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Safety measures to be adopted when working on or nearby overhead contact lines

*Mesures de sécurité à respecter pour les travaux sur ou à proximité des caténaires
Sicherheitsmaßnahmen bei Arbeiten an und in der Nahe von Oberleitungsanlagen*



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Contents

Summary	1
1 - General.....	2
1.1 - Scope	2
1.2 - References	2
1.3 - Field of application.....	2
2 - Definitions and abbreviations.....	3
2.1 - General	3
2.2 - Electrical	4
2.3 - Mechanical, physical and functional	5
2.4 - Working activities.....	6
2.5 - Safety	7
2.6 - Staff, organization and communication.....	9
2.7 - List of abbreviations.....	10
3 - Safety requirements and risk assessment	11
3.1 - Potential hazards when working on OCLs.....	12
3.2 - Risk analysis	13
3.2.1 - Track possession and train traffic	15
3.2.2 - Speed restriction on nearby tracks	15
3.2.3 - Induction	15
3.2.4 - Weather and visibility conditions.....	15
3.2.5 - Distance to be observed around live conductors	16
3.3 - Risk probability indicator.....	16
4 - Staff and work	17
4.1 - Staff employed in electrical work	17
4.2 - Organisation	18
4.3 - Communication	19
4.4 - Worksite.....	19
4.5 - Types of work activity	20

4.6 - Operating activities	21
5 - Working procedures	22
5.1 - Dead working procedure.....	22
5.1.1 - Disconnect completely	22
5.1.2 - Secure against re-connection	23
5.1.3 - Verify that the installation is dead	23
5.1.4 - Earthing and short-circuiting	23
5.1.5 - Protection against adjacent live parts	24
5.2 - Working in the vicinity of live parts.....	25
5.2.1 - Protection by screen, barrier, enclosure or insulating covering	25
5.2.2 - Protection by safety distance and supervision	25
5.3 - Live working	26
6 - General layout of working zones	27
6.1 - Air working distances.....	27
6.2 - Worker skills and machinery performances.....	29
6.3 - Air distances reduction	30
7 - Working zones and safety distances on the railway	31
7.1 - Non-electrical works	31
7.2 - Electrical works.....	35
7.3 - Temporary countermeasures to avoid electrocution.....	37
8 - Guide to working distances	38
8.1 - Minimum safety distances for skilled workers.....	38
8.2 - Minimum safety distances for ordinary workers.....	39
9 - Safety improvement and relevant statistics	40
Appendix A - Method for calculating air distances for working procedures	41
List of abbreviations	43
Bibliography	44

Summary

This document was prepared by the Energy and Electric Traction Experts of the UIC Infrastructure Forum to provide railways with standard guidelines for minimising the risk to the safety of staff working on or in the vicinity of electric traction lines.

In particular, this document deals with electrical and non-electrical works to be carried out along tracks in the vicinity of overhead contact lines with rated voltages equalling or exceeding 1,5 kV.

Safety measures for live working activities are not covered in this leaflet. In the countries where live working on overhead contact lines is allowed, the railways should state the necessary safety rules.

1 - General

1.1 - Scope

These guidelines relate to the dangers encountered by the staff of railway companies or contractors during electrical and non-electrical works carried out along tracks on or in the vicinity of overhead contact lines (OCLs).

The main objective is to develop a common approach in organising these works, adopting similar measures and minimising the risk of electrocution in the presence of live conductors.

1.2 - References

(see Bibliography - page 44).

1.3 - Field of application

The present leaflet sets out guidelines to ensure optimum safety for staff working on or near overhead railway contact lines supplied in DC or AC current with the following voltages:

- 1,5 kV and 3 kV DC;
- 15 kV - 16 2/3 Hz;
- 25 kV and 2 x 25 kV - 50 Hz.

The requirements provided in the present leaflet aim to ensure safety during maintenance and other works. They apply to all electrical and non-electrical work activities.

The present document focuses on electrical hazards; the risks arising from train traffic and other causes are only summarised.

2 - Definitions and abbreviations

Definitions for the terms used to describe the organisation and execution of works on tracks are given subsequently, with specific reference to the safety conditions of the staff involved, in order to avoid the risk of electrocution by live conductors or parts of the OCLs.

2.1 - General

Auxiliary catenary

Catenary suspended from the main catenary and supporting the grooved contact wires directly by means of droppers.

