

A Tentative Study on the Integrated Management of Locomotive and Car for the 160 km/h Power Concentrated EMU

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***A**bstract: The operation of the 160km/h power concentrated EMU trains is even more demanding in terms of management mode, operation, organization and emergency handling due to its flexibility in formation and operation & maintenance. To achieve unified and efficient management, China Railway Shenyang Group Co Ltd has fully integrated its resources in structural organization, rules and regulations, personnel exchange, production organization, crew operation, information management, etc. By doing so, an integrated management mode for power concentrated EMU trains has been studied and put into use.*

Keywords: power concentrated EMU; locomotive and car integration; integrated management

As the living standard of the public improves with the rapid growth of the national economy, passengers demand more comfortable, cheaper and safer mobility services. 160km/h power concentrated EMU was developed at the right moment as an iterative upgrade product replacing the conventional passenger trains^[1-4]. For high-standard and high-quality maintenance and manage-

ment of the power concentrated EMU, China Railway Shenyang Group Co Ltd (hereinafter referred as Shenyang Group) takes the opportunity of the operation of 160km/h power concentrated EMU on the Changchun-Baicheng Line, and makes an investigation in the integrated management mode of locomotive and car, trying to reform the existing management system, integrating the

locomotive and car resources, and building an optimal management system.

1 Features of Power Concentrated EMU

The 160 km/h power concentrated EMU is an important part of the Fuxing series EMUs, which has the following

(This paper is selected from *China Railway*)

advantages and characteristics [5-6]:

(1) Improved performance and shared resources. The power concentrated EMU is designed based on the existing locomotives and passenger cars, which not only fully absorbs the best concepts of EMUs, but also makes full use of the lessons drawn from the maintenance and repair of locomotive and car. On the one hand, it has improved the economic benefits, passenger comfort, advanced technology and flexibility, and has further improved the performance. On the other hand, it has ensured that the rolling stock repair resources and human resources basically meet the needs of its maintenance management, and the existing passenger service equipment and facilities can be used after slight reinforcement, so as to achieve the sharing of maintenance resources and human resources.

(2) Reliable technology absorbed from various platforms. The power concentrated EMU is composed of power car, trailer and control car, which fully integrates the structural features of existing locomotives and passenger cars. The power car is developed on the HX_D1G and HX_D3G electric locomotive platforms, while the trailer and control cars are developed on the 25T passenger car platform. Through optimization and adjustment, interoperability and mutual control are realized, and the safety performance of the train is improved. The technologies are mature and reliable.

(3) Integrated management and efficient operation and maintenance. The traditional mode of joint operation and separated management of locomotive and passenger car is abandoned. Instead, power centralized EMUs are managed and operated in unit. As a result of the cancellation of locomotive and car coupling and decoupling operations [7-8], locomotive, car and other related departments implement integrated maintenance and servicing in the passenger service depot, and the operation and maintenance efficiency is significantly improved. The implementation of unified D1-D6 maintenance strategy will help promoting the reform of the maintenance and repair system.

2 Practice on the Integrated Management of Locomotive and Car

Shenyang Group carried out investigation on the technical features of power centralized EMU and drawn lessons from the operation and maintenance experience of Beijing Group, Lanzhou Group and Shanghai Group. According to the professional management foundation of locomotive and rolling stock and on-site operation organization ability of the Group, after intensive discussion, a detailed and careful action plan was made with the decision to implement the integrated management of locomotive and car for power concentrated EMU in Changchun Car Depot in February 2019.

2.1 Merging of departments

At the Group level, on one hand, the roles of locomotive department and car department are redefined: the former is responsible of driver and traffic control while the latter is responsible of repair, serving and equipment quality. On the other hand, a joint working office is established with the deputy director of the locomotive department as the head, and members from the locomotive department, car department, locomotive depot, car

depot, EMU depot. The joint working office leads the drafting of regulations, coordinates on the solutions of daily issues, and supervises onsite the implementation of various tasks. Such top-level design of the management structure avoids the conflicts of interfaces among different departments.

At the working level, the EMU workshop of Changchun Car Depot is established with capable professionals from the locomotive depot, car depot and EMU depot. 129 persons (120 technicians and 9 managers) work in the workshop, with the average age of 25.3. 4 Functional units (12 posts) including operation safety unit, technical analysis unit, quality inspection unit, and comprehensive unit, as well as 6 operational units (18 posts) including integrated duty office, data analysis unit, D1 repair unit (2 units), D2 repair unit, train crew unit are set up, with specific responsibilities (see Fig.1, Fig.2 and Tab.1). With this locomotive-car integrated workshop, interfaces among different operational units are optimized.

