Republic of Uzbekistan
Uzbekistan Railways

Project for Capacity Development on Upgrading Track Maintenance and Train Operation Skills on Tashguzar - Kumkurgan Railway Line

Final Report

September 2013

Japan International Cooperation Agency

Japan Transportation Consultants, Inc.

UZ
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List of Abbreviations

Abbreviation	Description
ADB	Asian Development Bank
BTC	Beginning of Transition Curve
BCC	Beginning of Circular Curve
BIT	Beginning of Intermediate Transition Curve
BRT	Beginning of Reverse Transition Curve
CL	Curve Length
C/P	Counterpart
ECC	End of Circular Curve
ETC	End of Transition Curve
EIT	End of Intermediate Transition Curve
ERT	End of Reverse Transition Curve
F/S	Feasibility Study
IC/R	Inception Report
JBIC	Japan Bank of International Cooperation
JCC	Joint Coordination Committee
JICA	Japan International Cooperation Agency
JTC	Japan Transportation Consultants, Inc.
MOU	Memorandum of Understanding
M/P	Master Plan
ODA	Official Development Assistance
PDM	Project Design Matrix
PIU-E	Project Implementation Unit- Electrification
RRB	Regional Railway Branch
TCL	Transition Curve Length
TOR	Terms Of Reference
UTY	Uzbekistan Temir Yollari：Uzbekistan Railways

Chapter 1

Project Summary

1.1. Background

Uzbekistan must bear high distribution costs caused by its location as a double landlocked country. Since these costs constrain the development of industry, construction of transport infrastructure is an urgent issue. Although railways play an important role for freight traffic and cover 46% of land transport freight traffic in Uzbekistan (on a ton-km basis in 2011, excluding pipeline traffic), the railway sector needs to be further strengthened because railway freight is expected to further increase with recent rapid economic growth and growing reconstruction assistance for the reconstruction of Afghanistan. Against this background, JICA and the Government of Uzbekistan have implemented the ODA loan projects “Railway Transportation Modernization Project (UZB-P2)” (L/A signed in 1992) and “Tashguzar-Kumkurgan New Railway Construction Project (UZB-P8)” (L/A signed in 2004).

The railway line between Tashguzar and Kumkurgan is a 222km long single track, non-electrified line located in a mountainous area. The difference in altitude is 1,180m and the section has many steep gradients with more than 10‰ grade and sharp curves with less than 600m radius. Due to the increase in freight and passenger transportation volumes, it was necessary to enhance the capacity related to train operation and track maintenance skills in order to correspond to the traffic demand on the line.

Given this situation, JICA dispatched experts for the “Capacity Development Project of Tashguzar -Kumkurgan New Railway Construction in Uzbekistan” from April to August 2010. In the project, the experts pointed out that the following countermeasures are required: access to information on precise railway alignment through surveying as well as development of appropriate train operation, track rectification and locomotive maintenance plans. Meanwhile, JICA and the Government of Uzbekistan agreed to provide an ODA loan for the implementation of the “Karshi - Termez Railway Electrification Project” in February 2012. Since transportation capacity could be improved by changing locomotive traction from diesel power to electric power, the issues mentioned above need to be solved soon in order to improve the effectiveness of past and future ODA loan projects.

Accordingly, JICA decided to conduct the “Project for Capacity Development on Upgrading Track Maintenance and Train Operation Skills on Tashguzar - Kumkurgan Railway Lines” and entrusted Japan Transportation Consultants, Inc. to carry it out. The experts will assist UTY in developing train operation, track rectification and locomotive maintenance plans for railways in mountainous areas, which will contribute to the establishment of an operating structure corresponding to future traffic demand.

