Configuration Analysis and Technical Application Investigation of Television OB Van Systems - Postprint

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Abstract

TV broadcast trucks represent a highly specialized category of media equipment, primarily employed in television program broadcasting. Particularly in this new era of rapid network and information technology development, television broadcasting is subject to elevated standards, with heightened emphasis on real-time performance and operational convenience. TV broadcast truck systems function analogously to miniature television stations, capable of acquiring and processing on-site video information, thereby ensuring the efficiency and flexibility of television media operations. Consequently, the deployment of TV broadcast systems must align with technological evolution, continuously enhancing their practical application standards and capabilities. This article presents an analysis and exploration of the system composition and technical applications of TV broadcast trucks, thereby providing technical support for their operational deployment.

Full Text

Analysis of TV Broadcast Van System Composition and Exploration of Technical Applications

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Abstract

The TV broadcast van is a highly specialized media equipment primarily used for television program broadcasting. Particularly in the new era of rapid network and information technology development, television broadcasting faces

higher standards with greater emphasis on real-time performance and convenience. Similar to a miniature television station, the TV broadcast van system can acquire and process on-site video information, ensuring the efficiency and flexibility of television media. Therefore, the application of TV broadcast systems must align with technological development and continuously improve their specific application levels and capabilities. This article analyzes and explores the composition and technical application of TV broadcast van systems, thereby providing technical support for their utilization.

Keywords: TV broadcast van; system design principles; system composition analysis; technical application

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With China' s rapid development across various fields and the continuous improvement of national living standards, people now have higher expectations for life quality and spiritual fulfillment. Television serves as a primary household facility for daily entertainment and leisure. As demands for living standards and spiritual quality continue to rise, television quality must be further enhanced. System optimization and innovation can not only improve the operational efficiency of TV broadcast vans but also enhance the efficiency and security of television transmission. Therefore, analyzing the composition and application of TV broadcast van systems holds significant value and importance for the rapid development of the current television industry.

1. Overview of TV Broadcast Vans

TV broadcast vans typically adopt a four-functional-area layout. From front to rear, these areas are: audio zone, director zone (including subtitle operation and slow-motion control), technical zone, and secondary production zone (second-row workstations), with external interface panels and cable reels at the rear. Each functional area has a relatively independent operating space, enabling zones with different requirements for sound, lighting, and other conditions to work without mutual interference.

Generally, TV broadcast vans employ three vehicle scales: Type A, Type B, and Type C. Type A vans can accommodate a minimum of 24 cameras and associated equipment after expansion. Type B vans are 12-meter semi-trailers with no fewer than 10 camera channels and associated equipment, expandable to at least 16 cameras. Type C vans are 8-10 meter trucks with no fewer than 6 camera channels and associated equipment, expandable to at least 8 cameras.

2. Design Principles of TV Broadcast Van Systems

The role and functions of TV broadcast vans have gradually expanded, making them essential support for various large-scale events and programs, whether for live broadcasting or recording. Characterized by lightweight, miniaturized, and modular design, they possess strong broadcasting adaptability. However,

due to current limitations in media technology, TV broadcast van systems still face numerous difficulties and significant challenges during operation. Therefore, during the initial system design phase, it is essential to adhere to specific broadcasting requirements, employ optimization and upgrading methods to break through previous developmental bottlenecks, and effectively enhance the system' s pertinence, convenience, and effectiveness. The specific design principles include several aspects.

First, technical advancement. Under the premise of continuous development in network information technology, the development level and tier are determined by technology, and this applies equally to TV broadcast van systems. During the design process, basic design principles and production standards must be followed to diversify system functions, thereby providing broader development space for TV broadcast van systems.

Second, functional completeness. The function of TV broadcast vans lies in their ability to ensure efficient program broadcasting. Therefore, comprehensive program broadcasting must fully consider various operational factors, continuously optimize and explore innovative functions during practical application, thereby improving program production and broadcasting effectiveness, fully meeting public expectations, and ensuring the orderly execution of various TV program broadcasts.

Finally, operational reliability. TV broadcast vans play an increasingly critical role in current broadcasting and live programs, bearing heavier responsibilities. Equipment stability must be fully considered, and system design must incorporate comprehensive emergency protocols with safe and swift emergency operations. Dual-power backup with automatic switching plus UPS should be equipped to ensure power supply safety for live broadcasting.[1] All major equipment in TV broadcast vans requires dual power supply to ensure stable system operation. Various emergency program output switching channels must be available to guarantee system security and safe program broadcasting.

3. System Composition Analysis of TV Broadcast Vans

A typical TV broadcast van comprises eight subsystems: video/audio system, intelligent monitoring system, synchronization system, intercom system, TALLY indication system, vehicle body structure system, air conditioning system, and power supply system.