2.2 Integration of regulations and rules

At the group level, the *Specifications of 160km/h Power Concentrated EMU Operation and Maintenance in Shenyang Railway Group Co. Ltd* is formulated based on the Rules of

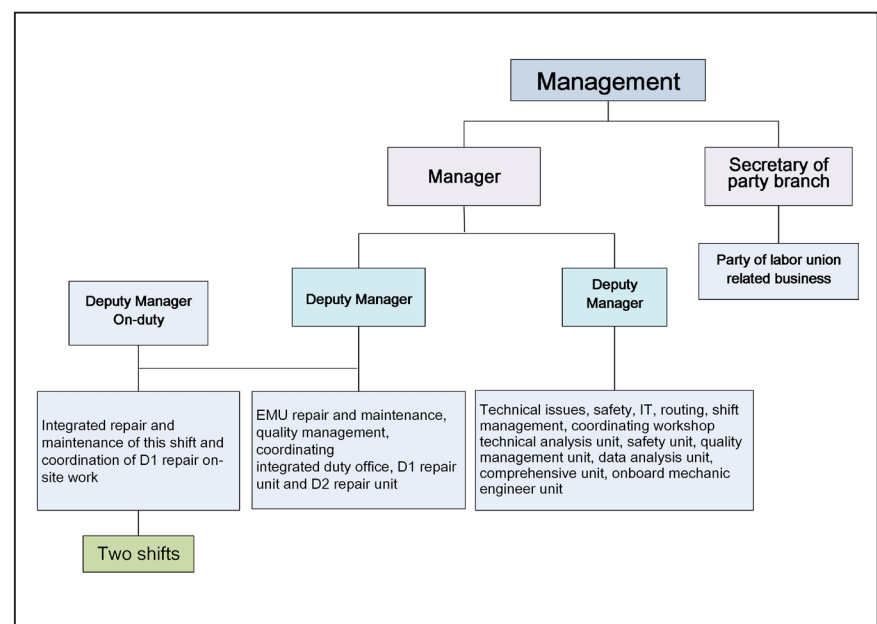


Fig. 1 Responsibilities of the managers

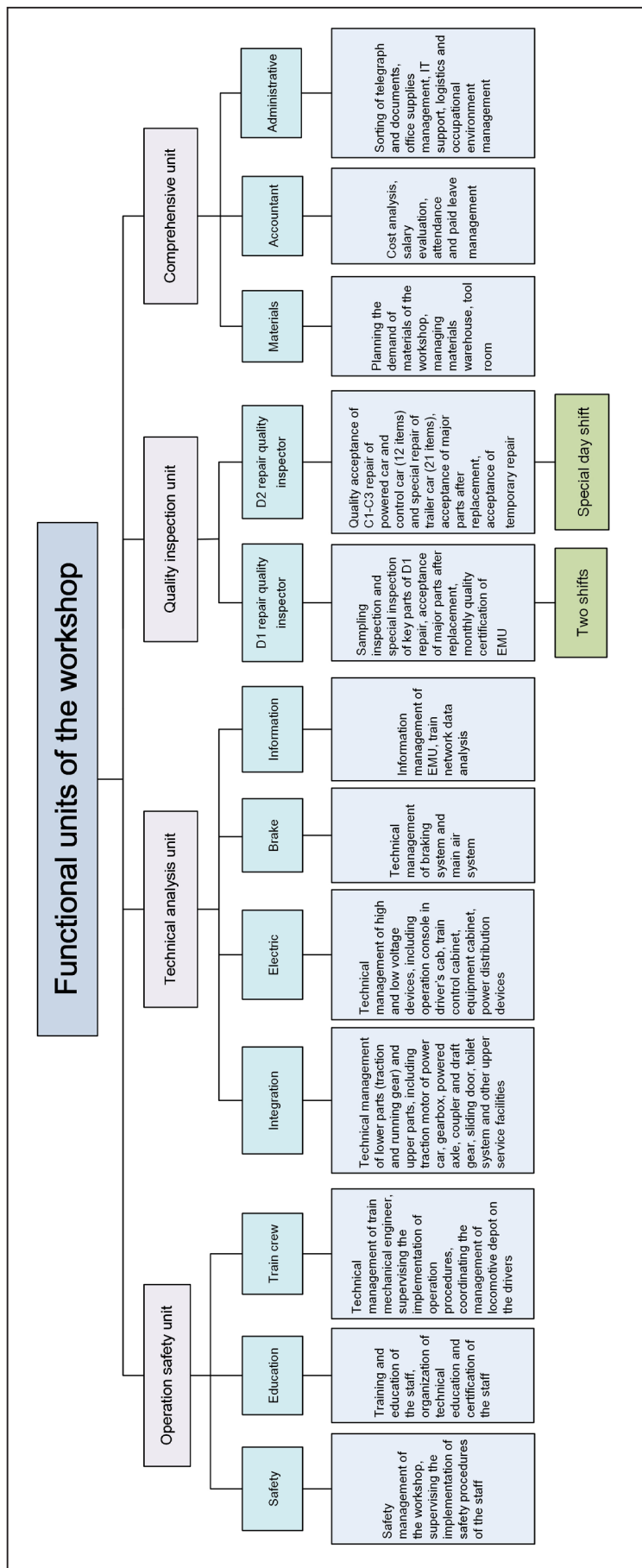


Fig. 2 Responsibilities of functional units

160km/h Power Concentrated EMU Operation and Maintenance issued by China National Railway Group Co. Ltd (CHINA RAILWAY) and the existing regulations. 10 supporting working manuals on D1 repair operations, integrated management, OCS power supply, EMU anti-rolling, key management, locomotive crew first operation, assistant driver and train mechanical engineer management, ground service driver management, downgraded train operation, emergency handling, etc. are released, which forms a 1+N regulation system.

At the operational level, Changchun Car Depot has formulated 17 regulations, 6 technical specifications and 79 operation guidelines, based on the *Specifications of 160km/h Power Concentrated EMU Operation and Maintenance in Shenyang Railway Group Co. Ltd*, which provides foundation and support to the management and operations.

2.3 Exchanging of professional staff

At the Group level, exchanges of technical personnel from locomotive department, EMU department and car department are carried out. One qualified professional from each of the electric and brake divisions is transferred to the passenger car office of the car department while one qualified car operation engineer is transferred to the EMU office of the locomotive department. These measures make the locomotive and car departments complementary to each other and promote the merging of departments.

At the operational level, the human resources for the locomotive and EMU professionals in the car depot are strengthened. The deputy director in charge of EMU operations from the locomotive depot was transferred to Changchun Car Depot as the deputy director in charge. One professional from the EMU division of the locomotive department was appointed as the chief of the EMU workshop of Changchun Car Depot. The chief of locomotive operation workshop was appointed as the party secretary of the workshop. Among all 120 new members of the staff, 40 were promoted deputy driver from the locomotive depot while the others were recruited from the Group, to cultivate locomotive-car inter-disciplinary talents.

2.4 Coordinated repair and maintenance

In terms of organization and share, the

Tab. 1 Responsibilities of the operational units

Unit	Posts	Responsibilities	Remarks
Integrated duty unit	Day shift duty officer	Overall business of duty office, dispatching plan of EMUs, formulation of D1-D2 repair plan, EMU profile data maintenance	Day shift
	Operation duty officer	Commanding the integrated operation of EMU, coordinating of operational units, instructing and supervising the operation plans	Two shifts
