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Analysis of Medium Wave Broadcast Transmission Technology and Lightning Protection Technology (Postprint)

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Abstract

Propelled by economic and technological advancements, the radio and television industry has undergone rapid development. Medium wave broadcasting serves as a critical channel for public leisure and entertainment, playing a vital role in promoting social harmony and enhancing public well-being. This paper analyzes medium wave broadcasting transmission and lightning protection technologies, beginning with an overview of relevant transmission technologies, followed by an examination of lightning protection measures and their significance, aiming to contribute to the advancement of broadcasting technology and the safeguarding of public leisure and entertainment.

Full Text

Analysis of Medium-Wave Broadcast Transmission Technology and Lightning Protection Technology

Abstract: Driven by economic and technological advancements, the broadcasting industry has developed rapidly. Medium-wave broadcasting serves as a crucial means for public entertainment and leisure, playing a vital role in promoting social harmony and enhancing public well-being. This paper analyzes medium-wave broadcast transmission and lightning protection technologies, first providing an overview of relevant transmission technologies before examining lightning protection measures and their significance, with the aim of contributing to the advancement of broadcast technology and safeguarding public entertainment.

Keywords: Medium-wave broadcast transmission; Lightning protection technology; Principle; Measures

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Medium-wave broadcast technology, as a key communication technology, primarily relies on ground wave diffraction and ionospheric reflection for transmission, offering low cost and high accessibility. With continuous technological advancement, this technology has developed substantially, with traditional electron tube transmitters gradually being marginalized and replaced by solid-state transmission facilities. These facilities utilize digital modulation technology for audio transmission, providing superior efficiency and modulation quality. The following sections present an in-depth analysis of medium-wave broadcast transmission and lightning protection technologies.

1.1 Working Principle

Currently, medium-wave broadcasting requires full solid-state transmission equipment as its foundation, necessitating thorough understanding of transmission principles and operational mechanisms. Generally, such equipment delivers ideal operational performance and transmission accuracy, with minor faults not affecting signal transmission. The working principle is examined below from a system architecture perspective.

1.1.1 Power Supply For medium-wave broadcast transmission facilities, the power supply system encompasses both high-voltage and low-voltage transformer equipment to provide comprehensive power delivery, ensuring efficient equipment operation. Specifically, devices such as RF amplifiers and power combiners require high-voltage supply, while other electrical needs are met through low-voltage transformation.

1.1.2 RF Power The RF power stage must accomplish tasks including power synthesis transmission and digital amplitude modulation. According to the operational sequence, an oscillator first generates the RF signal, which then undergoes amplification and power amplifier activation, followed by further RF amplification. Filtering equipment enables digital control, thereby achieving signal transmission.

1.1.3 Audio Processing This stage involves efficient monitoring and regulation of RF phase conditions, with real-time correction of deviations. The monitoring component typically comprises switches, ports, display screens, and other devices.

1.2.1 Cycle Adjustment

Cycle adjustment is primarily applied at the power amplifier level, following predetermined procedures to utilize thermal loads for modulation, thereby enhanc-

ing operational quality while reducing associated loads and effectively extending equipment lifespan. Through cycle adjustment, medium-wave broadcasting can efficiently monitor the power amplifier section. When abnormalities or failures occur in the power amplifier module, the system can immediately detect and shut down the affected equipment. Additionally, backup power amplifier devices are activated to address situations such as reduced operational quality.

1.2.2 Direct Digital Frequency Synthesis Technology

Frequency synthesis is widely applied in medium-wave broadcasting. This technology employs temperature-compensated crystal oscillator reference frequencies for frequency multiplication processing, with signals requiring only multiplication and digital synthesis before transmission. Technicians can preset frequency values via external DIP switches and transmit corresponding frequency characters to DDS circuits, which then generate the appropriate frequency signals.

1.2.3 Microcomputer Intelligent Control

Medium-wave broadcasting has advanced rapidly due to computer processing technology, particularly in modular applications that have greatly promoted intelligent transmission control. This technology utilizes single-chip processing elements to control circuits, effectively achieving intelligent management of transmission equipment. Furthermore, LCD touch-screen control systems have become widely adopted, enabling intelligent testing, control, and maintenance. Operators can monitor facility dynamics in real-time.

2. The Significance of Enhanced Lightning Protection for Medium-Wave Broadcast Transmission

Currently, implementing lightning protection technology from the perspective of medium-wave broadcast transmission stations is crucial for promoting broadcasting development and cultural construction. Natural lightning exhibits strong destructive power and suddenness, posing threats to buildings, equipment, and personnel. If broadcast equipment suffers lightning strikes, minor effects may cause stagnation or malfunction, while severe impacts can lead to high temperatures, combustion, or explosion. Therefore, strengthening lightning protection for medium-wave broadcast transmission is essential for ensuring stable broadcast operations. Simultaneously, advancing lightning protection represents an important pathway for broadcasting development and cultural construction foundation, demonstrating significant social and cultural value.