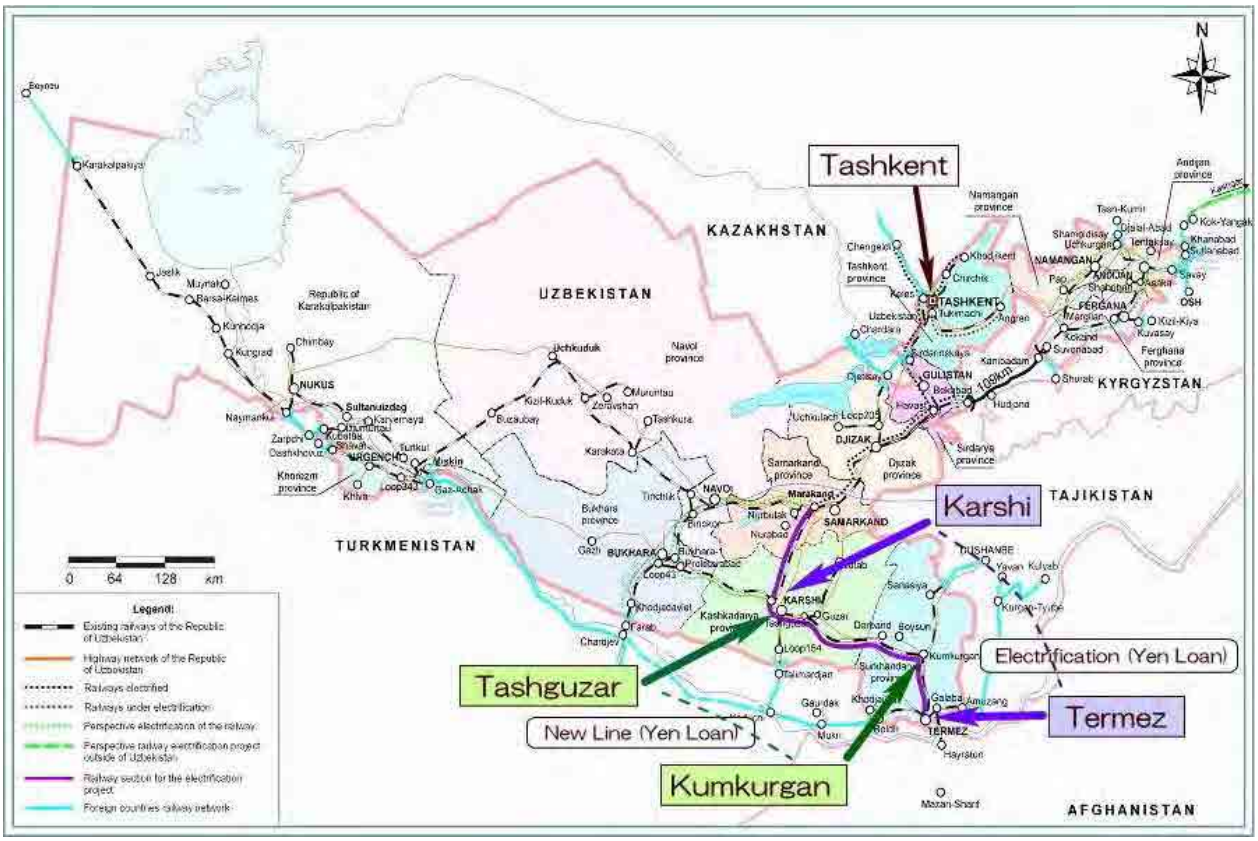
UTY was established by Presidential Decree No. PD-982 and its objectives are to ensure sustainable and safe operation of the railways in Uzbekistan. Although the supervision of railway transportation safety remains a task of the Uzbekistan Government, UTY is the sole organization responsible for the overall management and operation of railway transportation. UTY was later re-organized as a Joint Stock Company with 100% of the stock certificates belonging to the Government.

1.2. Location of the Project

Because the railway network in Uzbekistan was constructed during the former Soviet Union era, some of the rail routes passes across the Uzbekistan's national border and return again. The railway network in the south-eastern region which connects Tashguzar (Kashkandarya province) and Termez (Surkhandarya province) used to pass through Turkmenistan territory. Consequently, customs procedures and locomotive switch-overs were major bottlenecks. The Government of Uzbekistan therefore constructed a new 222km long railway line between Tashguzar and Kumkurgan to connect the railway network within the country's borders. This project was financed with a Yen Loan (UZB-P8: L/A signed in October 2004) covering the costs for the construction of 5 bridges, installation of signaling and telecommunications, and procurement of rail and track materials. In addition, the Government of Japan decided to provide a Yen Loan for the "Karshi - Termez Railway Electrification Project" (UZB-P10: L/A signed in February 2012) in order to increase the transport capacity on the same section.

