Postprint: Lightning Protection Technology Implementation Plan for Wireless Transmitter Rooms at Radio and Television Broadcasting Stations

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Abstract

To prevent lightning hazards to broadcast television wireless transmitter rooms and ensure normal equipment operation, Yanggu County Broadcast, Film and Television Center took proactive action and designed a lightning protection scheme for local wireless transmitter rooms based on actual conditions. This paper briefly introduces lightning hazards and intrusion pathways, elaborates on the specific conditions of wireless transmitter rooms and the lightning protection technical design scheme, and analyzes the functions and post-implementation significance of the transmitter room lightning protection technical design scheme.

Full Text

Lightning Protection Technology Implementation Plan for Radio and Television Station Wireless Transmission Station

Abstract: To prevent lightning hazards to radio and television wireless transmission stations and ensure normal equipment operation, Yanggu County Broadcast Film and Television Center has proactively developed a lightning protection plan tailored to local conditions. This paper briefly introduces lightning hazards and intrusion paths, focusing on the specific circumstances of the wireless transmission station, the lightning protection technical design scheme, and analyzes the functions and significance of the implementation.

Keywords: machine room; lightning intrusion; equipotential; grounding module; lightning protector

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1. Specific Situation and Lightning Protection Design Objectives

The wireless transmission station and transmission tower of Yanggu County Radio and Television are located on the roof of the Yanggu County Radio and Television Station office building. The station interior is divided into functional zones: signal monitoring and broadcast control area, signal transmission area, transmitter area, main power control area, and backup power control area. The lightning protection design must achieve the following objectives:

First, design effective lightning protection measures for the transmission tower. According to the national standard GB 50057-2010 *Design Code for Lightning Protection of Buildings* and the broadcasting industry standard GY/T5084-2011 *Technical Specifications for Grounding in Radio and Television Engineering*, the tower, main building reinforcement bars, and tower grounding grid must be tightly connected, with the tower equipped with compliant lightning rods. During a lightning strike, this ensures effective dissipation of current into the ground.

Second, implement comprehensive internal lightning protection for the station, including effective grounding and surge protection for the signal monitoring system, signal transmission system, power supply system, transmitters, and feedlines. This involves installing surge protective devices (SPDs), overvoltage protectors, and equipotential bonding to ensure equipment remains undamaged by lightning.

2. Lightning Intrusion Paths

Lightning can damage equipment through several distinct mechanisms:

Direct Lightning Strike occurs when lightning directly strikes buildings, structures, trees, or other objects. The combined electrical, thermal, and mechanical effects can destroy buildings and cause casualties. The electrical effects of direct strikes can subject station microelectronic equipment to surge overvoltages. According to building lightning protection design specifications, when lightning directly strikes a building, less than 50% of the energy is dissipated to ground through external lightning protection components such as down conductors, while the remaining energy is diverted through the building's power supply system, communication network cables, and other metal pipes and conductors.

Induced Lightning refers to discharges between thunderclouds or between thunderclouds and ground that induce voltages on nearby overhead lines, buried cables, metal pipelines, or similar conductive paths. These voltages are transmitted through conductors to equipment, indirectly destroying microelectronic devices. Within approximately 1000 meters (some sources indicate 500m or

1500m, with distance varying based on lightning intensity and shielding measures), lightning electromagnetic pulses (LEMP) generate induced surges of sufficient intensity on all conductors. Consequently, various power and information lines distributed inside and outside buildings can induce lightning and cause equipment damage.

Lightning Wave Intrusion occurs over larger ranges (several to tens of kilometers) when lightning strikes power or communication lines, traveling along transmission lines to invade equipment. Ground potential counterattack represents another form of lightning wave intrusion—when lightning strikes nearby buildings or other objects, ground voltage rises, creating substantial step voltage in the surrounding area. Lightning may then enter through the grounding system or between buildings.

3. Lightning Protection Design Scheme for Wireless Transmission Station

The grounding system design includes the following specifications:

(1) A lightning rod installed at the tower top, with the tower, tower grounding grid, and building's main reinforcement bars interconnected according to national standards.

