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Design specification for instrument system lightning surge protection in petrochemical industry

石油化工仪表系统防雷设计规范

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Design specification for instrument system lightning surge protection in petrochemical industry

1 Scope

This Specification specifies the design rules for lightning protection engineering of instrument systems.

This Specification is applicable to the lightning protection design of instrument systems for explosive environments and non-explosive environments in new construction, expansion and reconstruction projects of petrochemical and coal-based fuel and chemical product plants.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB 50057-2010, *Code for design protection of structures against lightning*

GB/T 18802.21, *Low-voltage surge protective devices -- Part 21: Surge protective devices connected to telecommunications and signaling networks -- Performance requirements and testing methods*

3 Terms and abbreviations

3.1 Terms

For the purposes of this document, the following terms and definitions apply.

3.1.1 air-termination system

Metal objects and metal structures used to directly receive or withstand lightning strikes, such as: lightning rods (formerly known as lightning rods), lightning strips (wires), lightning nets, etc.

3.1.2 down conductor system

Conductor connecting the air-termination system to the earth termination system.

5.2 When a building is set up with lightning protection according to Chapter 3 of GB 50057-2010, and instruments are installed inside, especially if it has outdoor signal lines, lightning surge protection engineering for instrumentation shall be implemented to prevent outdoor signal lines from introducing lightning into the room and damaging electronic equipment, endanger personal safety.

5.3 Factory areas where personnel have been injured by lightning strikes or lightning strikes that have endangered production safety shall implement lightning surge protection engineering for instrumentation.

5.4 When the regulatory authorities or owners assess that the possible economic losses caused by lightning strikes are greater than the tolerable economic losses, or the expected risks of lightning strikes are greater than the tolerable risks, lightning surge protection engineering for instrumentation shall be implemented.

5.5 When the number of lightning strikes with lightning current intensity above 130kA has occurred in the factory area ≥ 2 times/year, it is appropriate to implement lightning surge protection engineering for instrumentation. The number of lightning strikes and lightning current intensity can be determined based on data from the local meteorological department or self-measurement results.

5.6 Departments with corresponding management or supervision rights may implement lightning surge protection engineering for instrumentation in accordance with regulations without evaluation.

6 Earthing system in lightning surge protection engineering for instrumentation

6.1 Instrumentation earthing system in control room

6.1.1 The instrument earthing system in the control room shall adopt a mesh-structured earthing system, which can be used in various buildings and rooms equipped with instruments.

6.1.2 The protective earthing, working earthing, intrinsic safety earthing, shielding earthing, anti-static earthing, surge protective device earthing, etc. of the control room shall be connected to a unified mesh structure earthing system nearby. The mesh structure earthing system shall not distinguish between earthing types.

6.1.3 The mesh structure shall be in the form of multiple bonding bars connected into a grid. The bonding bar shall be arranged according to the arrangement of instrument cabinets and operating consoles, under the movable floor, in the cable trench, or in a suitable space under all cabinets and operating consoles that need to be earthed.

6.6 Earthing sign

6.6.1 The construction of various earthing wires, bonding conductors, bonding bars, etc. in the control room shall be easy to inspect and maintain. Visible signs shall be set up.

6.6.2 The connection to the bonding terminal shall be clearly marked.

7 Surge protective device

7.1 General

7.1.1 Surge protective devices shall be maintenance-free. They shall be able to withstand multiple lightning surges without being damaged.

7.1.2 Surge protective devices shall be inspected for parameters and performance on a batch-by-batch basis, and shall have an inspection certificate. The manufacturer of surge protective devices shall have simulation surge testing equipment with lightning standard test waveforms. Inspection shall be carried out by the manufacturer in accordance with GB/T 18802.21 or manufacturer's standards.

7.1.3 Units or institutions that do not have simulation surge test and inspection equipment with lightning standard test waveforms are not allowed to carry out any form or performance inspection, certification and issue certificates other than CCC certification.

7.1.4 When the instrument needs to be equipped with a surge protective device, it shall be configured according to the provisions of 7.2, 7.3, and 7.4.

7.1.5 Surge protective devices with monitoring functions can be used and corresponding centralized monitoring equipment can be configured.

7.2 Type of surge protective device

7.2.1 Commonly used surge protective devices for instruments include: signal type, DC 24V power supply type, AC or DC 220V power supply type, communication type, etc. The selection shall be determined based on factors such as protection purpose, signal type, operating voltage level, installation location, and installation method.

7.2.2 Two-wire, three-wire, four-wire 4mA ~ 20mA signal meters or other signal type meters, as well as 24V DC circuits that power a single outdoor meter shall be equipped with surge protective devices according to the signal type.

7.2.3 DC 24V power supply devices with power supply input lines with an outdoor overhead length exceeding 100 m shall be equipped with surge protective devices in

h) Other instruments that are sensitive to lightning surges or cannot withstand lightning surges.

7.4.5 Instruments that do not need surge protective devices:

a) Thermocouple;

b) Mechanical contact switches and buttons;

c) Instruments that are not electric or not related to electrical signals;

d) Other instruments capable of withstanding lightning surges.