Meanwhile, the electrification of the section between Karshi and Marakand is also being planned with financial support from ADB. When both electrification projects are completed and the sections connected with the already electrified Tashkent – Marakand line, freight transportation capacity will be drastically increased which in turn will contribute to reconstruction projects in Afghanista.

This project targets the newly constructed line between Tashguzar and Kumkurgan (refer to [Fig.1-1]). The railway track in Uzbekistan was constructed based on the design standards of the former Soviet Union era and has a 1,520mm gauge. The target section of this project consists of non-electrified single track.

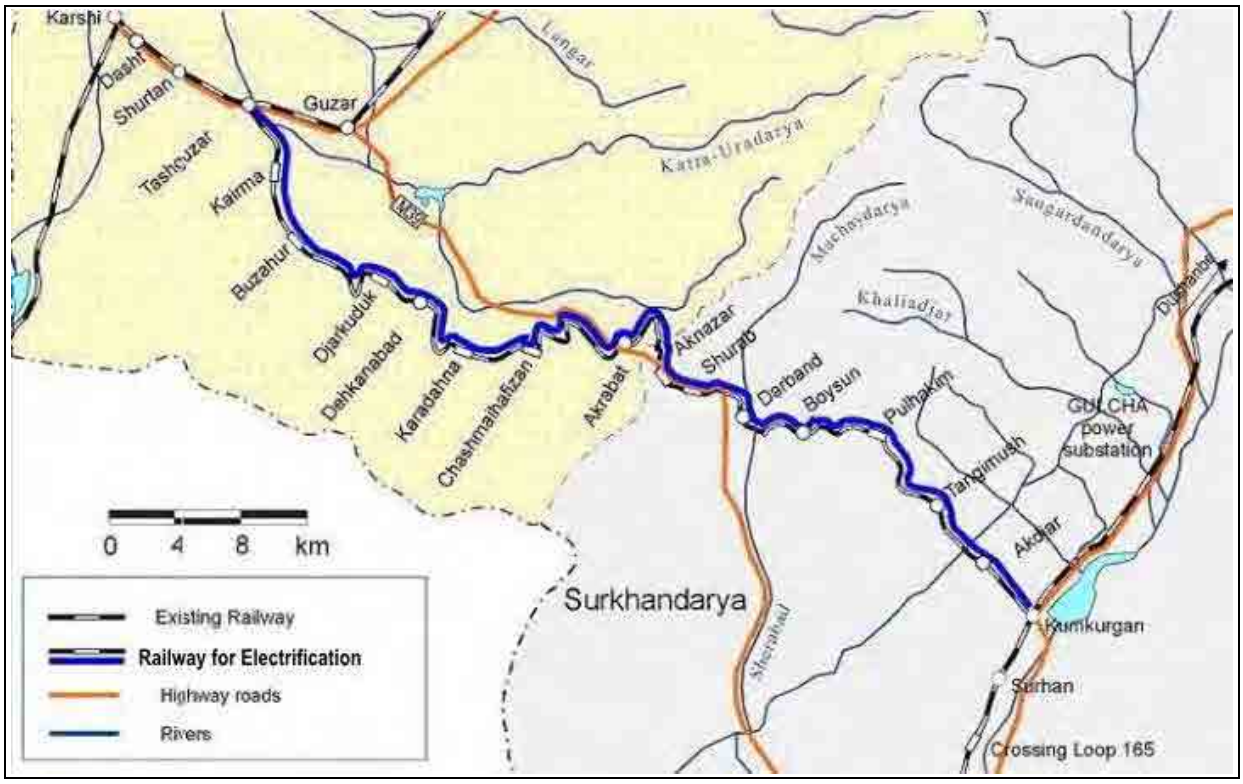


(Source: Final Report of JICA Experts, 2010)

