

Optimized Plan of Locomotive Routing of Heavy Haul Trains on Daqin Line

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Summary: Daqin railway, the first double-track and electrified heavy haul railway in China, is an important channel of coal output transport, with coal traffic volume accounting for 1/7 of that in the whole country. The traffic volume of the line has been increasing every year since its opening to traffic. After the strategy "to increase the traffic volume of Daqin Line" was put forward by MOR in 2003, a series of measures to exert the potentials and enhance the efficiency have been rolled out, including track equipment upgrading, technical equipment updating and integrating resources, etc., the traffic volume saw a rapid increase, even with an annual growth of 50 million tons. Based on the characteristics of heavy haul trains of Daqin Line, the author of this paper analyses and discusses issues on traffic organization, locomotive application, service and maintenance, personnel employment, etc., as well as the significance of optimizing locomotive routing and effects that has been achieved in this aspect. In addition, under the condition of restrictions during the traffic volume increasing plan, the paper also puts forth advices on how to further optimize the locomotive routings to effectively relieve the contradictions between volume increase and usage of equipment and personnel.

Index Terms: Daqin Railway, heavy haul, locomotive, routing

1 GENERAL

With the total length of 653KM, the Daqin railway is the first double-track and electrified railway in China running trains with carrying capacity of 10,000 tons and 20,000 tons. The line is connected with Jingbao Line, North Tongpu Line, Shenshuo Line, Dazhun Line, Yungang Branch Line and Kouquan Branch Line at the west end, with Jingha Line and Jingshan Line at the east end, and with Jingcheng Line and Jinji Line in the middle. Qiancao Railway, which was opened to traffic on December 26, 2006 in advance is connected with the Daqin railway at North Qian'an Station, becoming a high capacity hub connecting the main coal production area in China (Shanxi Province, Shannxi Province and Western Inner Mongolia) and major ports of Bohai Ring area with Daqin Line. Daqin railway to Jinggang Port and Caofeidian Port, To make the Daqin railway the top-rank heavy haul corridor for coal transport is an embodiment of MOR Leading Party Group to implement the strategy of connotation-oriented expansion and reproduction based on Scientific Concept on Development and target of constructing

a harmonious society. Since the 16th National Congress, MOR Leading Party Group has determined to develop Daqin line as a symbolic project of railway development, and a demonstrative and pioneering project of heavy haul transport. According to MOR's strategic deployment, continuous exploration and attempt has been done to optimize locomotive routing, innovate crew working system and improve repairing system of locomotives by means of exerting potentials and enhancing efficiency, promoting organization mode of "long routing, train circulating and continuous attendance". Since September 2009, Daqin Line has successfully operated combined trains with carrying capacity of 10,000tons. In March 2006, SS4 Type heavy-haul combined train with capacity of 20,000tons with "1 + 2 + 1" mode started running on Daqin Line; in August 7 2007, HXD Type locomotive was applied on heavy haul combined train with capacity of 20,000 tons under "1 + 1" traction mode for the first time in China even in the world. At present, Daqin Line is equipped with 360 HXD type locomotives, daily runs 38 trains with carrying capacity of 20,000tons, 24 unit trains with carrying capacity of 10,000trains and 40 combined trains with carrying capacity

of 10,000 tons according to train operating diagram. The carrying capacity of Daqin Line has been greatly released after optimizing locomotive routing, reducing number of locomotives and crew members.

2 TO OPTIMIZE LOCOMOTIVE ROUTING OF DAQIN LINE IS IMPERATIVE UNDER THE SITUATION

2.1 It is the Demand to Match the Change of Traffic Organization

Daqin Line has been adopting the transport mode of "integration of collection, distribution and transport" since September 2003. To be specific, firstly, construction of 44 loading points at the line dedicated to trains with carrying capacity of 10,000 tons and 20,000 tons, and 8 loading points for 20,000 tons; secondly, usage of dumper directly after loaded train arrives without off hook; thirdly, linkage of national railways and local railways; fourthly, employment of TDCS and CTC. The implementation of above mentioned measures have not only reduced the operation of dispatching of trains in loading stations and unloading stations but also reduced the shift change operation and assembly pressure of Hudong Station. Coal operation including loading, transportation and unloading will be conducted by the locomotives. The scientific method following the principles of "entire fleet loading and unloading, entering and exiting directly and centralized traffic dispatching" has been used to manage the traffic organization, which has released the capacity of Daqin railway by big margin.

