Analysis of Inter-Antenna Mutual Crosstalk Problems and Countermeasures: Postprint

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Abstract

The signal transmission quality of radio broadcast antennas is influenced by the antenna feedline system. As is well known, the antenna feedline system primarily consists of the main feedline, the antenna, and additionally, a power divider. The broadcast transmitter emits signals that, after transmission through the feedline system, are converted into outwardly radiated electromagnetic waves—this constitutes the principle of signal reception for television and broadcast programs. Consequently, the emergence of mutual crosstalk between antennas will impact signal transmission quality. Personnel should emphasize the issue of antenna-to-antenna crosstalk, ensuring rational design and installation of the antenna feedline system to prevent such occurrences. In practice, control over antenna installation, testing, and maintenance should be strengthened to avoid crosstalk. This paper, based on an investigation of existing problems in antenna feedline systems, introduces methods for feedline system installation and testing, aiming to contribute to the quality of television program signal reception and the development of the television industry.

Full Text

Abstract

The signal transmission quality of broadcast antennas is significantly influenced by the antenna feedline system. As is well known, the primary components of an antenna feedline system include the main feedline, the antenna itself, and power dividers. Broadcast transmitters emit signals that are transmitted through the feedline system and converted into radiated electromagnetic waves, which form the basis for television and radio signal reception. Consequently, any occurrence of mutual crosstalk between antennas directly impacts signal transmission quality. Technicians must pay close attention to antenna crosstalk issues and ensure rational design and installation of antenna feedline systems to prevent such interference. In practice, installation, testing, and maintenance of

antennas should be strictly controlled to avoid crosstalk. This paper examines problems in antenna feedline systems and describes methods for installation and testing, aiming to improve television signal reception quality and contribute to the development of the broadcast industry.

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1. Problems in Antenna Feedline Systems

The antenna feedline system is susceptible to water seepage, which accelerates aging and degrades performance. The primary causes of these problems stem from installation environmental factors. Antenna feedline systems are typically installed at high elevations on tower tops, where they endure continuous exposure to harsh natural conditions including intense sunlight, rain, and extreme temperatures. Such adverse environments reduce antenna service life and increase maintenance difficulty. In colder regions such as Northeast China, for instance, frost damage frequently causes persistent line faults and severe damage during winter inspections. These weather-related challenges complicate repair operations and significantly degrade signal reception quality. When technicians identify feedline system failures, they must promptly diagnose whether the issue involves antenna crosstalk or line damage and perform targeted repairs or replacements.

2. Installation, Debugging, and Testing of Antenna Feedline Systems

2.1 Preparatory Work

Before installing the antenna feedline system, thorough preparatory work is essential. Technicians must inspect antenna packaging and internal wiring for any damage or missing components. If defects are found, they must be rectified immediately to prevent recurrence. Comprehensive inspection is a critical step in preventing antenna crosstalk, as it can identify short circuits and other issues before they escalate. Only through meticulous pre-installation checks can future repetitive repairs be avoided, hazardous work reduced, and antenna performance improved. Multimeters are indispensable tools for quality inspection, enabling detection of short circuits, while proper fixation and sealing tools are equally important. When moisture or water ingress is detected at connection terminals, sealant must be applied immediately to prevent safety incidents and

ensure antenna quality. As waterproofing capabilities directly determine antenna longevity, selecting materials with excellent waterproof sealing properties is crucial. Commonly used waterproof sealing materials include silicone, glass glue, and waterproof tape, which prevent chemical reactions caused by water ingress that would otherwise increase resistance and degrade performance.

2.2 Antenna Installation

Antenna installation typically requires technicians to perform high-altitude work from cranes at tower tops. Throughout this process, installers must strictly follow predetermined procedures. The first step involves securing the antenna mounting bracket in a steel channel, followed by cable connection and smooth bracket advancement. The most critical step is cable fixation, performed from top to bottom using stainless steel clips. When installing air-dielectric coaxial cables, pre-inflation is necessary to maintain dryness and prevent efficiency loss due to moisture. During installation, dipole elements and cable connectors must always face downward. In adverse weather conditions, particularly during humid or rainy periods, technicians can use protective canopies to safeguard both personnel and equipment. Canopies prevent water ingress into tools and cable boxes, reduce lightning strike probability at high altitudes, and ultimately ensure operational safety and performance.

2.3 Debugging and Testing

After complete installation, the antenna feedline system must undergo comprehensive testing and quality verification before commissioning. Sweep frequency analyzers are commonly used to measure the voltage standing wave ratio (VSWR), a key parameter for evaluating whether components can operate cooperatively. When antennas experience mutual crosstalk, impedance mismatches occur in the feedline system, causing high-frequency electromagnetic wave reflection and resulting in standing waves. VSWR effectively indicates whether crosstalk exists and whether the feedline system is functioning normally or has suffered damage. Due to internal and external aging factors, the VSWR of antenna feedline systems gradually increases over time, rendering the antenna transmitter unusable when VSWR reaches approximately 1.5. Therefore, crosstalk can be identified through VSWR testing of the antenna feedline system.