3.1 Video and Audio System

This system constitutes the most critical component and key element of the overall TV broadcast van system. The video system includes cameras, special effects switchers, multi-format matrices, slow-motion servers, frame synchronizers, embedders/de-embedders, recording devices, monitors, and other equipment. The audio system comprises mixing consoles, speakers, audio peripherals, and other devices. Regarding the audio system, its internal composition

is extremely rich and diverse in both structure and content. Simultaneously, the system structure encompassed by the video system also exhibits diversification. Furthermore, during the normal operation of these two distinct systems, the operational process demonstrates multiplicity. Among these, signal source conversion and distribution represent crucial links. To fully accomplish the corresponding work of signal sources, smooth switching between signal sources is required. Only in this way can the efficiency and completeness of the TV broadcast van hardware system composition be effectively ensured. Since such meticulous work is indispensable to both video and audio systems of the broadcast van, it has a decisive impact on the quality of television video and audio playback.[2]

3.2 Intelligent Monitoring System

Compared with studios and master control, the most significant characteristic of broadcast vans is system uncertainty. Typically, studios and master control have their system functions determined during initial design, whereas broadcast vans execute different broadcasting tasks each time. The network monitoring system on broadcast vans should enable centralized control: through software systems, centralized control of equipment can be achieved, with quick storage and scheduling of relevant settings for multiple application scenarios. The system should also implement equipment monitoring functions: status monitoring for all equipment from main switchers, video matrices, intercom matrices, temperature and humidity, power systems, to various peripheral devices, with alarm prompts for any faults.

The monitoring software facilitates convenient matrix switching while enabling visual switching of signals on the video wall. Additionally, the software' s scene macro batch calling function allows broadcast vans to store video wall layouts as corresponding macros for different production scenarios (such as sports events or entertainment broadcasting) and recall them with a single click when needed, thereby satisfying directors' requirements for using their preferred monitoring wall signal layouts. Moreover, macro application resolves the defect of crosspoint information loss in matrices after prolonged power outages, as macro information is stored on computers and only requires macro operation calling when the van is deployed.

With visual switching software, technicians see not individual matrices but signals in designated areas of the video wall—a complete video wall. The software interface features a corresponding virtual video wall, enabling signal scheduling by clicking on signal areas of the video wall rather than first locating a specific matrix, then finding ports, and finally nervously executing the switch, making operation convenient and accurate.

3.3 Synchronization System

Generally, the synchronization system in TV broadcast van systems consists of synchronization signal distributors, synchronization switchers, and primary and backup synchronization equipment. Its workflow primarily involves transmitting signals from the primary and backup synchronization equipment to the switcher. When the primary synchronization equipment fails to transmit signals, it automatically switches to the backup synchronization equipment while maintaining signal continuity to meet the requirement of uninterrupted signal transmission. Subsequently, the synchronization switcher transmits the received signals to the distributor for output through various ports of the TV broadcast van.

During current high-definition television signal broadcasting, TV broadcast van systems typically utilize analog black burst signals and analog tri-level signals to achieve synchronization. In traditional television video system signal transmission, BB signals were often used for synchronization, characterized by their ability to transmit not only standard-definition television signals but also fully cover high-definition television signals.[3] With the development and advancement of television technology and related equipment, current high-definition television signals increasingly employ effective integration of BB synchronization signals and tri-level synchronization signals, substantially enhancing the stability of TV broadcast van systems.

3.4 Intercom System

The internal intercom system is designed to meet the standards of large-scale program production. Employing an intercom matrix approach, it implements complex intercom functions with multi-level, flexible grouping settings, enabling any point-to-point, point-to-multipoint, and multipoint-to-multipoint communication within the system. The intercom matrix organically combines camera positions, video/audio production workstations, technical adjustment workstations, program/technical director workstations, on-site audio/lighting control, stage management, and remote dispatching through wired and wireless means to achieve an effective intercom system. To satisfy different levels of intercom requirements, matrix point settings determine the permanent and selective connections of notification points, enabling convenient cascading with other intercom systems. External interfaces reserve 4-wire, 2-wire, GSM, and other interfaces with expansion capacity, and provide intercom devices and interfaces for multi-system cascading.

3.5 TALLY Indication System

This system serves as an auxiliary system in video system operation. It uses indicator light colors and character prompts to inform camera operators, directors, technicians, and hosts of currently switched signals, also known as the source indication system. During program recording, it coordinates personnel

cooperation and helps grasp work status. Whether in studios or TV broadcast van systems, this system constitutes a critical component.

3.6 Vehicle Body Structure System

Regarding broadcast van body structure, the primary requirements are defining vehicle dimensions, body frame, and outer skin materials. The vehicle must resist radio wave and magnetic field interference and undergo necessary anti-corrosion and anti-rust treatments. The body requires precision dustproofing and waterproof immersion protection. Since the roof is often used to mount cameras and signal transmission equipment during TV broadcast van operation, work platforms and guardrails must be installed on the roof. After body processing, rain tests and other examinations should be conducted, including full-load side tilt tests and high-voltage impact resistance tests.

3.7 Air Conditioning System

This system reasonably controls the temperature of work areas during operation of all broadcast van equipment. The air conditioning zone differs from the work area, ensuring airflow does not cause discomfort to staff. The system must possess ventilation and air exchange capabilities to provide a comfortable working environment for personnel. Air outlet noise in audio zones must comply with specified standards. The air conditioning system and ventilation ducts must undergo anti-corrosion and anti-rust treatments. It should operate normally under extreme temperature, humidity, and dust conditions. Condensate drainage must remain unobstructed to prevent condensation dripping in broadcast van air-conditioned areas.