2.2 It is the Demand to Match the Change of Traction Mode of Train

Before July 2003, trains with carrying capacity of 5000 tons and 6000 tons on Daqin Line was powered by SS₄ type home-made locomotive due to technical restrictions at that time. Since then, traction experiments were carried out. and on August 31, 2003, the most advanced DJ₁ large power AC electric locomotive was used on Daqin line by adopting the double locomotive traction method to run the through train of 10,000 train from Antaibao Station to South Liucun Station on Pingshuo Branch Line. The one-way running of the train reached 765 km, under the crew system of double-shift and single engineer driving. This locomotive routing of direct running from loading point to unloading point not only greatly released the pressure of insufficiency of passing capacity of Hudong Station, but also was a brave attempt of crew system adopted to the cargo locomotives on long-distance trunk line. In June 2004, by using 400M + 400K radio station, synchronous operation of manual calling and responding between the leading locomotive driver and the middle part of the train driver was realized. Train of 10,

000 tons was run successfully on Daqin line. Since October 2004, under the direct leadership of MOR, the rehabilitation of SS₄ locomotives and C80 trains started. With combination of LOCOTROL technology, the running test of heavy haul combined trains with capacity of 20,000 tons was carried out. One year and a half later, reliable data were obtained from aspects including traction system performance, brake system performance, vertical dynamic performance of train, dynamics performance of locomotive wagons, strength and proper operation of locomotives and the components, and in March 28, 2006, the official running was started with the locomotive traction way as "1 + 2 + 1", providing preconditions for the great increase of traffic volume of Daqin railway. In August 2007, the internationally advanced HXD high power AC drive electrified locomotive was used to haul the train of 20,000 tons. The traction way of the train was "1 + 1 + controllable end of train". making not only the traffic organization more flexible and convenient, but also providing reliable technical support for extending locomotive routing with its excellent performance.

2.3 It is the Demand to Match the Upgrade of Equipment at Stations and Yards

Daqin railway has adverse factors such as long intervals, large number of bridges, tunnels and long steep grades (please see the attached Figure 1) and poor operating conditions. Besides, the railway features with single supply of goods, large traction quality, large combination, high running density and strict requirement on the running speed of the train (restricted speed on loaded direction: 85 km/h, on unload direction: 90 km/h for C70 and C80 trains). Therefore, since the year of 2005, Daqin railway started capacity expansion and upgrading of track and bridge equipments, signal equipments, locomotive and rolling stocks equipments and traction power supply equipments. After the capacity expansion and equipments upgrading, Hudong station had both the upward and downward lines increase to 6 lines, with length of over 2800m to satisfy the demand of quick combination of 20,000 tons trains from loading or unloading unit trains of 10,000 tons arrived at Hudong Station. 4 new lines between South Datong Station to Hudong Station were constructed; A line connected to Dabao Line was built up between Gudian Station and Hudong Station to broaden the passage of Hudong Station in delivering and receiving trains. At the same time, with the increase of locomotives put into use, both the service depots and maintenance bases received capacity expansion and upgrading, the number of locomotive service line was increased to 12 from 9. A locomotive turnaround depot was newly built at Liunanerchang Station, the terminal of Daqin line. And locomotive turnaround depots were also built at Donggang Station, South Caofeidian Station and West Caofeidian Station of Qiancao Railway connected with Daqin rail-

way, doing service and detection together with Hudong Station. (see attached Table 1).

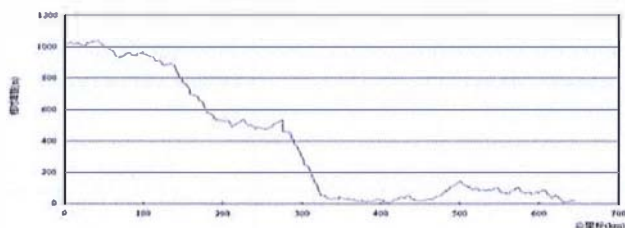


Figure 1 Vertical Section of Daqin railway along Heavy Haul

Table 1 Distribution of Service Spots on Daqin railway and Qiancao Railway

	Track	Length of trench (m)	Through capacity/day and Night (unit)	Remarks
Hudong depot	10	80	200	existing one
South Liucun turnaround depot	6	80 (part 37)	120	existing one
Qindong power turnaround depot	3	37	60	existing one
Donggang turnaround depot	3	37	60	Newly built
Caonan turnaround depot	3	37	60	Newly built
Caoxi turnaround depot	2	80	40	Newly built