[Fig. 1-1] Location of the Project within Uzbekistan

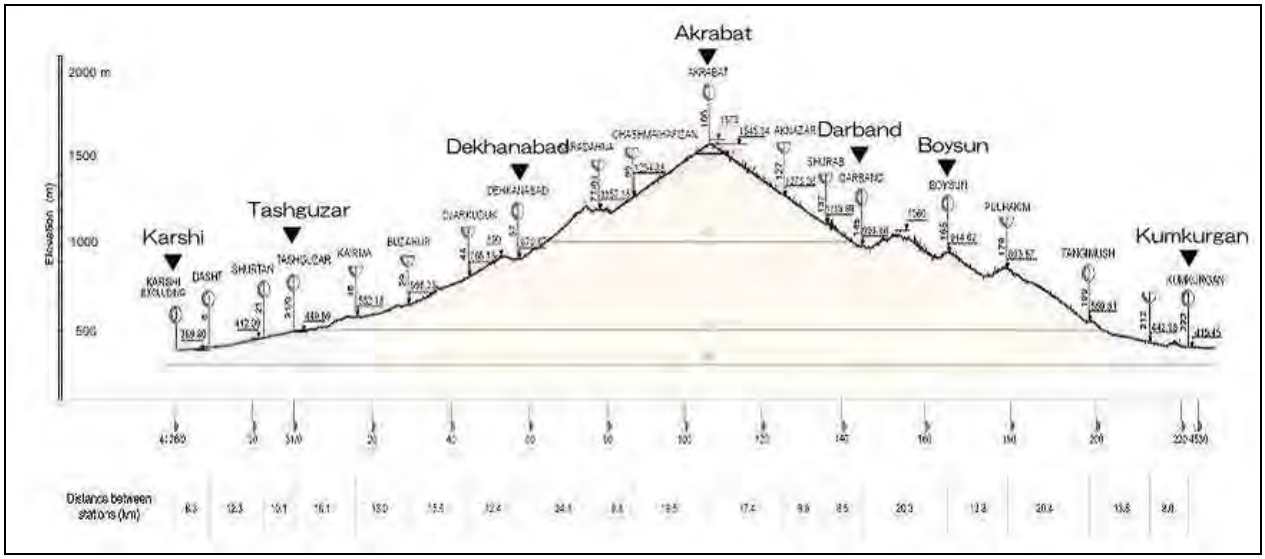
The railway network in Uzbekistan is used to transport not only domestic traffic or for connections to neighboring countries but also for international traffic as part of an international logistics link. The target railway line of this project (Tashguzar - Kumkurgan) is located on the trunk line extending toward the border of Afghanistan and Tajikistan and branches east at Marakand on the trunk line from Tashkent to Turkmenistan.

Since the line had to pass through the mountain range between Kashkandarya and Surkhandarya, it was constructed with continuous steep grades and sharp curves (refer to [Fig. 1-2]). As shown in [Fig. 1-3], Akrabat Station is located at the summit and almost all sections on either side consist of one-sided grades with a 1,180m difference in elevation.



(Sources: Final Report of JICA Experts, 2010)

[Fig. 1-2] Location Map of the Work Scope



(Sources: Final report of JICA Experts, 2010)

[Fig. 1-3] Vertical Alignment of the Line

The locomotives operated on the line are diesel locomotives manufactured in the USSR in the 1980s (type TE10M and TE16M) and are designed as multiple units with two or three coupled bodies. The trains operated on this line use locomotives with 3 or 4 coupled bodies at the front, and long train sets have an additional locomotive at the back of the formation to help push it.

1.3. Project Purpose and Output

Prior to implementation of this project, the following issues have been identified as existing difficulties on the target section.

- The line has many sharp curves and steep grades as the route was constructed without tunnels despite passing through a mountainous area.
- The track alignment is unfavorable and the maintenance level insufficient on some sections.
- Data on current track conditions are not well organized although they are essential for track maintenance and train operation planning. The data might also not be consistent with actual site conditions.
- The locomotives are in need of repairs and there is a possibility that the operation plan is not suitable considering the capacity of the locomotives and the heavy loads imposed.
- Even after electrification of the section, it is possible that its transport capacity cannot be maximized due to the lack of an appropriate rolling stock and train operation plan.

Against this background, JICA made plans to implement a technical cooperation project aiming to develop UTY's capacity to operate and manage railway lines in mountainous areas and had a series of discussions with UTY. As a result of these meetings, both sides reached an agreement and a Memorandum of Understanding (MOU) including a Project Design Matrix (PDM) and a Plan of Operation (PO) was signed on March 20, 2012 between the Chief Representative of the JICA Uzbekistan Office, Mr. Y. Ejiri and the Chairman of the Board of UTY, Mr. A.J. Ramatov.