3.1 Lightning Protection from the Power Supply Perspective

For medium-wave broadcast transmission, the power switch serves as the fundamental operational component across all equipment stages, playing a critical role while also being susceptible to lightning-induced faults. Therefore, technicians

must implement lightning protection designs at the power supply level. The primary principle of these measures is to “enhance power load capacity,” ensuring transformer capability can accommodate voltage surges associated with lightning events. Specifically, technicians should follow relevant lightning protection regulations by installing high-frequency inductance coils at the high-voltage terminal. Additionally, to balance loads between high- and low-voltage ends, three-phase surge arresters should be installed at the low-voltage distribution panel—such as the Zhongguang ZGB surge protector—to effectively buffer and discharge high-voltage loads while protecting low-voltage equipment components. Of course, no technology is a “permanent solution,” so to ensure real-time stability of power switch protection, technicians must prioritize lightning protection equipment maintenance and line grounding in routine inspection protocols to prevent lightning incidents. Furthermore, technicians should implement proactive lightning weather forecasting, analyzing not only direct strikes but also considering induced lightning and ball lightning to ensure flexible response and adaptation during multi-lightning scenarios, thereby providing external protection for power switches.

3.2 Lightning Protection from the Antenna Perspective

In the overall architecture of medium-wave broadcasting, antennas for transmission and reception functions are particularly vulnerable to lightning strikes. Relevant data indicates that when antenna equipment is struck, currents can reach 1kA, instantly raising equipment potential to 5kV. Without adequate lightning protection, high-voltage currents can penetrate the transmission station through the antenna medium, damaging internal equipment and causing not only broadcast interruption but also significant financial losses. Therefore, technicians must implement antenna-level lightning protection. First, when grounding antennas, technical processes should be modified by adding copper wires or lightning rods to enhance the antenna’s capacity to withstand instantaneous currents, thereby protecting effective signal transmission. Second, lightning voltage must be controlled by paying attention to the ground communication network and minimizing grid resistance to provide a more reliable circuit system for broadcast transmission. For instance, when installing grounding networks for antenna towers, technicians should plan burial and configuration based on local conditions. While lightning protection is crucial, the broadcast station also represents a key broadcasting technology component, so grounding network installation must maintain high standards. Burial depth should not be excessive, and shared installation configurations are typically employed for grounding.

3.3 Lightning Protection from the Wireless Antenna Tuning Network Perspective

When implementing lightning protection from the wireless antenna tuning network perspective, technicians should first focus on the parameters of

DC-blocking capacitors. Generally, higher transmission output requires higher power capacity in the corresponding DC-blocking capacitors, and vice versa. Second, graphite discharge spheres can be installed at appropriate locations to enhance the lightning protection capability of the tuning network. Graphite's favorable discharge properties enable instantaneous discharge when the network experiences lightning strikes, achieving the desired protective effect. However, practical application requires attention to the inverse relationship between sphere area and voltage discharge capacity; technicians must adjust sphere volume and gap spacing based on actual medium-wave transmission station conditions, typically maintaining a gap of approximately 1cm. The high-frequency grounding protection for the antenna tuning room essentially provides a suitable high-frequency ground potential for the broadcast station, minimizing interference between towers and transmitters while effectively enhancing their lightning protection independence.

3.4 Lightning Protection from the Main Equipment Perspective

Technicians should actively promote the development of dynamic, intelligent lightning warning and monitoring systems by deploying remote monitoring facilities at multiple points around the transmission station and connecting them to a central monitoring host, enabling real-time surveillance of all equipment operation stages. Additionally, the system should incorporate warning and intelligent scheduling modules that can immediately activate equipment shutdown or startup sequences when lightning disasters occur, thereby preventing lightning-induced faults. Since main equipment exhibits strong interconnection and systematic integration, damage to one component from lightning can threaten surrounding components. Therefore, technicians should adopt lightning protection concepts from other building systems, adhering to principles of "differentiation" and "targeted design" to create internal architectures that ensure the lightning protection network aligns with both the main equipment and its environment, thereby enhancing the station's lightning protection performance.

Conclusion

In conclusion, broadcast organizations driving innovation from the perspectives of medium-wave broadcast technology and lightning protection technology represent an important pathway for advancing broadcasting development and cultural construction. This paper has analyzed the principles of medium-wave broadcast technology and proposed improvements to lightning protection technology from the perspectives of power switches, antenna equipment, antenna tuning networks, and main equipment, aiming to contribute to enhanced broadcast transmission performance and equipment safety.

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