2.4 It is the Demand to Reform the Crew Working

Since the opening of Daqin railway, Hudong Station was regarded as the main depot, and arm routing from Hudong to South Liucun and from Hudong to Daxin on North Tongpu Railway as well as small rotation locomotive routings on Yun Branch Line and Kou Branch Line. Such locomotive crew routing cannot adapt the new transportation organization way and the locomotive application model of "long routing, train circulating and crew shifting" after the adjustment of distribution of productivity. The intermediate operation link from the loading station to the unloading station must be optimized to the largest extent, and the locomotive routing shall be transferred from arm routing type to half-circulating and circulating routing so as to solve the conflictions between transportation capacity and power better and improve the transportation efficiency of Daqin railway so as to adopt the demand of fast development of transportation situation.

3 OPTIMIZATION PRACTICE OF LOCOMOTIVE ROUTING ON DAQIN RAILWAY

3.1 Optimization Process of Locomotive Routing and Crew Working System on Daqin Railway

Attached Table 2.

Table 2

Time for optimization		Change of locomotive routing	Model of locomotive	Traction way	Locomotive routing	Crew Working System
2003	September 1	Unit train of 10,000 tons operated on Antaibao-Hudong Second Site-South Liucun;	DJ ₁ and SS ₄	Double locomotive	semi-loop	Double shift single driver trial
2004	June 25	Combined train of 10,000 tons operated on Hudong-Chawu;	SS ₄	Double locomotive combined traction	Arm type	Single shift single driver
	August 5	Combined train of 10,000 tons operated on Hudong-Chawu-Qindong.	SS ₄	Double locomotive combined traction	Arm type	Single shift single driver
	December 29	unloaded unit train of 10,000 tons on Daqin railway extended to Beidongpu and Yungang Branch lines from Hudong Site I.	DJ ₁ and SS ₄	Double locomotive	semi-loop	Double shift single driver trial

Table 2 *Con.*

Time for optimization		Change of locomotive routing	Model of locomotive	Traction way	Locomotive routing	Crew Working System
2005	January 15	unloaded load train of 10,000 tons on Daqin railway extended to Beidongpu Yungang Branch lines and Kouquan Branch Line from Hudong Site I.	SS ₄ 、DJ ₁	Double locomotive traction	semi-loop	Double shift single driver trial
	February 5	5 pairs of unit trains of 10,000 tons on Daqin railway, double shift and one driver, connected on Chawu, and continuous shift was cancelled.	DJ1	Double locomotive traction	semi-loop	Double shift single driver trial
2006	March 28	20,000 tons trains between Hudong and Liucun are operated, one pair a day, and will be gradually increased to 20 pairs in the end of the year.	SS ₄	1 + 2 + 1	Arm type	Double shift single driver trial
2007	January 16	railway between North Qian'an and Lingjiaoshan of Qiancao Railway was open, and the locomotive routing extended to Lingjiaoshan.	SS ₄	Double locomotive traction	Arm type	Single shift single driver
	April 8	20,000 tons heavy haul train directly linked to the dumper at South Liucun Station, and empty trains collected at Hudong Site I and ran to all the loading stations along North Tongpu Line.	SS ₄	1 + 2 + 1	semi-loop	Double shift single driver trial
	July 21	HXD locomotive used to haul 20,000 tons train.	HXD	1 + 1	semi-loop	Double shift single driver trial
	November 16	Donggang Coal Port opened, and 10,000 tons unit locomotive's routing extended to Donggang.	SS ₄ and HXD	SS ₄ double locomotive and HXD light locomotive	semi-loop	Double shift single driver trial
2008	April 18	20,000 tons trains on Daqin railway run among the loading station-Hudong-South Liucun and Donggang. Both empty loaded and trains can be connected at Hudong Station.	HXD	1 + 1	whole loop	Double shift single driver trial
	July 14	10,000 tons locomotive routing extended to Xuejiawan Station on Dazhun Railway.	HXD	light locomotive traction	Arm type	Single shift single driver

3.2 Locomotive Routing and Crew Working System After Optimization

According to train types and models, different locomotive routings and crew working systems on Daqin railway are described as follows:

(1) for 20,000 tons combined train running on north Tongpu Line and Yun Branch Line-Hudong-South Liucun (Donggang): it is a circulated routing with Hudong as the locomotive depot. The type of traction engine is HXD, a complete servicing work is carried out after continuous running of 3100km. The crew team residents in Liucun and Donggang, and makes fast shift in Hudong or

all loading stations on Yun Branch Line.