The document contains all essential matters and the project purpose and output are as outlined below:

(1) Project Purpose

The purpose of this Project is "Technical capability of UTY to develop valid train operation plan, track rectification plan and locomotive maintenance plan for the railway in mountain area is strengthened", and is expected to be achieved at the end of the Project period.

The overall goal of the Project is "More reliable and efficient railway transport network responding to the transit demands is achieved" and is expected to be accomplished by multiplier effects with other related projects in the future.

(2) Project Output

The Project outputs consist of the following:

1) Proposal to raise the effectiveness of the train operation plan is prepared
2) Proposal to raise the effectiveness of the track rectification plan is prepared
3) Proposal to raise the effectiveness of the locomotive maintenance plan is prepared

1.4. Essential Policy of Project Plan

As an implementing method of this Project to solve the current issues mentioned above, the following three approaches were specified as components of this Project in the PDM:

- Train operation plan
- Track maintenance plan
- Locomotive maintenance plan

As to the Experts' formation, five fields were designated in the TOR, namely (1) Team leader/Operation Planning, (2) Track Rectification Planning (Alignment Plan), (3) Track Rectification Planning (Track), (4) Electric Locomotive, (5) Survey.

Among the three approaches specified in the PDM, Track maintenance plan consisted wide range of concept including "Track maintenance work" which requires daily maintenance work to keep good track condition, and "Track realignment work" which needs civil works to reconstruct the alignment of the track to materialize smooth train operation by eliminating sharp curve and steep grade. Although these two concepts have common issues, this Project have been implemented by assigning two Experts having different expertise respectively, and then approaches of this Project was reorganized into four, basically.

(1) Train Operation Planning

In the broad sense of the term, "Train Operation Planning" entails examining the following subjects in sequence.

Traffic demand by railway >> Train set formation >> Rolling stock plan >>
>> Plans for "Train running time" and "Time, speed and load" >> Train operation plan >>
>> Mobilization plan of rolling stock and crew >> Rolling stock maintenance plan

Since track conditions such as curves and grades influence the performance of locomotives operated on railway routes in mountainous areas, special skill is required for "Rolling stock plan" , "Plans for Train running time" and "Time, speed and load" among the subjects above. If the maximum load of one train set is limited at this stage of examination, then we have to return to the stage of "Train set formation".

This "Train Operation Planning" component is aimed at developing the capacity of effective operation planning and maintaining maximum use of the capacity of the whole railway system.

(2) Track Rectification Planning (Realignment Plan)

This approach is to make a plan of re-alignment civil works necessary for ensuring smooth train operation by eliminating sharp curve and steep grade. In the case where the track is located in a flat land and width of roadbed has enough space, track can be shifted horizontally by heavy track maintenance machineries. However roadbeds have to be prepared by adding embankment or cutting line side earth in general and it

requires civil works and necessary budget. As the purpose of this Project is to develop capacity of planning process, the implementation of these civil works is not included in the scope.

(3) Track Maintenance Planning

This approach is to improve effectiveness of daily maintenance work and develop capacity to make its work plan for keeping good track condition, by utilizing existing machineries and tools. Along with this Project, JICA was planning to procure and provide equipment for track maintenance work to UTY, and in the TOR of this Project, assistant work to help procurement procedure by JICA was included. The activities of the Expert of this Project were not necessarily supposed to use the provided equipment; however, if the equipment was delivered on-site during the period of Expert's assignment, it could be utilized for the Expert's activities.

(4) Electric Locomotive Maintenance Planning

When the electrification of the line is completed, both UTY's existing electric locomotives as well as the newly introduced electric locomotives will be in use. Therefore UTY needs to establish necessary inspection and maintenance system in the relating Depots and Workshop. The electrification projects both by JICA and ADB include procurement of necessary equipment for maintenance of electric locomotives in Depots and Workshop of UTY in their scope. However, as the timing of the installation of such equipment would not be earlier than the period of activities of Expert in the field of locomotive maintenance of this Project, the scope of the Expert was planned to be aiming at developing the capacity of relevant organizations of UTY utilizing existing machinery and equipment there. In addition to that, the advice for determining appropriate technical specifications for the newly introduced electric locomotives was also included in the activities.

