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**Standard for construction and acceptance of cable line
electric equipment installation engineering**

电气装置安装工程电缆线路施工及验收标准

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Standard for construction and acceptance of cable line electric equipment installation engineering

1 General provisions

1.0.1 This standard is formulated in order to ensure the quality of cable line engineering construction, unify construction and acceptance criteria, standardize quality control requirements and acceptance conditions in the construction process.

1.0.2 This standard applies to the construction and acceptance of cable lines, which have a rated voltage of 500 kV and below, as well as their ancillary facilities.

1.0.3 The installation engineering of cable lines, which have special requirements, such as mines, ships, submarine, metallurgy, chemical industry, shall comply with the relevant provisions of relevant professional standards.

1.0.4 The construction and acceptance of cable lines shall not only comply with this standard, but also comply with the current relevant national standards.

2 Terms

2.0.1 Cable line

The entire system, which is composed of cables, accessories, auxiliary equipment, and auxiliary facilities.

2.0.2 Metallic sheath

Uniform and continuous sealed metal tubular cladding.

2.0.3 Armor

A cladding consisting of metal strips or wires. It is usually used to protect cables from external mechanical forces.

2.0.4 Cable termination

A device, which is installed at the end of a cable, to connect the cable to other electrical equipment or overhead power lines AND to maintain insulation up to the point of connection.

2.0.5 Cable joint

A device, that connects the conductor, insulation, shielding layer and protective layer of the cable to the cable, to make the cable line continuous.

2.0.6 Flexible joint

The intermediate joint, which is made by connecting unarmored cables under factory-controlled conditions, AND continuously armored with the cables.

2.0.7 Cable dividing box

A special electrical connection equipment, which completes the collection and branching functions of the cable lines in the power distribution system, BUT generally does not have secondary auxiliary configurations, such as control and measurement.

2.0.8 Cable tunnel and cable line online monitoring system

It is a system for monitoring, analyzing, auxiliary diagnosis, alarm, remote control of cable running status and cable tunnel and other line facilities. The monitoring system consists of six parts: field equipment, sensors, signal acquisition unit, monitoring host, monitoring sub-station, remote monitoring center.

2.0.9 Cable ducts

A duct, in which the cable is laid, for protection purposes AND for easy pulling out of the cable for replacement after a cable failure. There are structural forms such as single duct and row duct, also known as cable tube.

2.0.10 Cable bearer

A device, which is used to support and fix cables, is usually assembled by integral casting, profiles welding or fastener splicing.

2.0.11 Cable tray

A continuous rigid structure system, which is composed of a tray (bracket) or a straight section of a ladder frame, a non-linear section, an accessory, a support hanger, etc., to support cables.

2.0.12 Cable buildings

Structures such as cable trenches, shallow grooves, tunnels, interlayers, vertical (inclined) shafts, working shafts, which are specially used for laying cables or placing accessories.

2.0.13 Cable accessories

Cable terminals, joints, oil-filled cable pressure boxes are collectively referred to as cable accessories.

2.0.14 Cable auxiliary equipments

A general term for cable line components, such as cross interconnection boxes, grounding boxes, sheath protectors, monitoring systems.

2.0.15 Cable auxiliary facilities

A general term for cable line components, such as cable ducts, brackets, bridges, structures.

3 Basic requirements

3.0.1 Cables, accessories, auxiliary equipment shall meet the requirements of product technical documents; they shall have product identification and qualification certificates.

3.0.2 Safety technical measures shall be formulated for the construction of cable lines. Construction safety technical measures shall comply with the provisions of this standard and product technical documents.

3.0.3 The mechanical strength, corrosion resistance, flame retardancy and other properties of the fasteners shall meet the relevant standards. When steel fasteners are used, except for anchor bolts, hot-dip galvanized products or products with equivalent hot-dip galvanized properties shall be used.

3.0.4 For cable lines with anti-interference requirements, anti-interference measures shall be taken, according to design requirements.

4 Transportation and storage of cables and accessories

4.0.1 The transportation and storage of cables and accessories shall comply with the requirements of product technical documents. It shall avoid strong vibration, overturning, moisture, corrosion. It shall ensure that the outer surface of the box and the components inside the box are not damaged.

4.0.2 During transportation and loading & unloading, the cables and cable reels shall be prevented from being damaged. Cable reels shall not be transported or stored flat.

4.0.3 Before transporting or rolling the cable reel, it shall ensure that the cable reel is firm AND the cable shall be wound tightly. The oil pipe -- between the oil-filled cable and the pressure oil tank -- shall be fixed without damage. The pressure oil tank shall be firm; the pressure value shall meet the technical requirements of the product. When rolling, follow the arrow on the cable reel or the direction in which the cable is tightened.