	Train crew duty officer	Collecting EMU operation information, work shifts with train mechanic engineer, distributing spare parts, supervision and monitoring, EMU key handover	Four shifts
	Safety monitoring duty officer	Monitoring of power supply cut-off, 4T failure handling results recording, EMU data platform registration	Two shifts
	Emergency command duty officer	EMU failure emergency handling and command, failure information registration and report	Four shifts
Data analysis unit	Realtime data analysis engineer	EMU data storage and uploading, axle message data analysis, EMU failure data analysis, 4T data real-time monitoring	Two shifts
	Statistical analysis engineer	Locomotive statistics 6 and car statistics 181 analysis, TCDS data download and analysis, prediction of parts condition	Day shift
	Operation monitoring analysis engineering	Staff operation video and data monitoring and analysis, discover and correct misconduct	Two shifts
D1 repair unit	Unit chief	Overall business of D1 repair unit, quality control and acceptance of EMU condition	Two shifts
	Upper parts unit	Check and repair of interior parts, pantograph and roof antenna, train function test	Two shifts
	Lower parts unit	Lower parts check and repair, deicing and snow clearing, brake system test	Two shifts
	Running parts unit	Inspection and repair, failure handling of power car, control car	Two shifts
	Comprehensive unit	Disconnecter control and safety protection, EMU anti-rolling warm-up, road-rail vehicle operation	Two shifts
D2 repair unit	Unit chief	Overall business of D2 repair unit, quality control and acceptance of EMU condition	Special day shift
	Electric unit	Special inspection and repair of electric boiler, floor power supply, battery, high-low voltage equipment, kitchen	Special day shift
	Network unit	Special inspection and repair of safety loop, DC 600V power supply request, roof electric connection, train door	Special day shift
	Mechanical unit	Inspection of coupler and draft gear, maintenance of car-end and roof devices	Special day shift
	Brake unit	Inspection and function test of braking system	Special day shift
Train crew unit	Train crew supervisor	Supervising train mechanical engineer's technical service	Rotated shifts
	C1301/4 crew unit	Onboard service and emergency handling of power car trailer car failure of EMU No. C1301/4	Rotated shifts
	C1303/6 crew unit	Onboard service and emergency handling of power car trailer car failure of EMU No. C1303/6	Rotated shifts
	Z5001/6 crew unit	Onboard service and emergency handling of power car trailer car failure of EMU No. Z5001/6	Rotated shifts
	Standby unit	Replacing the mechanical engineer and service of temporary trains	Rotated shifts

power concentrated EMUs are allocated to the car depot, who is responsible of the integrated maintenance for operation (D1, D2 repair). For periodical repair (D3, D4 repair), the power car and trailer car are sent to the locomotive depot and car depot respectively.