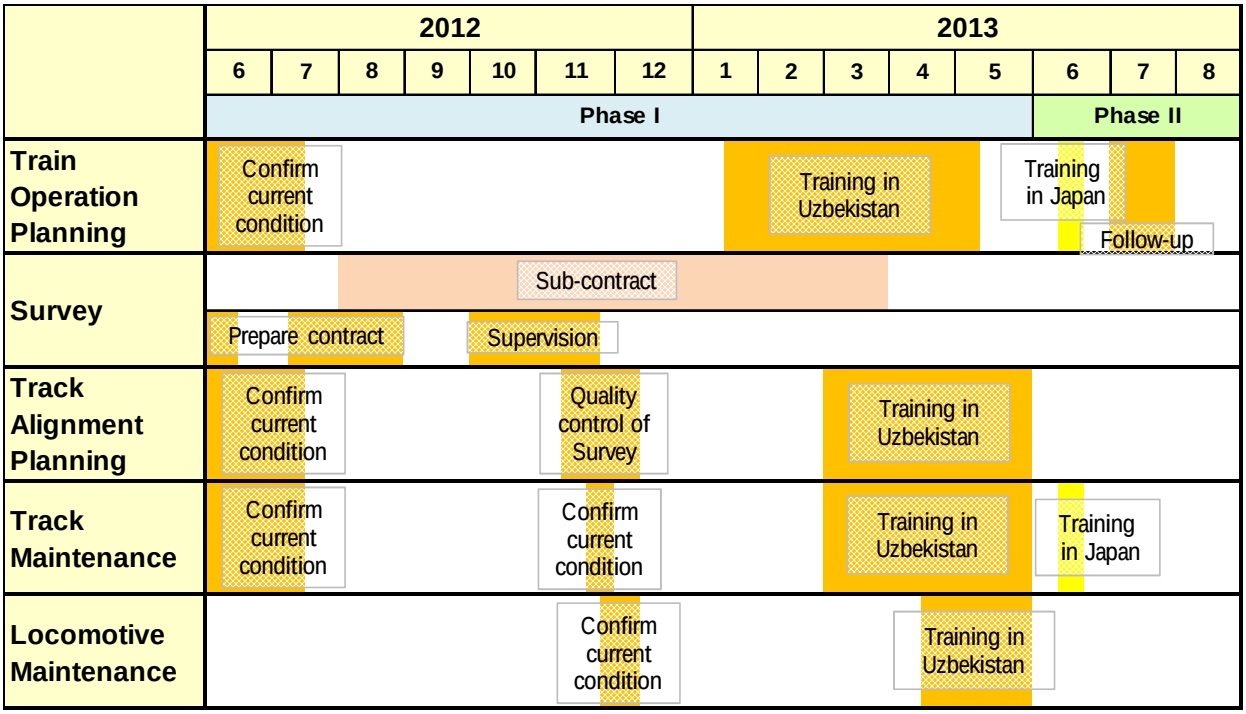
The four approaches mentioned above are mutually related to each other as follows:

- The train Run Curve is the basis when deciding Time, Speed and Load and is determined by using various track factors. The track rectification plan also affects the determination of the Run Curve.
- The performance of the newly introduced locomotives affects the planning work when determining "Minimum Running Time" and "Time, Speed and Load".
- Since the specification and structure of the locomotives determine the load on the track components, track maintenance work is thus affected.
- The load on the locomotive mechanics depends on the track alignment (condition) and consequently affects the planning of locomotive repair and maintenance work.

Because of the reasons listed above, it is better to tackle the approaches of this Project in a parallel way instead of independently.

1.5. Work Schedule

This Project commenced its activities in Uzbekistan in June, 2012, after preparation work had been done in Japan until May. The Phase 1 was until the end of May, 2013, followed by Phase 2 and on-site work was finished with the Project Completion Meeting held on August 5, 2013. Summarized work schedule is shown in [Fig. 1-4].



[Fig. 1-4] Work Schedule

With the commencement of Phase 1, Experts in the field of Operation Planning, Track Rectification Planning (Alignment) and Track Maintenance Planning collected information with observation trip to the target section, in order to understand the current situation of UTY in the respective field. The Track Profile that indicates curve radius and gratitude of this section was examined at the time of dispatch of JICA experts in 2010, and it was found that the data was not necessarily accurate representing existing track, therefore the scope of the survey in order to reconfirm exact track alignment by local subcontract agreement was planned in this Project. The Expert in the field of survey has begun his work to confirm the technical capabilities of survey subcontractors, as well as to examine the technical specification of the contract.

