

On the Maintenance and Management of Radio and Television Signal Transmission Systems: Postprint

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Abstract

Television program production itself entails substantial manpower and material resources, while high-quality signal transmission lines constitute a critical condition for ensuring the stable and complete presentation of television programs to audiences. Consequently, the daily maintenance and management of radio and television signal traditional systems hold significant practical importance. This article primarily proceeds by analyzing the characteristics of radio and television signal transmission system maintenance and management, and proposes measures to enhance and strengthen signal transmission system maintenance and management from both technical and managerial perspectives.

Full Text

On the Maintenance and Management of Broadcast Television Signal Transmission Systems

Abstract: Television program production requires substantial human and material resources, and high-quality signal transmission lines are essential for ensuring stable and complete presentation of television programs to audiences. Therefore, the daily maintenance and management of broadcast television signal transmission systems hold significant practical importance. This article analyzes the characteristics of maintenance management for broadcast television signal transmission systems and proposes measures to strengthen system maintenance management from both technical and managerial perspectives.

Keywords: broadcast television; signal transmission system; maintenance management

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With the development of electronic and information technologies, the performance of broadcast television signal transmission systems continues to improve. However, enhancing maintenance and management technical capabilities in daily operations remains essential to fully ensure transmission stability. Maintenance management requires comprehensive repair plans to guide inspection work and guarantee signal transmission security.

1.1 Broadcast Television Signal Transmission Methods

Current broadcast television signal transmission methods include satellite transmission and fiber optic cable transmission, with satellite transmission being the mainstream approach that already covers the entire nation. Satellite transmission systems consist of three components: ground receiving stations, satellite transponders, and uplink transmitting stations. In operation, the program production center sends program signals to the uplink transmitter, which processes, modulates, and up-converts the signals before high-power amplification and antenna transmission to the satellite. The ground uplink station transmits signals to the satellite transponder, which amplifies and frequency-converts the signals before retransmitting them to the ground service area. The satellite sends signals to ground receivers, which process them for direct delivery to monitors or television sets and finally to users. Fiber optic transmission primarily uses light waves as carriers, with optical cables as the transmission medium. Fiber optic transmission systems comprise three parts: optical transmission, optical propagation, and optical reception. Television signals input into the optical transmitter are converted into optical signals, which the optical cable transmits to the optical receiver for conversion back into electrical signals. After further processing, these become television signals.

When broadcast television signal transmission systems fail, promptly identifying fault points for repair is crucial for improving maintenance efficiency. Therefore, reasonable troubleshooting methods must be applied. Common fault handling methods include loopback testing, replacement, and instrument testing. Loopback testing refers to internal equipment self-looping, primarily used to detect line circulation status, repair internal system equipment, and eliminate faults. This method is typically applied to circuit boards, branch boards, and peripheral devices. Replacement involves substituting suspected faulty components in the system and observing whether system performance improves to determine the fault cause. This approach is commonly used for cables, equipment, boards, and chip-level repairs. Instrument testing employs various detection instruments for fault diagnosis, analyzing measurement data and comparing it with normal operating parameters to identify anomalies. Commonly used instruments include multimeters, error detectors, and OTDR. In practice, maintenance management must comprehensively consider comprehensive indicators such as transmission system signals, digital parameters, and power metrics to quickly determine fault

causes and formulate effective, applicable solutions based on actual conditions.

2.2 Maintenance Management of Key Equipment

First, monitor antenna connection status. Monitoring equipment must have high precision and stability to ensure antennas maintain normal connection states. Second, regularly inspect the installation of related equipment and devices to ensure reliable connections among all components and electronic elements. Any abnormal parts must be promptly addressed to improve overall system transmission smoothness. When assembling broadcast television antenna masts and adjustment plates, ensure equipment precision and stable operating performance to enhance signal transmission reliability. Second, monitor equipment tower operating status. To some extent, equipment towers directly affect broadcast television signal transmission. Compared with other equipment, towers operate in exposed outdoor environments with harsh conditions where weather factors significantly impact stability. Therefore, towers require regular inspection, with particular attention to weather forecasts during extreme weather conditions to implement preventive measures in advance. If towers sustain damage, reinforcement measures must be taken promptly. Additionally, timely remedial action must be taken for surface deformation and corrosion issues. Finally, maintain and manage feedlines. Feedline maintenance requires careful observation of connection status between feedline interfaces and transmitters to ensure effective and reliable connections. Feedline interfaces are prone to ignition phenomena, requiring preventive measures. Monitor the positional status of feedline interfaces for looseness, and promptly address any abnormalities to ensure secure connections. Furthermore, ensure reliable connection of corresponding cables to feedlines to improve overall equipment performance.

