

Standardized Planning and Construction of Broadcasting High-altitude Wireless Transmission Stations Postprint

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Abstract

High-altitude radio and television wireless transmission stations play an important role in broadcasting, undertaking transmission tasks for terrestrial digital television, frequency modulation broadcasting, CMMB transmission, and programs from central, provincial, and municipal radio and television stations. Therefore, implementing standardized planning and construction for these stations is essential to ensure their safe and normal operation in complex and variable environments. This paper focuses on the core content of standardized planning and construction of high-altitude radio and television wireless transmission stations, analyzing their current status, exploring the importance of standardized construction, and discussing implementation methods and measures, with the aim of enabling these stations to achieve standardized planning and construction.

Full Text

Standardized Planning and Construction of Broadcasting High-Altitude Wireless Transmission Stations

Abstract: High-altitude wireless transmission stations play a critical role in television and radio broadcasting, bearing the responsibility for terrestrial digital television, FM radio, CMMB transmission, and the relay of central, provincial, and municipal radio and television programs. Consequently, implementing standardized planning and construction for these stations is essential to ensure their safe and normal operation in complex and variable environments. This paper focuses on the core issue of standardized planning and construction of broadcasting high-altitude wireless transmission stations, analyzing their current status, exploring the importance of standardization, and discussing specific

methods and measures, with the goal of achieving comprehensive standardized planning and construction.

Keywords: broadcasting high-altitude wireless transmission stations; standardization; planning and construction

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1. Current Status of High-Altitude Wireless Transmission Stations

High-altitude wireless transmission stations in China currently shoulder critical responsibilities for signal data transmission, including FM radio, central and provincial/municipal television programs, and terrestrial digital television broadcasting. Throughout the entire broadcasting transmission process, these stations perform vital functions that directly affect the quality of radio and television programs. However, an examination of their actual operational mechanisms reveals numerous problems in the high-altitude transmission network. These issues primarily stem from severely aging wires and cables that cannot meet the load requirements for equipment room power supply; excessively long usage of ground network grounding resistance that fails to meet actual lightning protection grounding requirements; and inadequate temperature and dust control that cannot satisfy the diverse equipment types in modern transmission station equipment rooms. These problems prevent high-altitude wireless transmission stations from functioning normally during actual operations, thereby degrading broadcast quality.

2. Importance of Standardized Planning and Construction

As a mainstream media platform that is both popular among the masses and visually compelling, radio and television broadcasting has become an essential component of public cultural life. The general population has personally experienced the convenience and benefits that broadcasting brings to their production, daily life, and work. Consequently, improving the infrastructure of high-altitude wireless transmission stations and enhancing operational efficiency and relay quality plays a crucial role in disseminating the Party's guidelines and policies. Broadcasting serves as the mouthpiece of the Party and government, a bridge connecting the Party with the people, and an indispensable front for spreading advanced culture and promoting socialist spiritual and material civilization.

To ensure that China's broadcasting high-altitude wireless transmission stations operate normally in practical environments, implementing standardized planning and construction is imperative. This process must address the actual transmission needs of current stations, accommodate the evolving demands of broadcasting technology, and involve the construction and renovation of existing transmission station equipment rooms. Standardization efforts should focus on several key aspects: equipment rack mounting, anti-static flooring, grounding and lightning protection, equipment room power supply, and temperature and dust control. Additionally, standardized planning should adopt a long-term perspective, enhancing the scalability and availability of equipment room air conditioning systems to reduce operational difficulties and ensure the quality of television and radio wireless signals.

The principles of standardization include: **Reliability**—rational planning and implementation of all aspects of radio and television program transmission to ensure network security and reliability while meeting safe broadcasting requirements; **Practicality**—selecting equipment with optimal performance-to-price ratios while meeting technical requirements, and prioritizing urgently needed sub-projects; and **Compliance**—ensuring project selection meets planning requirements, strictly implementing national construction standards to achieve the goals of “high starting point, strong practicality, and low investment,” with full functionality that adapts to local social and economic development needs. Projects should follow principles of adapting to local conditions, economic rationality, safety and applicability, and convenient construction, while coordinating with the surrounding environment. Design must strictly comply with the National Radio, Film and Television Industry Standard “GY5062-1998” Code for Design of Television and FM Broadcasting Transmitting (Relaying) Stations.