Body voltage

Product of the current through the body and the body impedance.

Catenary

Longitudinal wire supporting the grooved contact wires either directly or indirectly.

Conductors

A conductor is a metal wire or cable, either solid or stranded, designed to carry electrical energy and forming part of the overhead contact line system.

Contact wire

Electric conductor of an overhead contact line with which the current collectors make contact.

Earth wire

Metal wire connecting supports to earth or to the rails to protect people and installations in the event of an insulation fault. It may also be used as a return cable.

(Effective) touch voltage

Voltage between conductive parts when touched simultaneously by a person or an animal.

Electric traction lines

Electric lines equipped to transmit electric power from sub-stations to trains.

Electric traction system

Railway electrical distribution network used to provide energy for rolling stock.

Electro dispatching

A central site equipped for remote command and control of electric traction installations from where shift operators control the energised state of installations and authorise their switching off usually at the request of the OCL personnel.

Energy system

All the electrical installations needed to supply an electric traction network including sub-stations, contact lines, return circuits and pantographs, as set out in the Technical Specifications for Interoperability (energy sub-system).

Failure

The termination of an item's ability to perform a required function. After failure, the item has a fault. A failure is an event, whereas a fault is a state.

Fault

The state of an item which is unable to perform a required function, unless this inability is due to preventive maintenance or other planned activities, or absence of external energy supply.

Feeder

Electrical connection between the contact line and the sub-station or the switching station.

Item

Any part, component, device, functional unit, equipment, system or sub-system (consisting of hardware, software or both) that can be considered individually.

Line feeder

An overhead conductor installed nearby to the contact line, either to supply successive feeding points or to increase the useful cross-sectional area.

Main catenary

Catenary supporting an auxiliary catenary by means of droppers.

Nominal voltage

Designated value for an electric traction system (*EN 50163* - see Bibliography - [page 44](#)).

Overhead Contact Line (OCL)

Contact line placed above the upper limit of the vehicle gauge and supplying vehicles with electrical energy through pantographs.

Overhead line

Electrical line consisting of conductors supported above ground by means of insulators and appropriate supports.

2.2 - Electrical

Fault current

Maximum current passed through the overhead contact line under fault conditions within a defined short time period, between live equipment and earth.

Feeding point

Point at which the feeding system supply is connected to the contact line.

Isolation

Disconnection of a section of the overhead contact line from the source of electrical energy, either in an emergency or to facilitate maintenance.

Sectioning point

An arrangement of the contact line equipment which provides insulation between adjacent sections of the contact line while allowing continuous current collection.

Short circuit

Accidental or intentional conductive path between two or more points in a circuit forcing the voltages between these points to be relatively low.¹

1. Any such conductive path whether between conductors or between conductor and earth is regarded as a short circuit.

2.3 - Mechanical, physical and functional

Cantilever

Support consisting of one or more transverse members projecting from a mast.

Disconnecter

A mechanical switching device which, in the open position, provides an isolating distance in accordance with a specified requirement. A disconnecter is capable of opening and closing a circuit only when negligible current is cut out or brought in.

Earthing device

Device used to connect a circuit to earth.

Height (of the contact wire)

Distance between the top of the rail and the lower face of the contact wire, measured perpendicularly to the track.

Insulated overlap

Sectioning point formed by overlapping the ends of adjacent sections of contact line, allowing their parallel running, insulation being provided by a suitable air gap between the two sets of equipment.

Insulator

Device designed to support and insulate a conductive element.

Lightning arrester

Device intended to protect the electrical apparatus from high transient overvoltages and to limit the duration and amplitude of the follow-on current.

Mast (pole)

A main vertical support construction with one end embedded in the ground adjacent to the track, either directly or through a separate base or foundation to provide for support, tensioning and registration of the overhead contact line.

Neutral section

Section of a contact line provided with a sectioning point at each end to prevent successive electrical sections, differing in voltage, phase or frequency being connected together by the passage of current collectors.

Overlap span

An arrangement of adjacent mechanical sections of the overhead contact lines providing continuous contact between the pantograph and the contact wires and continuous current collection.

Return circuit

The electrical circuit including the running rails or a return current rail, their electrical connections and the return cables to the sub-station.

Section insulator

Sectioning point formed by insulators inserted in a continuous run of a contact line with skids or similar devices to maintain continuous current collection.