4.0.4 After the cables and their accessories arrive at the site, they shall be inspected

5 Cable line construction of ancillary facilities

5.1 Processing and installation of cable ducts

5.1.1 There shall be no perforations, cracks, obvious unevenness in the cable duct; the inner wall shall be smooth; the metal cable duct shall not be severely corroded; the performance of the plastic cable duct shall meet the design requirements.

5.1.2 The processing of the cable duct shall meet the following requirements:

- 1 The nozzle shall be free of burrs and sharp edges;
- 2 After the cable duct is bent, there shall be no cracks and obvious depressions; the degree of bending shall not be greater than 10% of the outer diameter of the duct; the bending radius of the cable duct shall not be less than the minimum allowable bending radius of the cable;
- 3 Metal cable ducts without anti-corrosion measures shall be coated with anti-corrosion paint on the outside; anti-corrosion paint shall also be painted on the peeling zinc layer of galvanized tubes.

5.1.3 The ratio -- of the inner diameter of the cable duct TO the outer diameter of the cable passing through -- shall not be less than 1.5.

5.1.4 There shall be no more than three elbows and no more than two right-angle bends for each cable duct.

5.1.5 The laying of cable ducts shall comply with the following requirements:

- 1 The direction of cable ducts shall be parallel or perpendicular to the ground; the cable ducts laid side by side shall be arranged neatly.
- 2 The cable duct shall be installed firmly and shall not be damaged. The distance between the fulcrums of the cable duct shall meet the design requirements. When there is no design requirement, the distance between the fulcrums of the metal tube should not be greater than 3 m; the distance between the fulcrums of the non-metallic tubes should not be greater than 2 m;
- 3 When the linear length of the plastic pipe exceeds 30 m, an expansion joint should be installed; the expansion joint shall avoid the fixed point of the plastic pipe.

5.1.6 When laying concrete cable ducts, the foundation shall be solid and flat, without subsidence. When laying low-alkali glass steel pipes and other compressive but not tensile cable ducts, it should set a reinforced concrete cushion under them. The direct buried laying of cable ducts shall meet the following requirements:

- 1 The buried depth of the cable duct shall not be less than 0.5 m. When passing under the drainage ditch, the distance from the bottom of the drainage ditch should not be less than 0.3 m;
- 2 The cable duct should have a drainage slope of not less than 0.2%.

5.1.7 The connection of the cable duct shall comply with the following requirements:

- 1 The materials and specifications of the two cable ducts, which are connected to each other, shall be consistent;
- 2 Metal cable ducts shall not be directly butt-welded, BUT shall be connected by threaded joints or seal-welded with sleeves. When connecting, the two pipe openings shall be aligned; the connection shall be firm; the seal shall be good. The length of the threaded joints or sleeves shall not be less than the 2.2 times the diameter of cable duct. When metal hoses and alloy joints are used as cable protection connectors, both ends shall be firmly fixed and well-sealed;
- 3 When the rigid plastic pipe is socketed or inserted, the insertion depth should be 1.1 ~ 1.8 times the inner diameter of the pipe. Adhesive shall be applied to the jointing surface, to seal firmly; when socketing is used, sealing measures shall be taken at both ends of the casing;
- 4 The connection of cement pipes should be in the form of pipe clamps or socket joints; the pipe holes shall be aligned; the joints shall be tight; the pipe clips shall be equipped with waterproof gaskets and sealing rings, to prevent the infiltration of groundwater and mud;
- 5 When the cable duct is connected to the bridge frame, it should be led out from the side wall of the bridge frame; the connection part should be fixed with a pipe joint.

5.1.8 The position of the cable duct, which is leading to the equipment, shall be convenient for connection with the equipment AND shall not hinder the disassembly and access of the equipment. The nozzles of cable ducts, which are laid side by side, shall be arranged neatly.

5.1.9 When using the cable protection steel pipe as the grounding wire, the grounding wire shall be installed first; then the cable shall be laid; for the cable duct with threaded connection, the jumper shall be welded at the pipe joint; the cross-section of the jumper shall not be less than 30 mm².

5.1.10 The steel protective pipe shall be reliably grounded; the metal pipe joint should be used, between the steel pipe and metal hose, the metal hose and equipment; it shall ensure reliable electrical connection.

5.2.9 The turning radius at the turning point of the cable tray shall not be less than the minimum allowable bending radius of the cables (whichever is larger) on the tray.

