see 3 - page 4);
- the second part concerns: interoperable traction units running under d.c. systems at 750 V, 1 500 V and 3,000 V (see 4 - page 6).

Both parts apply to multi-system a.c./d.c. traction units.



2 - Objectives

Interoperability of traction units on European electrified railways using different systems requires that the compatibility of the protective systems between traction unit and sub-station be verified, regardless of the rail network in question.



3 - Traction units operating on a.c. lines

3.1 - Provisions to be met

Every traction unit is equipped with a circuit-breaker.

- On electrified railways using 25 kV 50 Hz¹, if there is an earth fault in the traction unit beyond the circuit-breaker, the latter must interrupt the short-circuit current. This can also be done by the circuit-breaker in the sub-station.
- On electrified railways using 15 kV 16 2/3 Hz. the sub-stations are connected in parallel. Consequently², the overhead/rails short-circuit current is normally much higher than that corresponding to the breaking capacity of the circuit-breaker on the traction unit. As a result, only the protective systems in the sub-station should be able to clear the fault by the action of the circuit-breaker in the sub-station.

NB : It should be noted that when the current of the short-circuit is very high, the triggering of the circuit-breakers in the sub-station must be very rapid.

3.2 - Action of the circuit breaker on the locomotive

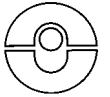
When a multi-current traction unit is located:

- under a 25 kV 50 Hz overhead line
any internal defect on the primary or secondary circuit (as seen by the supply transformer) must trigger the opening of the main traction unit circuit-breaker via its protective units
- under a 15 kV 16 2/3 Hz overhead line
 - any internal defect on the primary circuit (as seen by the supply transformer) is eliminated by the opening of one or more circuit-breakers in the sub-station(s). The opening of the circuit-breaker on the traction unit should be staggered in relation to the action of the circuit-breakers in the sub-station(s).
 - any internal defect located on the secondary circuit must trigger the opening of the main circuit-breaker on the traction unit.

3.3 - Auto-reclosing of one or more sub-station circuit-breakers.

The auto-reclosing systems (if any) for circuit-breakers in the sub-station are liable to re-energise the line. In such a case, the sub-station circuit-breakers may only be re-closed after the tripping of the circuit-breakers on the traction units present in the zone supplied by the sub-station. The traction unit circuit-breakers shall trip automatically within 3 seconds of loss of line voltage.

-
1. Overhead/rails short-circuit current normally 10-15 kA
 2. Overhead/rails short-circuit current normally up to 40 kA



3.4 - Neutral Sections

When trains use multiple pantographs, successive supply sections must not be electrically connected as the train crosses the neutral section.



4 - Traction units operating on d.c. lines

4.1 - Provisions to be met

Every traction unit is equipped with a circuit-breaker whose breaking capacity is less than the prospective value of the short-circuit current

On d.c electrified railways the sub-stations are connected in parallel. The overhead/rails prospective short-circuit current ¹ is higher than that corresponding to the breaking capacity of the circuit-breaker on the traction unit. As a result, only the protective systems in the sub-stations should clear the faults by the action of the circuit-breaker in the sub-stations.

NB : It should be noted that when the current of the short-circuit is very high, the triggering of the circuit-breakers in the sub-stations must be very rapid and thereby prevent the traction unit circuit-breaker from clearing faults on the traction unit.

4.2 - Action of the circuit-breaker on the traction units

Any internal defect on the circuits of the traction unit must trigger the opening of the main traction unit d.c circuit-breaker via its protective units.

4.3 - Reclosing of one or more circuit-breakers in the sub-station

The reclosing systems for circuit-breakers (if any) in the (parallel) sub-station are liable to place the line under voltage again. In such a case, the sub-station circuit-breakers may only be re-closed after the tripping of the circuit-breakers on the traction units present in the zone supplied by the sub-station. The traction unit circuit-breakers shall trip automatically within 3 seconds of loss of line voltage.

4.4 - Transient current during closure²

When the circuit-breaker of a traction unit is closed, with the input filter (if fitted), the transient current should not cause the protection devices in the sub-stations to trip unnecessarily. The requisite information shall be obtained from the infrastructure managers of the railways concerned when vehicle-mounted filters are being designed.

The di/dt differential of the transient current on closure of the traction unit circuit -breaker shall have a minimum overhead and sub-station inductance of 2 mH.

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1. Overhead/rails short-circuit current normally up to 50 kA
 2. This provision is only applicable to tractive units fitted with an input filter

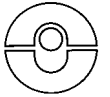


Table 1 :

t	condition applicable to di/dt
ms	A/ms
0 and 20	di/dt < 60 A/ms di/dt < 20 A/ms