Span

The part of the overhead contact line between one support or suspension point and the next.

Spark gap

Device used to connect a circuit to earth in the event of a fault.

Support structure

Parts which support the conductors and the associated insulators of an overhead contact line.

Suspension insulator

Component of a string of insulators capable of being loaded in tension.

Switch

Component fitted with an actuator and contacts to make and break a connection.

Track return system

System in which the running rails of the track form a part of the return circuit for the traction current.

2.4 - Working activities

Elementary maintenance activity

Unit of work into which a maintenance activity may be broken down at a given indenture level.

Examinations

Activities undertaken to check those parts of the installations which can be inspected thoroughly only with the overhead line switched off and earthed. They are arranged for specific areas, when required, as a result of inspections, measurement runs, short circuits and disruptions. Generally there is no prescribed frequency. Examinations may also be made on a spot-check basis.

Extraordinary maintenance

Interventions planned to re-establish the reliability of installations, recovering long periods of poor or non-existent routine maintenance.

Fault repair

The part of corrective maintenance in which manual actions are performed on the item (manual activity to repair faults). The reparation may be temporary or definitive.

Inspections

Activities to monitor the state of the overhead line and to evaluate the extent of maintenance work required, such as foot inspections, test car runs, observation of pantograph reaction etc.. The inspections are usually undertaken with the overhead line switched on.

Maintenability

The ability of an item under given conditions of use, to be retained in, or restored to, a state in which it can perform a required function, when maintenance is performed under given conditions and using stated procedures and resources.

Maintenance

Combination of all actions intended to retain an item in, or restore it to, a state in which it can perform a required function.

Maintenance interventions

All technical actions (excluding administrative and supervisory actions) intended to retain an item in, or restore it to, a state in which it can perform a required function.

Measurements

Activities carried out to measure the main parameters (geometrical, mechanical and electrical), which characterise the condition and the reliability state of the OCL system. Measurements may require track possession and the electrical line to be switched off.

Operation

All activities necessary to permit the electrical installation to function. These activities include such matters as switching, controlling, monitoring and maintenance as well as both electrical and non-electrical work.

Renewals

Interventions planned to improve the performance of operating installations through large-scale works, such as renewal of components, adjustments of particular functional aspects and/or improvements of operating characteristics.

Timetable for maintenance

Planned periods of traffic suspension on the tracks for maintenance.

Track possession

Availability of the track for works.

Track possession duration

Period for which the tracks are available for works.

2.5 - Safety

Barrier

A device which prevents or blocks movement in the direction of an electrical hazard.

Dead

With a voltage of zero or approximately zero, that is without voltage nor charge.

Dead working

Work activities on electrical installations which are neither live nor charged, carried out once all the necessary measures to prevent electrical danger have been taken.

Earthing and short-circuiting

Earthing is connecting the overhead contact line to earth. Short-circuiting is connecting the overhead contact line to the track. Depending on the work to be performed and on the power supply system, earthing, short-circuiting or both operations may be necessary.

Electrical danger

Risk of injury from an electrical installation.

Electrical distance

The distance which protects against electrical breakdown during live working. In generic terms, the electrical component is the minimum distance between two electrodes, which represent live and/or earthed parts, required to ensure that the probability of electrical breakdown is negligible when subjected to the most severe electrical stress likely to arise under the conditions prescribed.

Electrical hazard

A source of possible injury or health damages due to the presence of electrical energy in an electrical installation.

Electrical works

Works on, with or near an electrical installation, such as testing and measurement, repairs, replacement, modification, extension, erection and inspection.

Enclosure

A device providing protection of equipment against certain external influences and protection against direct contact from any direction.

Ergonomic component

The distance which allows for limited errors in movement and judgement of distance during the work required to be carried out at the minimum working distance. This needs to take into consideration the actions of the person as well as the tools that are to be used and manipulated.

Injury (electrical)

Death or personal injury from electric shock, electric burn, arcing, or from fire or explosion initiated by electrical energy caused by any operation of an electrical installation.

Insulating covering

A rigid or flexible cover made of insulating material used to cover live and/or dead parts and/or adjacent parts in order to prevent accidental contact.

Isolate

To disconnect all sides of an electric device or circuit from other electric devices and electric circuits by sectioning points which can resist to the expected voltage differences between the electric devices or the electric circuit and other electric circuits.