Until the completion of the agreement of survey work, it took more time than expected, but it started finally in August and survey Expert had undertook its supervision. In the original plan, it was expected to complete creating a Track Profile based on this survey work by November, and the experts would commence their activities depending on the current state of the track represented by the survey output. However, considering the technical capabilities of the Design Institute as a contractor, Expert in the field of track alignment was required to check the quality of deliverables during the on-site work in November to December, 2012, and

after that in Japan. The survey work had significantly delayed than expected, and its completion was the end of March 2013. Therefore, the assignment of Experts in Track Rectification Planning (Alignment) and Track Maintenance, whose activities would be based on the current state of the track of the target section, had to be postponed. The progress of the rescheduling will be described in detail in Chapter 3.

In the field of Operation Planning, Expert conducted seminars and practical workshop with C/P of relevant departments of UTY, from the second half of January 2013 until early May, in Uzbekistan. In the period of Phase 2, a training program in Japan was conducted, followed by a follow-up activities for the participants in July in Uzbekistan, then it was completed in early August by a Wrap-up seminar.

In the field of Track Rectification Planning (Alignment) and Track Maintenance Planning, training in Uzbekistan for the C / P was conducted for three months from March till the end of May 2013, and completed their activities at the end of Phase 1. In the initial plan, training of 10 C/Ps in Operation Planning were to be invited, however, as the need for training in Japan in Track Maintenance field had been recognized within the end of 2012, in consultation with UTY as the executing agency and JICA, 3 participants were transferred to the field of Track Maintenance training and the number in Operation Planning was reduced to 7.

For Electric Locomotive Maintenance field, first field work commenced in the end of November 2012, in order to confirm the current situation, and seminars in Uzbekistan were conducted for one and half months from the second half of April, 2013.

In the initial plan, Phase 1 would end in April 2013, activities in Uzbekistan would end in the beginning of July, then the contract with JICA for this Project would conclude by August 15, 2013. After rescheduling due to the delay of survey work, the end of Phase 1 moved to the end of May, and the contract conclusion was amended to the end of September. The detailed work schedule will be described in Chapter 3, 3-1.

Chapter 2

Project Output

2.1. Train Operation Planning

2.1.1. Confirmation of Current Condition of Target Railway Section

As UTY has basically managed the railway system in accordance with operational technology from the former Soviet Union era, the concepts of “Minimum train running time” and “Time, Speed and Load” (hereinafter referred to as “Speed Constant”) are different from those used in Japan. In order to effectively advance the capacity development activities of this Project, it is important to confirm the differences regarding the concept of Speed Constant that exist between Uzbekistan and Japan.

As preparatory work for transport, operation and facility planning on the section between Tashguzar and Kumkurgan, the following items were confirmed to form part of the current situation:

(1) Current Situation of Train Operation

a) Tractive Load

The “Time, Speed and Load” data for each section was determined and arranged in a standard table. The value for the target section of this Project is 2,200 tons with 3TE10M type locomotive traction.

It was also confirmed that the train sets are composed based on this standard table. However, the Tractive Loads of the respective train sets were not disclosed and only the statistic materials available at the station office and in the Transport Statistics Center could be observed.

As a result of the field survey, most of the Tractive Loads were confirmed to be approximately 2,100 tons per train and thus seemed to be consistent with the standard table.

[Fig. 2-1] Type 3TE10M Diesel Locomotive

b) Train Set Formation

According to the train set formation records kept in the Transport Statistics Center and main stations, which are prepared in the station where the train set is formed and then handed to the locomotive driver, the number of freight cars in each train set was between 30 and 35.

Although the train set formation tables are used to record the number of cars and axles as well as total load, they do not contain information on the type of freight cars and the commodities carried.

As a result of the survey, all train loads were found to be between 2,000 and 2,200 tons, and it was

confirmed that the standard “Time, Speed and Load” table was observed.

c) Pattern of Operation

In Uzbekistan, freight train schedules are planned in the stations depending on requests from shippers based on the so-called origin principle in which operations are planned in accordance with demand. However, a train diagram pattern model is also used. The train operation procedure is as follows: After the composition at the origin station is completed, the operation request is notified from the station to the Operation Control Center. In response to this request, the Operation Control Center determines the operation plan and notifies it to relevant stations and depots. The respective parties then prepare locomotives and crew and prepare for the operation in accordance with this plan.

