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Guidelines for personal safety restraint in electrical operations

电气运行场所的人身安全约束指南

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1 Scope

China's national guidelines for personal fall restraint in electrical work. Working on overhead lines, on towers, on poles and in substations puts people at height in circumstances that ordinary fall protection was not designed for. The equipment must not conduct: a steel karabiner or a wire-cored lanyard on a live structure is a path to earth through the wearer. The anchor points are not the engineered eyebolts of a building but the structure itself, which may be energised or may be a wooden pole of unknown condition. The worker needs both hands free and needs to move continuously along and around the structure, so a restraint that must be unclipped to pass an obstacle will be unclipped and left so. And the

rescue problem is acute: a person suspended in a harness after a fall suffers suspension trauma within minutes, and on a tower or a pole nobody can reach them quickly. The guidelines address the combination.

This document establishes the principles of electrical personal safety restraint in electrical operation place, and provides the contents and measures of electrical safety restraint for personnel, man-machine interaction and personnel interaction. This document is applicable to the electrical safety restraint of personnel in places where low-voltage electrical equipment and systems are operated.

2 Normative References

The contents of the following documents constitute indispensable clauses of this document through the normative references in the text. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 4025-2010 Basic and Safety Principles for Man-machine Interface, Marking and Identification - Coding Principles for Indicators and Actuators

GB/T 4026-2019 Basic and Safety Principles for Man-machine Interface, Marking and Identification - Identification of Equipment Terminals, Conductor Terminations and Conductors

GB/T 4205-2010 Basic and Safety Principles for Man-machine Interface (MMI), Marking and Identification - Actuating Principles

GB/T 4208-2017 Degrees of Protection Provided by Enclosure (IP code)

GB/T 22696 (all parts) Electrical Equipment Safety - Risk Assessment and Risk Reduction

GB/T 29481-2013 Signs for Electrical Safety

GB/T 33980-2017 Guide on Inclusion of Electrical Safety Aspects in Electro-technical Product Instructions

GB/T 34924-2017 Guidelines for Safety Related Risk Assessment and Risk Reduction for Low Voltage Equipment

3 Terms and Definitions

The following terms and definitions are applicable to this document.

3.1 Electrical Personal Safety Electrical personal safety refers to the exemption of personnel from injuries caused by various electrical accidents in electrical equipment and systems in the electrical field.

3.2 Restraint Restraint refers to the proposal of measures to ensure personal safety.

3.3 Collaborative Operation Collaborative operation specifies the behavior of a specially designed electrical equipment and system in a collaborative workspace with personnel.

[Source: GB/T 36008-2018, 3.1, modified]

3.4 Collaborative Workspace Collaborative workspace refers to a workspace where electrical equipment and systems and personnel can simultaneously execute tasks during production activities in the operation space. [Source: GB/T 36008-2018, 3.3, modified]

3.5 Protective Separation Distance Protective separation distance refers to the shortest allowable distance between any hazardous movable part of electrical equipment and systems and personnel in the collaborative workspace. [Source: GB/T 36008-2018, 3.6, modified]

4 Principles of Electrical Personal Safety Restraint

The electrical personal safety restraint preferentially complies with the relevant regulations on personal safety protection and the requirements of electrical safety technology for the acceptable risk level of personnel. The electrical personal safety restraint should be proposed in accordance with the following principles, but are not limited to.

---traceability, which is proposed in accordance with the electrical safety risks confronting personnel in the electrical operation place;

---operability, which is proposed in combination with the performance and application of electrical equipment and systems;

---time-domain characteristics, which considers the movement trajectories and changes of personnel and certain equipment (for example, movable equipment) in the electrical operation place with the passage of time;

---maintenance and repair. The electrical safety hazards of electrical equipment and systems are usually triggered by potential risks or unreasonable design in terms of electric shock, energy, ignition, heat, man-machine interface and ergonomics, etc. The relevant electrical safety hazards shall comply with the stipulations of GB/T 22696 (all parts). The hazard identification of operating scenarios should consider the contents and characteristics of operating scenarios. The operating scenarios may include routine workspace, safety protection space, collaborative workspace and environmental factors throughout the site. Electrical safety hazards of operating scenarios are usually triggered by changes in environmental factors, unreasonable safety distances (for example, protective separation distance in collaborative workspace) and unsafe states, for example, overlapped or intersected movement trajectories.

6 Measures of Electrical Personal Safety Restraint

Electrical safety restraint measures should be taken in accordance with the following priorities during the design stage.

- a) inherent safety measures, which may include inherent safety design measures for electrical equipment and systems, as well as inherent safety measures for personnel;
- b) protective measures, which may include measures proposed for electrical equipment and systems, such as. hazard protection and enclosure protection, etc., as well as measures proposed for personnel, for example, wearing protective equipment;
- c) information of application, including instructions delivered with electrical equipment and systems, safety signs on electrical equipment and systems, safety signs in operation place and operation manuals for personnel, etc. During the application stage, electrical safety restraint measures should be taken from additional protective equipment, personal protective equipment and training, etc.

7 Electrical Safety Restraint of Personnel

7.1 Personnel Information The personnel information that should be considered includes, but is not limited to.

---static information. information that does not change or is at the same level within a specific period of time, such as. safety skill level, safety experience, risk awareness and ability to deal with failures, etc.;

---dynamic information. information that changes over the passage of time, such as. physical health status, psychological status, operation / intervention / collaborative operation position (spatial extent of task execution) and movement trajectories, etc.;

---ergonomics information, which includes, but is not limited to. whether the characteristics of the common users of the equipment are considered, such as. gender, age, dominant hand, height and strength; whether relevant health factors (for example, physical defects like vision or hearing impairment) are considered, and whether continuous adjustments are made in accordance with design improvements.

7.2 Electrical Safety Risks of Personnel

7.2.1 Electrical safety risks triggered by changes of personnel information Electrical safety risks triggered by changes of personnel static information, dynamic information and ergonomics information (see 7.1).

7.2.2 Electrical safety risks triggered by electrical operation place Electrical safety risks triggered by electrical operation place may be considered from the following factors, but are not limited to.

---as a result of changes in environmental factors, such as. changes in temperature,