(2) The grounding grid uses 40$×$4mm galvanized flat iron and grounding modules, requiring a grounding resistance $\leq 4\Omega$.

(3) Based on site conditions, excavation is performed around the green belt below the building, creating a 40cm wide, 70cm deep U-shaped trench (adjustable according to actual construction conditions) to accommodate the flat iron and grounding modules.

(4) The 40$×$4mm galvanized flat iron is laid at the trench bottom as horizontal grounding conductors, with a grounding module placed every 5 meters to increase the contact area with soil.

(5) All grid welding employs electric welding, with weld lengths being twice the width of the flat iron (minimum three-sided welding).

(6) Welding points must be solid (not hollow), with asphalt paint applied for corrosion protection after completion.

(7) A 40$×$4mm galvanized flat iron serves as the grounding lead-in conductor, routed along the building exterior into the transmission station, maintaining good electrical connection with the internal grounding busbar and securely fixed along the building.

4. Specific Internal Lightning Protection Design

The internal protection system comprises these elements:

(1) Window shielding measures and full-steel anti-static flooring (600mm$×600*mm*×$35mm, edged, slip-resistant, flame-retardant, environmentally friendly, wear-resistant, with 25cm high floor supports). Cable trays are installed beneath the raised floor.

(2) A 95mm^2 multi-strand copper cable serves as the grounding lead-in conductor, connected to the building's main reinforcement bars and routed through walls into the station, maintaining good electrical connection with the station's equipotential bonding bar.

(3) A 40$×4*mmcopperbarisinstalledalongwallsasanequipotentialbondingbar*, *connectedtothebuilding′smai*
multi-strand copper cable, maintaining proper distance from cable trays.

(4) At the main distribution cabinet, a 10/350 waveform 25G surge protector is installed as the primary power protection, with a 25mm^2 multi-strand copper grounding cable connected to the equipotential bonding bar.

(5) At sub-distribution cabinets, 80kA surge protectors are installed, with 25mm^2 multi-strand copper grounding cables connected to the equipotential bonding bar.

(6) Each of the four transmitters is equipped with a 40kA surge protector, with 16mm^2 multi-strand copper grounding cables connected to the equipotential bonding bar.

(7) For fine-level protection at power ends, six equipotential connection outlet strips are installed at ordinary power outlets throughout the station.

(8) All feeder tubes are connected to the equipotential bonding bar using 25mm^2 multi-strand copper cables, with 120kA equipotential connectors added at connection points to avoid affecting feeder signals.

(9) All equipment chassis are connected to the equipotential bonding bar using 25mm^2 multi-strand copper cables.

5. Functions of the Lightning Protection Scheme

(1) With the lightning rod installed at the tower top and the tower, tower grounding grid, and building reinforcement bars interconnected, the grounding resistance is less than 4Ω, meeting national standards [3]. The station building falls within the protection range of the lightning rod. During a lightning strike, these protection devices effectively dissipate lightning current to ground, making direct strikes unlikely.

(2) The grounding grid employs grounding modules and galvanized flat iron because each module contains built-in galvanized steel or copper strips. When connected to the protected grounding conductor, the effective contact area between the metal grounding body and soil increases substantially. Due to their strong moisture retention, hygroscopicity, and stable conductivity, grounding modules significantly reduce contact resistance

between the metal grounding body and soil, thereby achieving more pronounced resistance reduction.

6. Conclusion

Following implementation of this lightning protection design for Yanggu County Radio and Television wireless transmission station, the system can effectively protect equipment and personnel safety during lightning events, preventing lightning-related accidents. This saves financial resources while ensuring normal broadcast signal transmission, timely dissemination of higher-level directives to rural grassroots levels, and maximum satisfaction of the public's growing spiritual and cultural needs.

References

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[3] Ministry of Construction. *Design Code for Lightning Protection of Buildings.*

Note: Figure translations are in progress. See original paper for figures.