3.8 Power Supply System

To ensure the safety of TV broadcast van power supply systems, broadcast vans typically design both AC and DC power distribution systems. AC power supply generally employs three-phase five-wire systems with balanced three-phase distribution, isolated from external power through isolation transformers. Isolation transformers should be selected for low field, low saturation, strong heat dissipation performance, and normal operation across different temperatures (-20℃ to 50℃). Onboard equipment power must pass through voltage regulators with a regulation range exceeding $±$10% of the mains rated value and output power 30% higher than total equipment consumption to avoid inrush current during equipment startup and facilitate future system expansion. Power input should feature low voltage, overvoltage, low current, overcurrent protection, error phase detection and adjustment, and leakage protection warning devices. All equipment process grounding wires on the vehicle body must be safely gathered at independent terminals. The broadcast van DC system primarily provides power for emergency lighting equipment, cable reel motors, rain canopies, and other devices. The power supply uses maintenance-free batteries unified with the vehicle

driving system battery voltage to facilitate subsequent electrical maintenance, with the DC power supply system controlled by a master switch.

4. Exploration of Technical Applications for TV Broadcast Van Systems

In the operation of TV broadcast van systems, technical application is the most critical factor. Therefore, safe implementation and application of technology constitute the powerful guarantee for fully demonstrating the utility of TV broadcast van systems.

4.1 Strengthening Safety Control of TV Broadcast Van Systems

Specifically, strengthening continuous technical improvement and optimization during operational testing of TV broadcast van systems enhances their operational efficiency and security. Additionally, before broadcast van missions commence, comprehensive inspections must be conducted on power supply, location, conditions, signal sources, ports, and surrounding equipment. All systems should undergo debugging and demonstration, with broadcast signal strength tested to meet program broadcasting standard requirements. Particularly, comprehensive detection of signal output ports, power supply systems, switchers, and other equipment must be performed to thoroughly eliminate various hidden dangers in TV broadcast systems and prevent broadcasting accidents.

4.2 Avoiding Frequent Changes to Internal Equipment and Devices

Since connection devices and equipment in TV broadcast vans are operated and controlled through designated systems, any adjustment or modification to a particular device during program broadcasting will impact overall broadcasting or live streaming operations. Under normal circumstances, this creates significant trouble and confusion, and in severe cases, may cause the entire broadcasting or live streaming process to be suspended or even fail. During actual program operation, not only must corresponding operational plans be established, but the overall broadcast van system must also undergo reasonable and effective management, operation, and control. Furthermore, related operational aspects of the broadcast van system must be treated with greater safety and meticulousness. Not only should drawings and improvement schemes undergo rehearsal and preparation, but post-rehearsal summaries and studies should also be conducted to propose corresponding suggestions and opinions, thereby ensuring the accuracy and effectiveness of overall system changes and equipment adjustments. Additionally, after program recording and broadcasting completion, temporarily modified operational systems should be promptly restored. This not only prevents interference with recording and broadcasting of other formats and different standard projects but also fully ensures the rationality and standardization of overall broadcast van system operation. In summary, during specific operations, TV broadcast vans should not undergo frequent adjustments and changes to in-

ternal connection devices and equipment. When changes are necessary, they must be performed strictly according to reasonable and scientific operational standards and procedures while ensuring accuracy and reliability. Moreover, after recording and broadcasting completion, the system must be restored in a timely manner.

4.3 Ensuring Adequate Power Supply for Broadcasting Systems

Before utilizing the TV broadcast system, the power supply system must be inspected, including power sources, supply capacity, and emergency power devices. To enable continuous broadcast signal transmission, the overall program broadcasting process must be analyzed in advance, with comprehensive power safeguard measures established and power emergency plans formulated. Additionally, on-site safety control must be strengthened to prevent unexpected incidents during TV broadcasting and ensure successful program recording and broadcasting completion.[5]

4.4 Strengthening Inspection and Maintenance of TV Broadcast Vans

To effectively enhance the service life of TV broadcast vans and program recording quality, regular maintenance and inspection must be strengthened. Technicians should perform periodic maintenance on TV broadcast vans to prevent significant damage. Before each recording session, technicians from all trades must inspect various system equipment, immediately addressing any discovered issues to prevent problems during recording that could cause program recording failure, thereby effectively ensuring the stability and reliability of broadcast van operation.

TV broadcast van systems represent fully functional and typed mobile studios, constituting reliable and stable broadcasting systems composed of multiple technical devices. TV broadcast vans do not have fixed operational modes, but their design concepts are interoperable and can greatly satisfy specific requirements. The main characteristic of TV broadcast van system operation lies in its ability to better meet practical operational conditions, ensuring efficient and stable overall system operation. Even though current TV broadcast van system operation still has certain deficiencies, with corresponding issues existing at both software and hardware levels, continuous development and optimization of TV broadcast vans are underway alongside rapid technological advancement and increasing public awareness. Consequently, TV broadcast van systems possess broad development space and prospects for the future.

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