(2) for 10,000 tons unit trains running on Dazhun Railway, North Tongpu Railway (extended to South Shenchchi), Yun Branch Line, Kou Branch Line-Hudong-South Liucun (Qindong and Donggang): it is a semi-loop routing with Hudong as the locomotive depot. The traction engine is HXD type, and a complete servicing work is carried out after continuous running of 3100 km. The crew team implements double shift and single driver, residents in South Liucun and Qindong and makes fast shift in Hudong.

(3) for 10,000 tons combined train running on North Tongpu Railway, Yun Branch Line, Kou Branch Line-Hudong-Qindong (Jingtang Port): it is the shoulder type routing with Hudong as the locomotive depot. The type of traction engine is SS4. The maximum continuous running mileage of locomotive is 1500 km as maximum. The crew team implements single driver operating, shifting at Chawu Station.

(4) for trains of 5,000 tons and unit trains of 10,000 tons running between Dabao railway and Hudong Station: DF8B is the traction type. The traction for 5,000 tons trains running between North Taiyuan and Hudong and Dazhun Railway and Hudong undertaken by Taibei Depot is SS4 locomotive, which will be changed at Hudong Station, using arm type routing.

3.3 Running Structures of Heavy Haul Train Change Along With That of Locomotive Routing

With the continuous optimization of traffic organization way and locomotive routing, the upgrading of traction power as well as the reasonable configuration of labor resources, the carrying capacity of Daqin railway has been greatly enhanced. Taking the running structure of heavy haul trains as example (see attached Figure 2): from September 2003 to March 2006, with the increase of pairs of unit 10,000 tons and combined 10,000 tons trains, the number of 5,000 tons trains were gradually reduced. Since July 2006, Hudong Station started to depart only 10,000 tons and 20,000 tons trains. Starting from August 2007, 2 sets of HXD locomotives were taken to replace 4 sets of SS4 locomotives for the traction of 20,000 tons combined trains. The quality of traction has been quadrupled, while the locomotives and personnel inputted have only been doubled.

3.4 Implementation of Separation of Ground Service and Train Crew Work

In order to reduce the servicing work time of the crew in locomotive depot and improve the performance of locomotives, several measures have been taken, e. g. enlarge the scales of locomotive depots and turnaround

depots, a professional locomotive cleaning and maintenance team has been established. After locomotive entering the depot, the inspectors and maintainers of ground service take the job that originally belongs to the train crews, so called separation of ground service and train crew work.

