Preventive Maintenance of Shortwave Broadcasting Transmission Systems (Postprint)

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Abstract

To ensure the stability and security of broadcast signal transmission at our station, practical and feasible preventive maintenance measures must be implemented to optimize the signal quality of shortwave broadcast transmission systems. Generally, the internal structure of shortwave broadcast transmission systems is relatively complex, and their actual operation is easily constrained by various factors, leading to operational failures. To address this issue, this article, from the perspective of broadcast and television technicians, elaborates on the internal structure and operating principles of shortwave broadcast transmission systems, identifies the current types of failures in these systems, and proposes specific preventive maintenance strategies for reference.

Full Text

Preventive Maintenance of Shortwave Broadcast Transmission Systems

Abstract: To ensure the stability and security of broadcast signal transmission in our station, practical preventive maintenance measures must be implemented to optimize the signal quality of shortwave broadcast transmission systems. Generally speaking, the internal structure of shortwave broadcast transmission systems is relatively complex, and actual operation is easily constrained by various factors, leading to operational failures. From the perspective of broadcast technicians, this paper elaborates on the internal structure and application principles of shortwave broadcast transmission systems, identifies current fault types in these systems, and proposes specific preventive maintenance countermeasures for reference.

Keywords: shortwave broadcast; transmission system; internal structure; preventive

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To some extent, shortwave broadcasting offers advantages such as long transmission distances and wide coverage, with excellent received signal quality. Based on these advantages, the application and propagation scope of shortwave broadcasting has been further expanded. Drawing from my work experience, the most significant difference between shortwave broadcast transmission systems and other transmission systems lies in their ability to meet long-distance signal transmission requirements, addressing the shortcomings of traditional systems that could not transmit or receive signals over long distances. This capability holds certain practical significance. However, considering the development situation of our station, we currently have three 10-kilowatt shortwave electronic tube transmitters, which are older models. Under prolonged operation, these shortwave electronic tube machines exhibit numerous hidden problems that require urgent resolution.

1.2 Internal Structure

The shortwave broadcast transmission system primarily consists of a transmission system and an antenna system. The transmission system, also known as the feedline system, typically employs overhead balanced configurations during operation to ensure signal transmission quality and safety. Based on past experience, overhead balanced configurations show significant variations in implementation, such as two-wire configurations, representing part of the feedline system within shortwave broadcast transmission systems. To further ensure signal transmission quality, our station has configured two of the 10-kilowatt transmitters to use double-cage type feedlines. In this configuration, the emitted radio waves are transmitted and delivered through the antenna to complete the signal transmission task, which can be considered the primary operational function of the shortwave broadcast transmission system [2].

1.1 Working Principle

Shortwave broadcast transmission systems must operate within a specific frequency range, utilizing the transmission characteristics of radio waves and relying on ionospheric reflection for long-distance signal transmission. We can regard this process as the working principle of shortwave broadcast transmission systems. When the transmission system operates in this mode, the signal transmission distance in the ionosphere becomes much greater than before, and the wave attenuation also increases significantly. Under these circumstances, certain channels in shortwave broadcast transmission systems may be affected and unable to operate normally [1]. To address this, we typically implement

the following measures based on the working principle of shortwave broadcast transmission systems.

First, increase the actual power of the transmitter in the shortwave broadcast system to ensure the quality safety and transmission continuity of long-distance radio signal transmission. Second, enhance the gain effect of the antenna internal system using reliable calculation methods to provide solid guarantees for normal signal transmission. To some extent, this method can effectively solve previous problems of poor signal transmission quality. Third, select safe and high-performance transmission equipment to increase field strength within the system service area, preventing signal interference from other regional field strengths during actual transmission and maintaining normal system operation. Finally, certain important components of the shortwave broadcast transmission system require regular inspection, such as system monitoring. Any damaged components must be replaced promptly.

2. Common Fault Types in Shortwave Broadcast Transmission Systems

The internal structure of shortwave broadcast transmission systems is relatively complex, and the large volume of internal system antennas makes it easy for operational hazards to emerge during system operation. When the system operates normally, the path distance that feedline transmission signals travel is often much longer than in other operational systems. Combined with the heavy workload the system must bear, this substantially increases the actual maintenance difficulty. Therefore, technicians must promptly identify common fault types in shortwave broadcast transmission systems and implement targeted maintenance measures to fundamentally ensure safe and reasonable system operation.

