Analysis of Technical Safeguard Measures for Secure Broadcasting in Television Station Machine Rooms (Postprint)

Authors: Wang Tao

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Abstract

Television programs constitute an important component of daily entertainment and exert a significant influence on the quality of people' s spiritual life. The normal broadcasting of television station programs is contingent upon the support of safety broadcasting technologies in station machine rooms. With the advancement of modern technology, increasingly stringent requirements have been imposed upon safety broadcasting technologies for television station machine rooms. Therefore, to enhance the technical level of safety broadcasting in television station machine rooms and further optimize television program broadcasting effects, this paper, contextualized within television stations, analyzes factors affecting safe broadcasting and the functions of machine room safety broadcasting technologies, and finally proposes several technical safeguard measures, aiming to contribute to the advancement of radio and television broadcasting.

Full Text

Analysis of Technical Support Measures for Safe Broadcasting in TV Station Machine Rooms

Author: Wang Tao (Shandong Province Sishui County Converged Media Center, Sishui, Shandong 273200)

Abstract: Television programs constitute an important part of people' s daily entertainment and significantly influence the quality of their spiritual life. The normal broadcasting of TV station programs relies heavily on the technical support of safe broadcasting systems in station machine rooms. With the advancement of modern technology, higher demands have been placed on these safe broadcasting technologies. Therefore, to improve the technical level of safe broadcasting in TV station machine rooms and further optimize program playback quality, this paper analyzes the factors affecting safe broadcasting and the

role of machine room technologies in the context of TV stations. Finally, several technical support measures are proposed to contribute to the development of radio and television broadcasting.

Keywords: TV station; broadcast control room; television broadcasting; safe broadcasting technology; digital broadcasting system

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The broadcast control room serves as the core component of a TV station, directly determining whether television signals can be transmitted securely and substantially influencing program broadcast quality. Implementing effective optimization of safe broadcasting technologies for control rooms not only ensures their secure and efficient operation but also provides technical support for other related tasks, ultimately enabling TV programs to achieve their intended broadcast effects.

Driven by rapid socioeconomic and technological progress, television program broadcasting has evolved from traditional models to current digital broadcasting formats. Compared with conventional systems, digital broadcasting features more complex architecture, more frequent operations, network interconnectivity, video storage on hard disks, and demands higher technical proficiency from operators. Modern digital broadcasting systems primarily involve five structural components: (1) the equipment room, which manages and maintains servers, broadcasting equipment, and network switching devices; (2) the master control room, which schedules external signals to ensure efficient and high-quality broadcasting of signals from sub-control channels; (3) the sub-control room, which manages specific channels; (4) the ingest room, responsible for converting TV station videotapes into digital signals on hard disks; and (5) the UPS room, which ensures uninterrupted program broadcasting during power failures or malfunctions. Each of these components affects broadcast quality and security, and all are indispensable.

Factors Affecting Safe Broadcasting in TV Station Machine Rooms

The primary factors influencing safe broadcasting in TV station machine rooms include: (1) **Equipment factors**: Since broadcasting equipment typically operates continuously without interruption, it is prone to damage and significant wear. Hidden problems can be difficult to detect promptly, and their gradual deterioration may ultimately compromise safe operation. (2) **Personnel factors**: The technical competence and professional quality of machine room staff directly affect operational security and stability. (3) **Network factors**: Broad-

casting machine rooms frequently face malicious attacks from hackers and other bad actors, disrupting safe and efficient broadcasting. (4) **Management factors**: Inadequate or lax management practices, such as allowing unauthorized personnel to enter the machine room, also impact safe broadcasting.

Safe Broadcasting Technologies for TV Station Machine Rooms

Safe Power Supply

The stable operation of TV station machine rooms depends on reliable power supply systems. Typically, TV stations employ dual-circuit municipal power supply systems (as shown in [Figure 1: see original paper]). Based on whether the power supply uses external lines or backup equipment, these can be categorized as dedicated or non-dedicated lines. Dedicated power supply lines, primarily 120KVA circuits, are usually connected to the UPS room and can automatically switch to bypass mode. Input dual-power supply methods should also be adopted to meet the needs of automatic switching between power equipment and parallel connection of online dual UPS power sources, ensuring continuous power supply and stable operation during outages. Additionally, diesel generator sets are maintained for emergency power supply during unexpected power failures.

Video Server Security Technologies

TV station operations currently involve signal sources including satellite signals, optical fiber signals, and digital signals, with each channel equipped with multiple redundant signal sources. Signal channels employ redundant backup channel structures with ACO switches, enabling automatic failover when the primary signal fails. This effectively resolves issues such as black screens and frozen frames, enhancing broadcast stability. Video servers utilize distributed storage technology to distribute data across each server node, rationalizing storage load and significantly improving server access rates and storage efficiency. Ingest software should feature AutoQC and MD5 verification functions to automatically detect black screen issues in programs and enhance the accuracy of material migration processes.

Video server operations are susceptible to operator influence. For instance, manual review during program ingest can pressure decoding boards and bandwidth, potentially causing system crashes. Distributed storage technology in servers can effectively prevent fault propagation and minimize the impact of maintenance and reconstruction on program broadcasting. Furthermore, video servers should employ dual gigabit-or-higher network card structures with identical IP addresses designed for data transfer. When a failure occurs, the alternate switch channel can immediately replace data, effectively preventing data errors and enhancing server stability. A video server schematic is shown in [Figure 2: see original paper].

Database and Playout System Security Technologies

Safe television broadcasting relies on hardware backup support, which ensures continuous equipment operation during broadcast failures. The dual-node redundant database hardware architecture (shown in [Figure 3: see original paper]) offers alarm functions, automatic deletion of expired data, master-slave redundancy, and certain disaster recovery capabilities, effectively ensuring broadcast stability and continuity. Additionally, an automatic hard disk broadcasting system can be constructed to backup data in the database, with auxiliary disk-tape hybrid playback functions in emergency video recorders to provide solid guarantees for safe and high-quality program broadcasting.