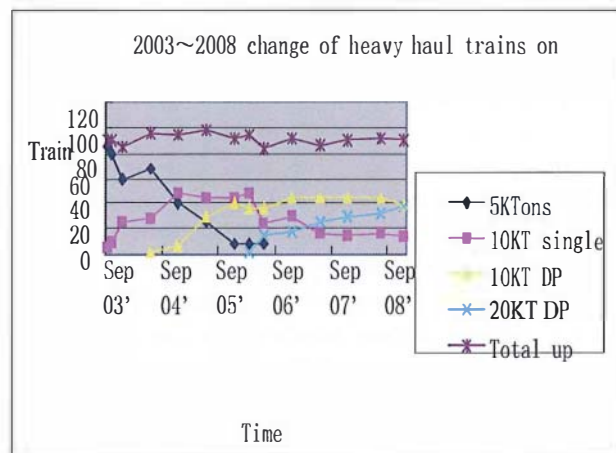


Figure 2

4 ACHIEVEMENTS OBTAINED AFTER THE OPTIMIZATION OF LOCOMOTIVE ROUTING OF DAQIN RAILWAY

4.1 The Extension of Personnel and Locomotive Routing Have Enhanced the Labor Efficiency

After the optimization of locomotive routing of Daqin railway, the running distance of SS4 locomotive has been extended to 1500km from 620km, and to 2800km for maximum during the construction period. The running distance of HXD locomotive has reached 3100km. The coverage of "double shift and single driver working system" has changed to "get on duty at Hudong-departure at the loading station-shift at South Liucun-return to loading station-get off duty at Hudong" from the original "get on duty at Hudong-departure at Hudong Site II- shift at Chawu-shift at South Liucun-shift at Chawu-get off duty at Hudong". Trains of 10,000 tons and 20,000 tons can run smoothly at Chawu and Hudong stations successively, which not only makes the stop time of locomotive at stations reduced 3 hours, but also saves labor of nearly 100 crews by canceling the shift. Because of proper measures taken, the traffic volume and number of locomotives on service have increased, meanwhile, the rate of increase of crew members has reduced.

4.2 The “separation of ground service and train crew work” Has Improved the Quality of Locomotive Servicing Operation

In May 2004, the “separates ground service and train crew work” was implemented for the first time on Daqin railway. The maintainers of ground service are responsible for the cleaning, lubrication, self-inspection and repairing, withdrawing tickets and check experiment; and the crew members go through off-duty formalities in the dispatching office, namely, delivery of responsibilities, dynamic ticket withdrawing and transfer the storage of conveyor documents. The optimization of servicing operation guarantees the quality of locomotives and improves the efficiency, the time spend on assistant service and locomotive service by crew members has been reduced by respectively 45 minutes and 25 minutes, and the utilization rate of servicing line has been enhanced by 20% with seamless connection of different links.

4.3 Optimization of Locomotive Routing Has Accelerated the Reform of Repairing System

4.3.1 Significant technical renovation has been carried out on SS4 locomotive

Since October 2004, the domestic SS4 locomotive has been through technical reform of heavy-haul traction performance in 4 aspects. To be specific, automatic neutral section passing device was installed to realize synchronous manipulation and passing neutral section of master and slave locomotives; No. 13 steel coupler with C level was replaced by the one with E level to improve the anti-impact performance of coupler; the MT-3 type draft gear was replaced by plastic rubber one to reduce the impact to the locomotives from the wagons; a communication radio was opened using GSM-R network to make train crews conduct communication through network and transmit dispatching order in-time. In order to improve the locomotive performance to match the heavy haul transport, 22 technical reforms were made in five aspects, namely, mechanism, electrification, brake, traction and detection. In particular, a series of scientific research projects have been carried out to enforce safety control of running gear of locomotives through scientific monitoring means, e. g. development and installation of “axle temperature alarm device”, “alarm device of locomotive driving wheel loosening”, “anti-slip monitoring system” and “running gear members of locomotive anti-falling device”.

4.3.2 Optimization of Auxiliary repair of locomotives

(1) The auxiliary repair way of SS4 locomotive has been optimized with repair mileage properly extended. Since the year of 2004, in order to satisfy the demand of heavy haul traction and locomotive routing optimization of Daqin

railway, the newly delivered SS4 locomotive saw auxiliary repair miles being extended to 40,000 ~ 60,000km from 30,000km, and one light repair after three times of auxiliary repairs was adjusted to after twice auxiliary repairs. The two measures have helped to reduce the number of auxiliary repair locomotives by one third, and of light repair locomotives by 20%.

(2) Efforts have been made to explore repair system for HXD locomotive. The repair shall focus on production line stage and centralized repair according to the characteristics of HXD locomotive. To be more specific, to increase the scale of special repair and to reduce the time of auxiliary repair, to conduct repair system of combining preventive repair and actual state repair. The special repair became more effective after improving light repair techniques and elaborating repair time table and scale. And finally a new repair system was shaped up with combination of half year repair (running mileage of 140,000 – 150,000km), yearly repair (running mileage of 280,000 – 300,000km) and two years repair (running mileage of 560,000 – 600,000km). The new repair system has not only saved huge amount of repair cost, but also increased 5 more serviceable locomotives everyday.