In terms of operation organization, D1 repair adopts integrated operation mode with train as unit for inspection and maintenance. Inspection team and maintenance team are set up. The ground service mechanic of the inspection team not only checks the power car, but also the trailer, carries out technical inspection and functional test on the EMU on and off the train, and the maintenance team repairs the fault according to the professional division of responsibilities. The integrated operation of locomotive and car gives full play to the integration advantages and greatly improves the work efficiency and operation efficiency.

In terms of operation command, an integrated duty office was set up with production, information, emergency, attendance and departure, data analysis duty desks. Led by the integrated duty office, the integrated shift meeting is held by the passenger transport, electric power, supplier, cleaning and other departments every day to prepare and issue the operation plan, command the on-site operation, master the operation progress and train operation status in real time, and deal with all kinds of problems in time, so as to build an Accurate and Efficient production command center.

In terms of coordination mechanism, the Group organizes the coordination meeting of relevant departments every week or every other week, the joint office of locomotive and car organizes the joint work meeting of the rolling stock system every week, and Changchun Car Depot organizes the cooperation meeting of integrated member units every month, so as to solve the major problems of interfaces by establishing coordination mechanisms at different levels.

2.5 Joint work shift of locomotive and car staff

In terms of post setting, the func-

tions of assistant driver and on-board mechanical engineer are merged, so that the assistant driver shall be also the on-board mechanical engineer. The assistant driver can take up the position only after obtaining the double qualification of assistant driver and on-board mechanical engineer, which not only mobilizes the enthusiasm of the ground service mechanical engineer in the depot, but also provides more opportunities of promoting the driver, creating conditions for the combination of positions and reducing the number of staff to increase efficiency.

In terms of attendance and shift mode, the maintenance business and crew team are separated, and the traditional allocated attendance system is changed into the rotating shift system. By installing the locomotive operation safety management system in the integrated duty office of the EMU workshop, the technical inspection responsibilities of the driver, the assistant driver and the ground service mechanical engineer as well as the ex-workshop test items are optimized, so that the driver and the assistant driver can be waiting for duty, on duty and off duty at the same time, and establish a one-to-one master-apprentice relationship with each other, which not only improves the teamwork, but also helps the assistant driver learn skills.

In terms of emergency handling, an emergency command desk is set up in the integrated duty office of the EMU workshop in the car depot, and an emergency command unit for 12 kinds of faults, such as power supply and traction, is set up. The members of the unit are from the Group, the station, the depot and the supplier. The commander-in-chief and operation process of each unit are defined. In case of operation failure, the driver and the onboard mechanical engineer are under unified command, which improves the efficiency of fault handling.

2.6 Shared data facilitating operation

In terms of data application, a data analysis unit is set up in the EMU workshop of the car depot, with 6 analysis engineers to monitor the

TCDS and CMD monitoring data in real time, and inform the assistant driver to confirm the disposal in case of any fault; retrieve and analyze the process data of 5T, 6A, CMD, LY, LKJ and other monitoring systems to form the repair notice, guiding the on-site maintenance, and use the system to check and accept the fault treatment. At the same time, the monitoring system is used for Machine Inspection on air conditioning, inverter power supply, hot box alarm, fire alarm and other equipment, to reduce the Human Inspection of D1 repair and improve the operation efficiency.

In terms of IT system, based on the temporary transition information system of the power concentrated EMU of China Railway, combined with the existing locomotive and car information system, and in line with the principle of locomotive and car data integration, the Group designs the application and maintenance information construction scheme of power concentrated EMU from the aspects of information collection, process control and data analysis, so as to realize the operation control, quality traceability and cost analysis, and provide basic data for the reform of repair cycle and maintenance strategy.

3 Conclusion

The practices on the integrated management of 160km/h power concentrated EMU have brought Shenyang Group merged systems and complementary advantages between locomotive and car departments, as well as good growth momentum of integration, coordination, efficiency and joint efforts. In the future, Shenyang Group will begin with this new mode of integrated management of locomotive and car departments, and keep exploring the new mechanism of shared resources, interconnected data and coordinated training of talents.

(Translated by Zhao Zhangshan)

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