For playout systems, two-level link and control systems are typically employed (see [Figure 4: see original paper]), separating scheduling operations from broadcast control and establishing specific standards and content for equipment maintenance, alarms, and operations. Dual hot standby management enables automatic switching between primary and backup control workstations when faults occur. Moreover, broadcast control software should not only support data exchange between broadcasting and business data but also be compatible with multiple network access and file transfer methods, enabling timely processing of media data content and automatic upgrades to ensure machine room security and stability.

Daily Maintenance

Daily maintenance is fundamental to ensuring stable machine room operation in TV stations. Maintenance work should first control room temperature within 20°C–35°C and humidity at 45%RH–75%RH, ensuring clean, circulating air without visible dust. Second, equipment maintenance must be effectively implemented through regular and irregular inspections, with immediate remedial measures formulated upon discovering potential issues. Finally, the broadcast system should be upgraded periodically, with appropriate hard disk broadcast management systems introduced based on the station' s actual development needs to enable real-time monitoring of broadcast signals and rapid fault location and resolution.

Television Broadcast Signal Monitoring

The broadcast stage represents the final checkpoint for safe program transmission in TV stations, making signal monitoring critically important. Monitoring encompasses three aspects: (1) **Transmission signal monitoring** enables real-time oversight of master and sub-control room operations to promptly identify factors interfering with program signals. (2) **Image monitoring** detects faults such as signal interruption, black screens, frozen frames, and mosaic artifacts during broadcasting. Frozen frame monitoring tracks the cumulative duration of identical image frames during program broadcast, triggering alerts when exceeding a defined threshold. Black screen monitoring follows a similar

principle, recognizing black frames when they accumulate beyond a certain duration. Color bar monitoring checks for specific frame patterns in broadcast images, dividing frames into n×m blocks to facilitate comparison and analysis of specific color bars. Prolonged color bar duration triggers system alerts. Monochrome monitoring analyzes R, G, B data in images, identifying a frame as monochrome when two colors approach zero while the third nears 255. Audio monitoring uses a 100ms sliding window to detect maximum level values, comparing them against thresholds for excessive volume or silence to identify audio issues. Mosaic monitoring primarily detects frame-to-frame continuity, identifying mosaics when no gradual change occurs but clear edges exist with module matching coefficients reaching threshold values. (3) **Hardware monitoring** requires dedicated monitoring cards, interfaces, monitoring points, and alarm systems.

Technical Support Measures for Safe Broadcasting in TV Station Machine Rooms

Enhanced Database Maintenance and Management

In TV stations, data backup effectiveness directly impacts program broadcast quality. Therefore, staff must conscientiously implement data backup procedures, starting from safe broadcasting technologies to rationally plan and configure corresponding hardware, optimizing database operation efficiency and quality to ensure effective data backup. Additionally, personnel should strengthen daily database management and maintenance, promptly identifying and resolving software operation issues and system warning messages. Regular cleanup of expired data is also necessary to release memory and optimize databases for long-term stable operation.

Strengthened Playout System Operation Management

To ensure efficient and high-quality playout system operation, management should delineate and separate scheduling work areas from broadcast control areas, clarifying job responsibilities and content for both scheduling and equipment monitoring to optimize the playout system management framework. Even when the primary control station encounters issues, staff can promptly use switching controls and backup stations for replacement, ensuring program broadcast continuity and quality.

Enhanced Environmental Monitoring of Broadcast Control Rooms

In TV stations, the machine room environment directly affects equipment performance and operator health. Therefore, to ensure effective implementation of safe broadcasting technologies, staff must continuously monitor the machine room environment, tracking electromagnetic fields, humidity, and corrosive gases to optimize conditions and ensure equipment safety.

Conclusion

With the continuous development of China' s radio and television industry, safe program broadcasting has become increasingly important. To provide high-quality television programs to the public, TV stations and their personnel must intensify the application and research of safe broadcasting technologies, continuously monitor control room operations, and promptly resolve identified issues. Optimizing equipment working environments through regular and irregular maintenance ensures consistently high performance and provides guarantees for safe program broadcasting. Furthermore, TV station staff must adapt to evolving requirements by continuously updating their knowledge and mastering advanced safe broadcasting technologies to efficiently resolve various broadcast issues and promote further development of China' s radio and television industry.

References

[1] Yu Huiqiang. Analysis of Technical Support Measures for Safe Broadcasting in TV Station Machine Rooms [J]. Media Forum, 2020(15): 181.
[2] Wang Haiyan. Discussion on Technical Support Measures for Safe Broadcasting in TV Station Control Rooms [J]. Contemporary Tourism, 2018(6): 1.
[3] Mairhaba·Tulafu. Discussion on Technical Support Measures for Safe Broadcasting in TV Station Machine Rooms [J]. Vision, 2020(6): 1.
[4] Wang Fang. Discussion on Technical Support Measures for Safe Broadcasting in TV Station Machine Rooms [J]. Science and Technology Communication, 2019(22): 108-109.
[5] Li Xinli. Discussion on Technical Support Measures for Safe Broadcasting in TV Station Machine Rooms [J]. Digital Technology and Applications, 2019(7): 78.
[6] Zhang Jukui. Discussion on Support Measures for Safe Broadcasting of Radio and Television [J]. Digital Users, 2019(2): 127.

Author Bio: Wang Tao (1974–), male, from Sishui County, Shandong Province, holds a bachelor' s degree and is an engineer. His research focuses on radio and television broadcasting.

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