3. Methods and Measures for Standardized Planning and Construction

3.1 Standardization of Equipment Racks

Achieving standardized planning and construction requires implementing rack standardization through several approaches. First, due to limited internal space in high-altitude station equipment rooms that must accommodate numerous machines, standardized cabling should be implemented to facilitate daily operation and maintenance. Second, equipment must be rack-mounted. High-power transmitters generate significant local heat during operation, necessitating proper ventilation and heat dissipation, regular cleaning of internal dust, and minimization of static electricity to prevent interference and damage to equipment. Standardizing equipment racks using specifications of 1U or N-U within transmitters enables safe and healthy management and maintenance of high-altitude wireless transmission stations.

3.2 Standardization of Power Supply Systems

Television and radio broadcasting equipment rooms operate continuously 24 hours a day. To ensure normal operation, standardized power supply design and planning are essential. The power supply system for high-altitude transmission stations must provide uninterrupted service to meet the diverse power demands of various equipment. Power supply equipment can be managed separately, dividing lighting, air conditioning, and power systems within the equipment room. In accordance with relevant construction standards for wireless FM broadcasting transmission stations, two high-voltage power supply lines can be planned with two 100KVA transformers and low-voltage dual-power switching equipment to accommodate future high-power, multi-device electricity demands. The power frequency should reach 50Hz with voltage at 380V, and the main control three-phase power should be 300A. Air switch control and UPS power can use independent dual-circuit power supply, with three-phase UPS power and 16A three-phase air switches for high-power equipment. An external UPS dual-circuit power supply model can be employed, with the UPS primarily bearing important load supply functions to provide stable power for servers, switches, and network equipment.

3.3 Standardization of Lightning Protection

Most high-altitude wireless transmission stations in China are built on high-altitude mountain peaks, requiring effective lightning protection to ensure each system in the power supply equipment room can be independently grounded without sharing cables. To achieve effective lightning protection, lightning rod facilities should be installed at the top of high-altitude transmission stations, surge protection measures should be implemented to prevent induced lightning, and weak-current bridge work should be grounded. Standardization can be achieved through: (1) ensuring grounding resistance does not exceed 10 ohms when transformer total capacity reaches 100kVA; (2) installing lightning protection wires according to regulations to create a protective channel for station communications; and (3) installing single lightning rods on transmission towers to reduce lightning strike faults, using anti-backstrike measures instead of anti-shielding measures. This approach can be applied to sections or towers prone to lightning strikes, effectively reducing outage probability while achieving cost savings.

3.4 Standardization of Equipment Room Management

Standardized management requires implementing standardized planning for equipment operation and management to ensure healthy and safe operation of all links within the equipment room, enabling timely synchronization of broadcast optical fiber, satellite, and microwave primary/backup signals. Additionally, dust content and temperature must be controlled, with personnel regularly scheduled for periodic maintenance and cleaning of equipment rooms. Technical maintenance of equipment should be performed quarterly. Necessary

tools and instruments should be provided to promptly resolve technical issues, with regular inspections conducted to monitor equipment operation, maintain and repair problematic components, and ensure normal operation of all station equipment.

3.5 Standardization of Temperature and Dust Control

With the solid-state, precision, and intelligent evolution of equipment in high-altitude broadcasting transmission station equipment rooms, proper equipment layout, constant temperature, and dust control have become particularly important. Standardized planning requires timely implementation of temperature and dust control measures, including regular dust removal and daily management of equipment room operations. The backbone equipment, with its high integration and extensive use of integrated components, generates substantial heat and transmission power. Airborne dust can easily cause electrostatic adsorption, significantly reducing equipment service life and creating hidden faults that severely impact normal station operation. Therefore, regular and timely cleaning and maintenance must be performed, with fault detection conducted promptly. The internal working environment temperature should be controlled within 25°C, with humidity maintained within 85%. To achieve standardized temperature and dust control, high-power air conditioning should be installed, supplemented with humidifiers to improve the working environment. Additionally, relevant personnel should be assigned to clean the equipment room environment, wipe dust from equipment, and regularly clean dust filters to prevent static electricity and ensure normal station operation.

Conclusion

Broadcasting high-altitude wireless transmission stations play a vital role in television and radio signal transmission. To ensure transmission quality, comprehensive standardized planning and construction must be implemented. This standardization should adopt a long-term perspective, addressing temperature and dust control, power supply systems, grounding, lightning protection, and other aspects. Proper maintenance and repair will enhance station economy and functionality, creating a safe and healthy operating environment that improves radio and television transmission quality.

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

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