2.3 Enhancing Channel Anti-Interference Performance and Ensuring Signal Transmission Security

The equipment within signal transmission systems itself reduces channel anti-interference capability, particularly during initial signal transmission where signal strength decreases with distance. Therefore, improving channel anti-interference capability is necessary to ensure transmission quality. Even with fiber optic transmission, signals remain subject to various interferences that degrade transmission quality during propagation. Thus, enhancing channel anti-interference capability and optimizing signal transmission quality is essential. Within reasonable limits, increase the number of signal base stations to strengthen signals during transmission. When applying channel transmission, utilize high-frequency and high-voltage transmitters as much as possible to ensure transmission distance, combined with base station relay to significantly improve signal anti-interference capability and transmission effectiveness. Additionally, employ diversified safeguard measures to enhance signal transmission security. Broadcast television signal transmission requires high security, yet the phenomenon of multiple signal receiving endpoints is

common in practice. Therefore, encrypting signals before transmission is necessary to prevent interference, ensure transmission security, and improve transmission quality.

3. Institutional Key Points for Maintenance Management of Broadcast Television Signal Transmission Systems

Beyond high-level technical measures, effective institutional management is crucial for ensuring the stability and reliability of broadcast television signal transmission systems. Therefore, we recommend improving management systems from the following aspects.

3.1 Establishing a Sound Quality Management Responsibility System

Broadcast television signal transmission system maintenance management is highly professional and demands high safety standards. Problems can lead to severe consequences, making comprehensive implementation of management responsibility systems essential in daily operations. Subdivide maintenance and inspection processes, delegate management responsibilities to individuals, and clarify job responsibilities. Under clear accountability, management gray areas can be effectively avoided. Constrained by management responsibility systems, individuals will enhance their sense of responsibility to improve work efficiency. Additionally, improve corresponding incentive mechanisms by incorporating management performance into salary and benefits systems. Apply material and spiritual rewards to motivate employees to proactively upgrade their skills and fulfill job responsibilities. Naturally, departments and individuals with high accident rates that affect overall system operation must face corresponding penalties to spur positive progress and enhance work responsibility.

3.2 Establishing an Inspection System

To reduce broadcast television signal transmission system failure rates, a sound and comprehensive inspection system is necessary to ensure preventive effectiveness. On one hand, broadcast enterprises must strengthen daily inspections, meticulously record operating conditions of all system equipment, and organize weekly departmental safety transmission meetings to summarize and evaluate system operation, analyze failure causes, and develop improvement strategies. Maintenance personnel must enhance their professional capabilities to fully understand signal transmission processes, enabling timely and effective solutions during emergencies. Before major program broadcasts, conduct comprehensive inspections of transmission equipment to avoid transmission failures during program airing. On the other hand, focus on controlling high-failure-rate system components, meticulously documenting each failure's cause, resolution method, and outcome to accumulate rich fault analysis experience and reduce failure incidence. If overall equipment adjustment or line modification is required,

maintain detailed records. During maintenance and inspection, ensure transmission equipment remains in normal operating condition. Naturally, both routine inspections and key monitoring require standardized workflows to ensure inspection management effectiveness.

3.3 Strengthening Professional Training for Maintenance Management Personnel

Broadcast television signal transmission systems contain numerous precise and complex devices. Maintenance management personnel must possess excellent professional qualities to ensure effective equipment maintenance. Therefore, strengthen education and training for equipment maintenance management personnel, covering multiple specialties including automation, electronic circuits, mechatronics, and information technology related to signal transmission system operation. On one hand, enterprises should raise technical personnel recruitment thresholds, focusing on professional competence assessment during hiring. On the other hand, conduct regular training and education for employees after hiring, encouraging technical personnel to learn advanced technical knowledge. Since equipment maintenance requires care and patience, in addition to professional knowledge training, strengthen professional ethics training to maintain staff responsibility and conscientiousness. This not only helps improve signal transmission quality and stability but also benefits employee personal safety.

In summary, broadcast television signal transmission systems demonstrate strong professional and confidential characteristics. In daily maintenance management, understanding transmission methods, grasping maintenance management characteristics and inspection key points, and achieving organic integration of technology and institutions are essential to ensure the safety, preventive nature, and comprehensiveness of signal transmission system maintenance management, thereby providing audiences with high-quality and stable signal transmission services.

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