5.2.10 The overall length of metal cable holders, bridges, shafts must be reliably grounded.

5.3 Cable line protection facilities and structures

5.3.1 The construction of construction projects, which are related to the installation of cable lines, shall comply with the following requirements:

- 1** The construction quality of buildings (structures) shall comply with the relevant provisions of the current national standard GB/T 50300 "Unified standard for construction quality acceptance of construction engineering";
- 2** Before the cable line is installed, the construction project shall meet the following conditions:
 - 1) Embedded parts shall meet the design requirements; the placement shall be firm;
 - 2) The flooring and plastering of cable trenches, tunnels, shafts, manholes shall be completed; the installation of manhole ladders shall be completed;
 - 3) Temporary construction facilities, formwork, construction waste at cable layers, cable trenches, tunnels, etc. shall be cleaned up; construction roads shall be unimpeded; cover plates shall be complete;
 - 4) The drainage of the cable trench shall be smooth; the doors and windows of the cable room shall be installed; the waterproof performance of the structures related to the cable line shall meet the design requirements;
- 3** After the cable line is installed and before it is put into operation, the decoration work shall be completed in the construction project.

5.3.2 The size of the cable working shaft shall meet the requirements for the minimum bending radius of the cable. There shall be a sump in the cable shaft and a grating on the top.

5.3.3 The identification of the urban cable line channel shall be set, according to the design requirements. When there is no requirement in the design, obvious signs or stakes shall be set, at every 15 m ~ 50 m of the straight section of the cable channel, at the turn, at the T-shaped opening, at the intersection, at the entrance to the building (structure).

6 Cable laying

6.1 General requirements

6.1.1 Before cable laying, inspection shall be carried out, according to the following requirements:

- 1** The depth, width, bending radius of cable trenches, cable tunnels, cable ducts, cable shafts, cross-spanning pipes, direct-buried cable trenches shall meet the design requirements. The cable channel shall be smooth. The drainage shall be good. The corrosion-proof layer of metal part shall be complete. The lighting and ventilation in the tunnel shall meet the design requirements.
- 2** The rated voltage and model specification of the cable shall meet the design requirements;
- 3** The appearance of the cable shall not be damaged. When there is any doubt about the appearance and sealing state of the cable, it shall judge whether it is damped; the buried cable and submarine cable shall be tested and pass the test; for the cable whose outer sheath has a conductive layer, the outer sheath shall be subject to the insulation resistance test and pass the test;
- 4** The oil pressure of the oil-filled cable should not be lower than 0.15 MPa. The oil supply valve shall be in the open position; the action shall be flexible. The indication of pressure gauge shall have no abnormality. All pipe joints shall have no oil leakage. The oil sample shall pass the test;
- 5** The cable pay-off frame shall be placed stably; the strength and length of the steel shaft shall be compatible with the weight and width of the cable reel; the equipment for laying cables shall be checked and adjusted normally; the cable reel shall have reliable braking measures;
- 6** Before laying, the length of each cable shall be calculated, according to the design and actual path. Each cable shall be reasonably arranged, to reduce cable joints. The position of the intermediate joint shall not be set at inclinations, turnings, intersections, building doors, crossing with other pipelines or narrow passages;
- 7** There shall be reliable safety measures for laying cables in live areas;
- 8** When using mechanical laying of cables, the traction machine and guiding mechanism shall be debugged well; there shall be measures to prevent mechanical damage to the cables.

6.1.2 When cables are laid, the waterproof layers of cable trenches, tunnels, cable shafts, manholes shall not be damaged.

sequence or polarity identification. The handwriting on the identification plate shall be clear and easy fall off;

- 4 The specification of the sign should be uniform; the sign shall be anti-corrosion; the hanging shall be firm.

6.1.19 Cable fixing shall meet the following requirements:

- 1 The cables at the following parts shall be firmly fixed:

- 1) Cables laid vertically or inclined over 30° shall be firmly fixed on each holder;
- 2) Cables laid horizontally shall be firmly fixed, at the first and last ends of the cable and at the ends of turns and cable joints; when there are requirements for cable spacing, they shall be fixed firmly, at intervals of 5 m ~ 10 m.

- 2 The fixing of single-core cables shall meet the design requirements.

- 3 After the single-core cable or three-core cable of the AC system is phase-separated, the fixing fixture must not form a closed magnetic circuit; non-ferromagnetic materials should be used.

6.1.20 For the metal sheath or cable metal duct of the exposed cables, along the electrified railway or on the bridge passing by the electrified railway, shall be insulated from the metal holder or the metal components of the bridge, along its entire length.

6.1.21 When cables enter cable trenches, tunnels, shafts, buildings, panels (cabinets), entering pipes, the entrances and exits shall be closed AND the pipe openings shall be sealed.

6.1.22 For lighting towers equipped with lightning rods, the laying of cables shall also conform to the relevant provisions of the current national standard "Code for construction and acceptance of grounding connection electric equipment installation engineering" GB 50169.