5 PROBLEMS REMAINED TO BE SOLVED FOR FURTHER OPTIMIZATION OF LOCOMOTIVE ROUTING ON DAQIN RAILWAY

5.1 Influences to Carrying Capacity of Hudong Station Site I From Cross Routing

At present, all heavy haul trains depart from or pass by Hudong Station Site II are the ones of 10,000 tons and 20,000 tons. The unloaded trains returned back to Hudong Station include 20,000 tons combined trains, 10,000 tons unit trains, 10,000 tons combined trains and 5,000 tons trains. The number of running pairs of empty trains and heavy haul trains are unbalanced. Without interruption of construction, if Hudong Site II daily run 90 loaded trains, the number of unloaded trains returning back from west of Chawu Station shall reach 120 sets. There are two reasons for this unbalance. First of all, after arriving at Liunanerchang Station, trains with 20,000tons shall be separated before being unloaded, the leading locomotive shall haul the fore part wagons to the dumper, locomotive at the middle part shall haul the rear end wagons to the dumper, then, the empty wagons shall be recombined. After the completion of empty train compound operation, the whole train has comparatively long time of air filling, so in order to shorten the circulation time, after the unloading of the 20,000 tons train directly going downward to the port station, there will be around 20 wagons return in the form of empty load train of 10,000 tons. Secondly, most combined trains are loaded or unloaded at different stations, when returning back,

empty wagons are not recombined or are separated before arriving at Hudongyichang. The second reason is that because most of the combined trains of 10,000 tons have different loading stations and unloading stations, when they return in empty load, no combination will be carried out or decomposition will be carried out before arriving to Hudong Site I. Therefore, the empty trains that arrive in Hudong Site I will enter the warehouse by wagon taken out from Path 11 ~ 20, or locomotives from the warehouse will come for combination, horizontally cutting the west throat, has seriously affected the empty train passing capacity of Hudong Station. Therefore, interference of crossing routes must be reduced so that empty trains that arrive to Hudong Site I can be fast diversified, and to compress the time of departure to the largest extent and guarantee the smooth running of the empty train line.

5.2 Connection of wagons in Hudong Site II is not compact

As the flagship and an important shunting yard where dispatch heavy haul trains of Daqin Line, it is required to handle the pass or quick shift of more than 25 train sets with carrying capacity of 20,000 tons in 24 hours, and at the same time, to collect about 50 train sets of 10,000 tons and 60 train sets of 5000 tons from North Tongpu Line, Dabao Line, Dazhun Line, Yun Branch Line and Kou Branch Line in order to finish traffic volume of 400 million tons. The wagons at the shunting yard shall be combined into trains of 10,000 tons or 20,000 tons according to wagon types, coal categories and destinations. So the control center shall consider to group the trains of same or similar destinations, the same coal category, and the same type into the same arrival-departure line. However, in actual operation, it is very difficult to realize the above requirements. At the same time, restricted by non-unified locomotive models and different crew configuration standards of the Daqin railway, the locomotive models used for compound 10,000 tons and unit 10,000 tons and 20,000 tons cannot be adjusted mutually (SS4 locomotive for traction of compound 10,000 tons trains, and HXD locomotive for traction of unit 10,000 tons and 20,000 tons trains). The realization rate of periodical plan within 3 hours for the trains to be departed after grouping in Hudong Station is not high. Although Hudong electrified locomotive depot and Hudong Station have established the mutual contact system and implement the 1 ~ 2 hours menu type locomotive demanding plan, the quantity and the type of locomotives that enter the warehouse shall keep consistency with that in Hudong Site II. Connection not match often occurs on the wagons. Therefore, two kinds of consequences have been caused; first is there are a lot of locomotives left in the depot or locomotive running line to be departed from the warehouse; and the second one is long-time waiting for locomotives after being connected with heavy haul

trains in Hudong Site II. Therefore, the station must organize running more the trains of 20,000 tons and less trains of compound 10,000 tons and unit 10,000 tons, which can not only improve the operation efficiency of Hudong Site II, but also reduce the rates of decomposition of compound 10,000 tons trains in middle stations and return with empty load in small wagons.