Common fault types in shortwave broadcast transmission systems mainly include the following: First, feedline arcing during system operation. Generally, the primary cause of this problem lies in discrepancies between the actual dimensions of the feedline and standard specifications, causing subtle changes in the system's impedance characteristics. As these impedance characteristics continue to change, the current passing through the feedline increases significantly, eventually leading to electrical arcing when reaching a certain threshold. Second, reflector net arcing during system operation. When the antenna precision in operating systems deviates significantly from specified values, it can trigger reflector net arcing, threatening normal system operation [3].

3. Preventive Maintenance Countermeasures for Shortwave Broadcast Transmission Systems

As mentioned above, shortwave broadcast transmission systems involve high construction costs and are extremely prone to operational failures that cannot be repaired in a timely manner or are limited by funding constraints. To address this, technicians must implement preventive maintenance for shortwave

broadcast transmission systems to improve the current situation. The following are relevant countermeasures I propose based on my work experience to optimize preventive maintenance of shortwave broadcast transmission systems for reference.

3.1 Implement Daily Inspection Routines Inspection routines refer to technicians following relevant inspection requirements to gain a general understanding of shortwave broadcast transmission system operation and conducting comprehensive examinations based on system performance to promptly identify hidden hazards. Drawing from past experience, they can develop practical and feasible fault elimination solutions. Notably, external factors cause high interference to shortwave broadcast transmission systems, requiring staff to regularly inspect system operation, especially intensifying inspection efforts under adverse environmental conditions.

Additionally, during inspection rounds, staff must maintain relevant records, such as whether potential operational failure hazards exist, to fundamentally strengthen operational safety of shortwave broadcast transmission systems. Through rational arrangement of daily inspection routines, previous system failure problems can be avoided to achieve system optimization objectives.

3.2 Implement Monthly System Inspections Based on past operational observations, we can easily see that shortwave broadcast transmission systems exhibit significantly different operational states across different seasons, with certain variations in working conditions. Consequently, this causes varying degrees of change in system signal transmission quality. For this reason, I recommend that staff implement targeted inspection plans in different seasons, adjusting core circuits such as feedlines and down-leads according to the system's operational state to avoid system failures.

For example, when insulators in the internal system structure become covered with dust, technicians must attach great importance to promptly cleaning the dust from insulator surfaces and checking whether related equipment in the system remains unaffected and in safe operation. It should be noted that shortwave broadcast transmission systems require feedline support for normal operation. Therefore, porcelain cross-arms can be appropriately installed when optimizing system design to ensure feedline operation rationality and safety. I believe that accomplishing these points can substantially reduce monthly inspection workload [5].

3.3 Implement Annual System Inspections Implementing annual inspections holds important practical significance for shortwave transmission systems. To a certain extent, conducting necessary annual inspections on shortwave broadcast transmission systems can essentially ensure the quality of all system components. To achieve these requirements, technicians must perform performance evaluations of all components within the system during annual

inspections and maintain complete records of specific evaluation results. Annual inspection content for shortwave broadcast transmission systems mainly includes the following aspects.

First, focus on detecting whether antenna vibrator tension and antenna curtain vertical height meet specified standards and whether vertical height deviations exist. Any deviations must be promptly adjusted to reasonable ranges to avoid affecting signal transmission quality.

Second, perform necessary tension adjustments on main lines connected to the transmission system to ensure guy wire tension meets expected requirements, guaranteeing signal transmission quality and efficiency. For lines with insufficient tension, workers must tighten them to ensure line tension rationality and safety.

Third, to strengthen the preventive effects of maintenance measures, technicians can develop practical and reasonable adjustment plans based on local weather conditions and establish specific detailed and maintenance content. The goal is to address current deficiencies in shortwave broadcast transmission systems and eliminate hidden hazards [6].

In summary, constructing shortwave broadcast systems requires full consideration of various factors to ensure safe and stable system operation. Objectively speaking, shortwave broadcast systems involve high actual construction costs and subsequent maintenance difficulties, undoubtedly increasing workload for technicians. Meanwhile, shortwave broadcast transmission systems are also relatively susceptible to certain factors during operation, such as environmental conditions, reducing system operation safety. Therefore, while strengthening preventive maintenance efforts, technicians must also seek new development models, such as all-solid-state machines, which can effectively circumvent existing deficiencies in shortwave broadcast transmission systems.

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