External factors also significantly affect VSWR. Water ingress causing chemical reactions and excessive resistance will elevate VSWR. When broadcasting at high power levels, closely spaced transmission systems cannot adequately mitigate high-power effects through inter-network mutual inductance. Extensive testing demonstrates that transmitters may fail to operate normally in high-frequency mutual inductance networks, necessitating the addition of series resonance to reduce negative crosstalk impacts. Adding resistance alleviates antenna bandwidth constraints and reduces crosstalk effects. Process improvements primarily introduce double-loop networks, which enhance signal transmission while

suppressing mutual antenna crosstalk, ensuring reliable signal propagation in confined spaces and improving feedline system stability.

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3. Solutions for Antenna Crosstalk

3.1 Regular Inspection and Maintenance

Regular inspection and maintenance of antenna feedline systems rely primarily on VSWR testing to identify specific problems. Targeted repairs of faulty components can effectively extend overall system lifespan. Safety hazards discovered during routine maintenance must be eliminated to ensure normal electromagnetic wave transmission and uninterrupted broadcast programming. Weather conditions substantially impact antenna performance, particularly during humid or rainy seasons, when more frequent inspections are required. Special attention must be paid to moisture sealing of cable connectors and plugs. Any oxidation must be cleaned promptly, while water-damaged lines and systems require immediate replacement and resealing to maintain dryness and ensure normal operation.

3.2 Detection and Improvement of Soldering Issues

Many internal components in antenna feedline systems require soldering, and desoldering can cause serious consequences. The traditional yet efficient lug lead soldering method can ensure normal feedline system operation. Inspections frequently reveal desoldering caused by moisture or chemical reactions, and timely resoldering of these joints effectively resolves such faults.

3.3 Process Improvements Based on Local Conditions

Different regions face varying weather impacts, with humid and rainy climates posing the greatest threat to antenna feedline systems. In southern China, where temperatures are high and rainy seasons are prolonged, humid air causes extensive desoldering and connector oxidation. For example, at a site in the mountainous area of Guilin, Guangxi, three newly installed antenna systems experienced connector oxidation and breakage during normal operation due to heavy rainfall, causing signal transmission failures and direct interruption of local television programming. After inspection and repair, technicians implemented the following adjustments: loosening internal feedline connectors to reduce cable tension and adjusting the tightness between connectors and cables. These targeted process improvements gradually reduced system failures and improved mutual antenna crosstalk in that region.

3.4 Addressing Internal Safety Hazards

Due to site constraints, antenna feedline systems often operate with closely spaced signals, typically high-frequency electromagnetic waves requiring high

power for normal program reception. Consequently, antenna crosstalk significantly impacts the feedline system, as high-power signals increase the likelihood of transmitter malfunction. This necessitates enhanced signal conversion capabilities in the antenna feedline system. To reduce high-power signal transmission, transmission efficiency must be improved through system modifications. The primary improvement involves changing antenna terminal circuits from parallel to series configuration. Extensive calculations demonstrate that reducing antenna terminal current decreases power consumption. Adding capacitors to the circuit effectively reduces current flow, minimizing power loss in long-term operation and improving circuit tolerance. Increased coupling capacitance enhances circuit compatibility.

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4. Conclusion

This paper has analyzed mutual antenna crosstalk problems and discussed various factors affecting signal transmission quality. It is hoped that technicians will pay greater attention to antenna crosstalk issues and ensure rational design and installation of antenna feedline systems to prevent interference. After examining problems in antenna feedline systems, this paper proposed installation, debugging, and testing methods, followed by solutions for mutual antenna crosstalk. When studying these issues, we must recognize that achieving high-quality electromagnetic wave transmission requires technicians to improve their work efficiency and technical proficiency throughout the entire safety management process. Strict control of every step from installation onward is essential for prevention. Enhanced coordination among personnel is also critical during operations, as high-altitude tower work involves certain risks. Only through effective teamwork can personnel safety be ensured while resolving antenna crosstalk issues and reducing repetitive future repairs. It is hoped that these recommendations will contribute to solving practical antenna crosstalk problems.

References

[1] Jiang Zhaojie. Television transmitting antenna system maintenance and common fault troubleshooting[J]. Home Appliance Maintenance Technology, 2014.

[2] Lei Yulin, Zhang Yonghong. Design and research of dual-loop television transmitting antenna[J]. Communications Technology, 2015.

[3] Pan Yifang. Experience in television transmitting antenna maintenance and debugging[J]. Henan Science and Technology, 2015.

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