5.3 Servicing ability of turnaround point is insufficient

Among the 6 servicing points in Daqin railway and Qiancao Railway, the servicing ability of Hudong Depot is 51%, and the rest 5 occupy 49%. In order to guarantee the quality of locomotives being used, a complete servicing operation must be carried out for SS4 locomotive after continuous running for 1530 km and HXD locomotive for continuous running of 3100 km. Because the concept of servicing for HXD locomotive is different from the domestically manufactured DC locomotive, it is not satisfied with only separation switch operation and sand and oil supplement in the warehouse, dynamic test and operation log downloading are also required to carry out fault diagnosis and treatment on the electric part of locomotive by analyzing the operation status of the locomotive. However, except Hudong Depot, at present, the rest back-turning points do not possess the conditions of servicing operation on HXD locomotive due to the restrictions of ground service personnel and technical capacity. If electric fault occurs on locomotive during running, it can only be treated in Hudong depot, which has increased the shift operation of the number of locomotives entering and leaving the warehouse in Hudong Site I and II. Therefore, the technical capacity and operation level of servicing of the back-turning points shall be improved to reduce the locomotives entering Hudong depot in advance before reaching the regulated kilometers of running, and to effectively improve the use rate of locomotives.

6 PROPOSALS AND COUNTER MEASURES

With current traffic organization, locomotive application and carrying capacity of equipments, Under current transportation organization method, locomotive and equipment passing ability conditions, the traction quality, the train running speed and density on Daqin railway has reached the limit. In order to further improve the transportation capacity, the following measures shall be adopted:

6.1 To Advocate the Plan of Fully Connection of Personnel and Locomotives of Trains of 20,000 tons

The trains of 20,000 tons running between loading points and unloading stations (such as South Liucun, Donggang and Caoxi, etc.) shall be serviced once after the loco-

tives circulating twice. The crew shall change the shift in the loading station and the unloading station. By compressing the shift operation time of trains of 20,000 tons in Hudong Station, the passing ability and transportation efficiency of Hudong Station have been further improved to reach the target of saving locomotives and personnel. From the practice and conclusions drawn from the shift of crew of 20,000 tons trains in loading stations on Yun Branch Line since July last year, it has been proved that under the preconditions of strengthening dispatching conduction level and station operation connection, it is completely feasible to extend the empty train crew routing of 20,000 tons on Daqin railway to the loading stations in North Tongpu Railway and Yun Branch Line. In order to increase the transportation volume on Daqin railway, and the running trains of 20,000 tons reach 52 pairs, this measure will be very effective under the situation of the grouping ability of the two sites of Hudong is not sufficient.

6.2 Double-shift and Single Driver System is used to run Combined Trains With Carrying Capacity of 10,000tons

At present, all the combined trains on Daqin railway take shift at Chawu Station, the capacity of which is still the 'bottle neck'. By strengthening the training on crews, the double-locomotive and single driver implementation method will be realized under efforts in the end of 2009. Chawu Station will only keep the shifts of screw of Jialing and Gaogezhuang disconnection parts, the rest locomotive routing will be fully connected. Eventually all the crews on Daqin railway will possess the qualification of working on trains of 10,000 tons and 20,000 tons with different traction methods.

6.3 Fast Servicing Point to be Built at Hudong Section II

After capacity expansion, the out depot routing between

Hudong locomotive depot to Hudong Site Ⅱ was extended toward west. The distance between the last group of switches of the depot to the braking post is 2.5km and the running distance from the switches to coupling location is 6km. If the coupling failed due to long time stay at the locomotive running line or in the depot, cars must be arranged to send technicians and fittings to the station for treatment, which will delay the receiving and departure of trains in the station. If a fast servicing depot with 6 lines is built at the east end of Hudong Site II, the time of locomotive running out of depot and staying on the waiting line can be reduced.

6.4 Connection of Locomotive Routing Between Daqin Railway and Dabao Railway to be Realized as Soon as Possible

As an important corridor of increasing the traffic volume of Daqin railway, Dabao Railway is going to finish its electrification upgrading soon. After opening to traffic, the trains can directly enter Daqin railway from Dabao Railway, instead of to Hudong Station by turning around at Pingwang Depot. If routing connection was realized at the early stage of electrification of Dabao Railway, and the principle of "train circulating and crew shifting" was utilized, the transportation efficiency of Daqin railway would be even higher.

6.5 Servicing Abilities and Test Methods of all Turnaround Depots to be Improved

In order to relieve the servicing load of Hudong and reduce the number of times of locomotives entering and leaving warehouse in Hudong Station, test equipment for HXD type locomotive was installed at turnaround depot, and technicians and maintainers were also arranged to guarantee the quality of locomotive and lay foundation for the complete connection of the locomotive routing on Daqin railway.