7.5 Surge protection in AC power supply

7.5.1 The lightning protection design and surge protective device configuration of AC power supply equipment shall comply with the provisions of Articles 6.4.4~6.4.7 of GB 50057-2010.

7.5.2 For on-site AC power supply instruments that need to be equipped with surge protective devices, surge protective devices shall be equipped according to the AC power supply parameters.

8 Surge protection for instrumentation in control room

8.1 Shielding for instrumentation in control room

8.1.1 Control room instruments shall be installed in steel cabinets or metal casings. Separate components such as the door, top, bottom, and side panels of the cabinet shall be conductively connected using insulated multi-stranded copper wires with a cross-sectional area of ≥2.5 mm^2 or other effective methods.

8.1.2 The cabinet shall be equipped with a protective bonding bar connected to the cabinet body, and shall be connected to the nearest bonding bar below the cabinet.

8.2 Installation for surge protective device

8.2.1 Control room instrumentation shall be equipped with surge protective devices as specified in Chapter 7.

8.2.2 Control room instrument surge protective devices shall be installed in the cabinet.

8.2.3 After the instrument cable enters the control room, it shall be connected to a surge protective device first, and then to subsequent instruments (including fuse terminals).

8.3 Earthing and bonding for surge protective device

8.3.1 The surge protective device installed in the control room shall be installed on a metal rail. The rail shall be used as a bonding bar (trip).

8.3.2 For special surge protective devices that do not use metal rails as bonding bars (trips), a bonding bar (trip) shall be provided.

8.3.3 The surge protective device earth rail or bonding bar (trip) shall be connected to the bonding bar under the cabinet or to the protective bonding bar (trip) inside the cabinet.

9 Lightning and surge protection for field instrumentation

9.1 Lightning protection for field instrumentation

9.1.1 The instrument shall avoid being installed on the top or protruding position of outdoor equipment, platforms, buildings and other objects to become a lightning-receiving object.

9.1.2 When the installation position of the instrument may cause the instrument to form a lightning contact object and cannot be moved, the instrument shall be installed in a steel protective box or protective cover. The box or protective cover shall be earthed.

9.2 Installation for surge protective device

9.2.1 Field instruments shall use fabricated surge protective devices. For instruments where fabricated surge protective devices cannot be installed, built-in surge protective devices can be used. The parameters of the surge protective device shall comply with the provisions of 7.3. Field instruments shall use line-line protection surge protective devices.

9.2.2 The prefabricated surge protective device shall be in the form of a sealed thread and installed at the vacant line inlet of the field instrument body or the tee interface provided outside the line inlet. The external tee interface shall adopt a sealed thread installation structure.

9.2.3 The wiring of the fabricated surge protective device shall be as short as possible. No excess wire shall be left or crimped.

9.2.4 The surge protective device assembled with explosion-proof instruments shall not change the explosion-proof structure and explosion-proof performance of the instrument body. The explosion-proof surge protective device installed on the instrument inlet shall pass the national compulsory product certification (CCC

connected to protective earthing at both ends. When the cable trough is long, multiple earthing points shall be repeated, and the distance between earthing points shall be ≤30 m.

10.2.12 The inner shield of the cable shall be insulated from other conductors when connected in the junction box. Unearthed shield ends shall be insulated.

10.2.13 The metal armor layer terminal of the armored optical cable shall use an armored connector with a earth wire. A protective earth shall be connected to the optical cable terminal. The metal core and protective layer in the optical cable shall be connected to protective earthing at the terminal.

10.2.14 Metal cable ducts or protective steel pipes shall be connected to electrical bonding outdoors at the entrance to the control room.

10.3 Spare cable and spare core of cable

10.3.1 The shielding layer of the spare cable and the spare core of the cable without shielding layer shall be connected to the protective earth on the side of the control room.

10.3.2 For shielded cables whose shielding layer has been earthed, cables laid through steel pipes or laid in metal cable troughs, the spare core does not need to be earthed and shall be insulated at the cable terminals.

11 Surge protection for intrinsic safety system

11.1 Surge protective device for intrinsic safety system

11.1.1 Surge protective devices for intrinsically safe systems used in explosion-risk areas shall pass the national compulsory product certification (CCC certification) of China's nationally authorized explosion-proof certification agency and obtain a certificate (intrinsic safety certification for relevant hazardous areas). Foreign certifications that have mutual recognition with Chinese national inspection agencies shall also provide proof of relevant mutual recognition agreements when providing intrinsic safety certificates.

11.1.2 Intrinsically safe surge protective devices shall comply with the design and manufacturing standards for intrinsically safe equipment.

11.1.3 If the field instrument surge protective device and the control room end surge protective device in the same intrinsically safe line are not intrinsically safe "simple equipment", the intrinsic safety parameters of both shall be included in the engineering design calculation of the intrinsically safe line.

11.1.4 If the surge protective device is not an intrinsically safe associated instrument, a

surge protective device installed in a safe location shall not be certified as an intrinsically safe associated instrument.