6.2 Buried cable laying

6.2.1 Protective measures shall be taken, for areas along the cable route, that may cause the cable to suffer from mechanical damage, chemical action, underground current, vibration, thermal impact, corrosive substance, pest hazards.

6.2.2 The burial depth of cables shall meet the following requirements:

- 1 The distance between the surface of the cable and the ground shall not be less than 0.7 m; it shall not be less than 1 m, when passing through farmland or laying under the roadway. It can be buried shallow, when leading into buildings, crossing

intersection point, when the cables pass into the pipe OR are separated by partitions, the crossing net distance can be 0.25 m;

- 3) Although the clear distance between cables and heat pipes (trenches), oil pipes (trenches), flammable gas and flammable liquid pipes (trenches), thermal equipment or other pipes (trenches) can meet the requirements, the maintenance pipeline may damage the cable, THEN, protective measures shall also be taken, within 1 m before and after the crossing point. When the net crossing distance cannot meet the requirements, the cable shall be inserted into the pipe, meanwhile the net distance can be 0.25 m;
- 4) When the cable is parallel to or crosses the thermal pipe (pipe trench) and thermal equipment, heat insulation measures shall be taken, so that the temperature rise of the soil around the cable does not exceed 10 °C;
- 5) When the DC cable is parallel to the rail of the electrified railway, meanwhile the net crossing distance between them cannot meet the requirements, anti-galvanic corrosion measures shall be taken;
- 6) When directly buried cables cross city streets, highways, railways, OR pass through gates with heavy-duty vehicles, OR enter the corners of buildings, OR enter tunnels, manholes, OR lead out from the ground to the surface, the cables shall be laid in a pipeline that meets the strength requirements; meanwhile it shall seal the nozzle well;
- 7) When cables are laid through pipes, the minimum parallel distance to roads, street pavement, tower foundations, building foundations, drainage ditches, etc. can be halved, according to the data in Table 6.2.3.

6.2.5 When cables intersect railways, highways, city streets, factory roads, they shall be laid in solid protective tubes or tunnels. The two ends of the cable duct should protrude more than 0.5 m from both sides of the road subgrade, 0.5 m from the drainage ditch; it shall protrude from the road pavement in urban streets.

6.2.6 The upper and lower parts of directly buried cables shall be paved with soft soil sand layers, which are not less than 100 mm thick; meanwhile it shall be covered with protective plates. The covering width shall exceed 50 mm on both sides of the cable. The protective plates may be concrete cover plates or bricks. There shall be no stones or other hard debris in the soft soil or sand.

6.2.7 For the directly buried cables, it shall be provided with obvious orientation marks or stakes, at intervals of 50 m ~ 100 m in the straight section, at cable joints, at turns, at places entering buildings, etc.

6.2.8 Before backfilling directly buried cables, the hidden works shall pass the inspection and acceptance; the backfill shall be compacted layer by layer.

6.3 Intraductal cable laying

6.3.1 When directly burying cable ducts in places which are susceptible to mechanical damage and places with high stress, pipes with sufficient strength shall be used. In the following places, the cable shall have a protective tube, which has sufficient mechanical strength or install a protective cover:

- 1 Cables enter buildings, tunnels, pass through floor slabs and walls;
- 2 The part leading from the trench to the tower, equipment, the outer surface of the wall or the place where pedestrians in the house are easily accessible, the part below 2 m above ground;
- 3 There is load-bearing equipment moving over the section above the cable;
- 4 Other places that may be subject to mechanical damage.

6.3.2 There shall be no accumulated water inside the pipeline, meanwhile there shall be no blockage by sundries. When passing through the cable, the sheath must not be damaged; a non-corrosive lubricant (powder) can be used.

6.3.3 Before the cable is laid, the cable duct shall be dredged to remove the sundries. After the cable is laid in place, the cable shall be fixed and the nozzle shall be sealed; protective measures shall be taken for the contact between the nozzle and the cable.

6.3.4 The position of the cable passing through the duct and the number of cables passing through the duct shall meet the design requirements; AC single-core cables shall not be inserted into the steel tube alone.

6.3.5 In the pipe arrangement with a slope of more than 10%, components to prevent the cable from slipping due to thermal expansion and gravity shall be installed, in the working shaft at the higher end.

6.3.6 The cable nozzle in the working shaft shall be waterproofed, according to the design requirements.

6.4 Cable laying structures

6.4.1 Cable arrangement shall meet the following requirements:

- 1 Power cables and control cables should not be arranged on the same layer of holder.
- 2 High and low voltage power cables, strong current and weak current control cables shall be arranged in layers in order; they should be arranged from top to bottom. However, when high voltage cables above 35 kV are leaded into the panel, they

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