Live working

Works in which workers enter into contact with live parts or reach into the live working zone with either parts of their body or tools, equipment or devices they are handling.

Live working zone

A space around live parts in which the insulation level to prevent electrical danger is not assured when encroaching into it without protective measures. The outer limit of the live working zone is called D_L .

Minimum working distance

The distance to be maintained between any part of the body of a worker, or any conductive tool being directly handled, and any part at different potentials, live or earthed. The minimum working distance is the sum of the electrical distance and the ergonomic component. It is understood that the safety distances are measured from the nearest point under voltage.

Non-electrical works

Works in the vicinity of an electrical installation, such as construction, excavation, cleaning, painting, etc.

Risk

A combination of the probability and the degree of potential injury or health damage to a person exposed to hazards.

Safety distance

The distance around live conductors which workers must never enter during work nor reach into with arms, body parts or tools.

Screen

Any device (insulated or not) which prevents approaching any equipment or part of an electrical installation which presents electrical danger.

Vicinity zone

A demarcated space surrounding the live working zone. The outer limit of the vicinity zone is called D_V .

Work activity

Any form of electrical or non-electrical work where there is the possibility of exposure to an electrical hazard.

Works in the vicinity of live parts

Work activities in which workers enter into the vicinity zone with part of their body, a tool or any other object without entering the live working zone.

Worksite

Sites, places or areas where work activities are to be, are being, or have been carried out.

2.6 - Staff, organization and communication

Instructed person

That person adequately advised by skilled persons to enable them to avoid dangers which electricity may create. In this leaflet the instruction refers in particular to electrical danger which OCL may create.

Nominated Person in control of an Electrical Installation (NPEI)

That person with direct operational responsibility for the electrical installation. Parts of this responsibility may be delegated to others as required.

Nominated Person in control of a Work Activity (NPWA)

That person with direct operational responsibility for the work activity. Parts of this responsibility may be delegated to others as required.

Notification

Messages or instructions which are either verbal or in writing relating to the operation of any electrical installation.

Ordinary person

A person who doesn't know the danger which electricity may create. They are neither a skilled person nor an instructed person. In this leaflet the ordinary person doesn't know the electrical danger which OCLs may create (e.g. new staff during the training). Such person cannot work without supervision

Skilled person

That person with relevant education and experience to enable them to avoid dangers which electricity may create. In this leaflet the education and experience required is particularly referred to the working capabilities in OCLs.

2.7 - List of abbreviations

(see also List of abbreviations - [page 43](#)).

AC	alternative current
D _B	smallest electrical distance preventing discharge
DC	direct current
D _L	outer limit of the live working zone
D _S	distance between screen and live part higher than D _B
D _V	outer limit of the vicinity zone
NPEI	nominated person in control of an electrical installation
NPWA	nominated person in control of a work activity
OCL	overhead contact line
RPN	risk probability number

3 - Safety requirements and risk assessment

The recommendations and guidelines set out in the present document concern the safety of people working on or near electrified lines and OCLs.

Works are considered "electrical" when they involve carrying out electrical maintenance, tests, measurements and renewal operations.

Works are considered "non-electrical" when they do not involve electrical installations, but when it may be necessary to intervene in their function (e.g. de-energise, short-circuit, etc.).

The personnel involved are either under the infrastructure managers or are under contract. Moreover, all people who have to walk along the tracks or approach the rail infrastructures and installations in the course of their duties, are considered here.

The improvement of protection for people working on, or near, the rail infrastructures and installations must be continuously pursued and the establishment of their safety must be a clear priority for all rail organisations.

Minimising workers' exposure to hazards should be an objective of all parties involved in the design, management and operation of railways.

Electrical equipment, for example, should be designed to operate reliably leading to a reduced need for human intervention. Similarly, diagnostic systems should be expanded to prevent failures and to guide safely the maintenance personnel.

Furthermore, electrical installations and OCLs in particular should be placed in a position where inadvertent contact is unlikely.

In order to work on OCLs and in particular near live conductors, it is necessary to have thorough knowledge of the safety conditions with regard to:

- work organisation and the type of work to perform;
- the distances from tracks open to traffic and from live conductors;
- characteristics and sizes of the means adopted;
- knowledge of the workers.

The requirements for maintaining safety when working on and in the vicinity of OCLs are usually set out in standards, national laws, internal rules, instructions and recommendations.