11.1.5 The performance and functions of surge protective devices and safety barriers in intrinsically safe systems are different, and the two shall not replace each other.

11.1.6 The surge protective device combined with the safety barrier shall be of plug-in type, and the signal circuit shall not be interrupted after the surge protective device is pulled out.

11.2 Installation for surge protective device

11.2.1 Surge protective devices that protect indoor instruments in intrinsically safe circuits shall be installed before outdoor cables enter the control room and are connected to the safety barrier.

11.2.2 Surge protective devices and safety barriers can be installed side by side in the same cabinet or in different cabinets. When installed in the same cabinet, the guide rails shall be installed side by side as shown in Figure 6.2.1. They shall not be installed on the same rail.

11.2.3 The installation of surge protective devices for on-site intrinsically safe instruments shall comply with the provisions of 9.2.

11.3 Bonding in intrinsic safety system

11.3.1 The earth wire of the Zener barrier bonding rail shall be connected to the earth rail of the surge protective device or the working earth or protective bonding bar (trip) of the cabinet. It shall be connected to the negative pole of the DC power supply through the earth according to the earthing diagram in Figure 6.2.1. Isolated safety barriers shall not be earthed.

11.3.2 Intrinsically safe field instruments shall be earthed according to the provisions of 9.3.

12 Surge protection for fieldbus system

12.1 Surge protective device for fieldbus system

12.1.1 Fieldbus surge protective devices shall be used for lightning protection of fieldbus systems. The main parameters of the surge protective device shall comply with the provisions of 7.3.

12.1.2 Surge protective devices for fieldbus instruments and equipment shall be suitable

Design specification for instrument system lightning surge protection in petrochemical industry

1 Scope

This Specification aims to be concise and practical, clarify basic concepts, focus on operation, implementation and execution, and prepare engineering design regulations that are easy to follow. This Specification does not demonstrate or discuss the theory of electromagnetic protection, and strives to avoid involving controversial theories and methods. For unavoidable problems, only engineering methods that have been proven feasible in practice are prescribed.

This Specification is applicable to the prevention engineering of on-site instruments and control room instrument systems in petrochemical enterprises. It fills in the content and scope that are not covered and addressed by other relevant domestic standards and specifications.

The lightning protection project of the instrument system is an important disaster prevention and reduction project in the petrochemical plant. The implementation of this Specification has achieved remarkable results over the years. This revision is based on the practice and effective methods of lightning protection engineering for instrument systems in petrochemical plants in recent years, with a view to better guiding engineering design and construction and preventing, reducing and eliminating lightning accidents and losses.

3 Terms and abbreviations

This Specification only stipulates the terms and abbreviations that appear in the text. Some terms and abbreviations are universal. The statements in this Specification strive to be accurate and smooth. Some are used and defined in this Specification, which may be different from other standards, specifications and data. When applied, the definitions in this Specification shall prevail.

4 General

4.2 Every basic method adopted for instrument lightning protection is effective, and certain methods cannot be ignored one-sidedly. For example: the earthing of the instrument provides a discharge path for lightning current, but the discharge of lightning current also requires the cooperation of methods such as the installation of surge

protective devices. Shielding can only reduce the intensity of lightning surges, but cannot effectively limit the surge to the range that the instrument can withstand.

Measures such as equipotential bonding, laying of earthing wires, and reasonable wiring have been reflected in the determination of the main methods, and therefore are not specified as separate methods.

4.3 The various earths of the instrument are connected to the earth grid and finally to the earth termination system. The earth resistance complies with the relevant standards and specifications of earth termination systems and the designed earth resistance, so the instrument profession no longer proposes or requires special requirements.

4.5 Since the signal transmission of optical cables is not affected by lightning, it is recommended to use optical cables for outdoor instrument system communication networks.

5 Decision of lightning surge protection engineering for instrumentation

Some standards divide the space where the protected equipment and systems are located into different lightning protection areas from the outside to the inside to distinguish the intensity of the lightning electromagnetic field in each space and take protective measures. Different standards have different divisions of lightning protection areas, and the methods of lightning protection projects are also different. Some methods are not feasible in engineering. In view of the situation of petrochemical plants and the characteristics of instrument system lightning protection engineering, this revision inherits the effective method of the previous edition, summarizes and unifies the instrument system lightning protection engineering methods, and does not use lightning protection zones.

The degree of lightning activity is related to the design of lightning protection engineering. However, when evaluating the degree of lightning activity, only the annual average number of thunderstorm days in a region cannot accurately reflect the actual lightning strike situation. The lightning activity in the local area where the device is located, the geographical environment, and the form of buildings (structures), etc. shall be comprehensively considered. factor. In addition, the annual average thunderstorm day value cannot express the value of lightning intensity.

Some specifications stipulate different lightning protection levels and different lightning current parameters, which are used to set lightning protection measures. Due to the randomness and dispersion of lightning current in the actual lightning strike process and the uncertain factors of lightning current calculation parameters, it is difficult to determine and adopt it in engineering. Therefore, this Specification specifically stipulates lightning protection engineering methods for instrument systems

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