As a result of the survey, the number of trains per day was found to be around 14, which shows that almost the whole train schedule model pattern on this section is used up. In order to accommodate future increases in transport demand, the line capacity of the mountain section needs to be improved by reviewing “Time, Speed and Load” and the operation plan.

[Fig. 2-2] Freight and Passenger Train

d) Delay Shown in the Operation Records

Examination of the train operation records did not reveal any significant delays.

UTY’s locomotives are equipped with tachographs and their actual running speed is recorded. The analysis of the tachograph records showed no significant difference between actual running time on each section and the train diagram pattern model. However, examination of locomotive running conditions on the recorded charts revealed that the trains were operated at low speeds of around 20km/h over a long period of time on a continuous incline section.

According to the Driving Theory Manual of Russia (the former Soviet Union), the minimum continuous operation speed of type 3TE10M locomotives (the most common type used by UTY) is 23.4km/h. At the time of the survey, the trains were therefore running at the speed limit which might have caused heat generation of the main traction motor or generator.

The balanced speed of 2,200 tons on 15 ‰ grades for 3TE10M type locomotives is 25km/h which shows no less than the minimum continuous operation speed.

(2) Russian Software for Traction and Power Calculation (Ter Vsm)

When high-speed Talgo trains were introduced in January 2011, UTY began using the Russian made "Ter Vsm" software for running time assessment. After that, it was reported that experts were invited from Russia to conduct training for relevant staff. The software was then distributed to UTY's Train Operation Department, Operation Control Center, Locomotive Department and Power Supply Center as well as two Design Institutes, which shows that the software was put into practical use. Since there were plans to use this software as part of this Project, this possibility was examined during the early stages of the first on-site work.

Interviews with UTY and Boshtransloyiha (one of the Design Institutes) revealed that this software was actually being used only by the Design Institute and not UTY, which simply receives operation plans developed by the Design Institute using the Ter Vsm software.

Although the UTY staff in charge of operation planning has basic knowledge of operation theory, it was confirmed that they are not in practice able to utilize the computer software to operate it.

Because of this, the work plan of this Project was modified to also include practical training for UTY's C/Ps using simple software made in Japan to develop an operation plan for the mountain section. The training is also to include case studies of emergent management in unusual situations and countermeasures against heavy snow during snowfall.

(3) Identify Issues on Current Transportation Planning

UTY does not have such a long history of providing railway services in mountainous areas. The diesel locomotives used on this section were originally used on flat lines and have since undergone partial mechanical conversion.

In order to prepare a transportation plan for this section, it is necessary to develop a model operation plan which in turn requires the creation of a Run Curve.

However, interviews with UTY showed that the Ter Vsm software had in fact not been used by UTY. The experts therefore decided to create a standard Run Curve and collected necessary data to develop the diagram. The experts also tried to create a comparison model diagram for the electric locomotives which are assumed to be introduced after electrification. This was done by supposing their technical performance data, calculating their traction power and inserting the data into simple Run Curve software made in Japan.

(4) Current Track Conditions of the New Line

In the existing Track Profile obtained from UTY, the grade of the section is shown from the difference of altitude along the track at 100m intervals. In some locations, the grades of each 100m adjoining section vary extremely. If the actual vertical alignment of the track is as same as shown in the Track Profile, it is anticipated that some accidents may occur, i.e., the pantograph of locomotive becomes separated from the catenary due to the wide distance between the overhead catenary and the rail, or derailment of rolling stock by buckling due to unusual compressive forces generated to couplers.

2.1.2. Outline of Seminars in Uzbekistan

The expert of train operation planning has begun his activity in the project area from the middle of January 2013. He has implemented seminars for UTY's specialists in charge of train operation planning and locomotive. As a result of discussion with Mr. Djalalov, Head of PIU-Electrification, about the participants for the seminars, it was decided that the participants shall be not only the person who works at the Headquarters in Tashkent but also at Karshi RBB and Termez RBB. Then, 10 persons from each location were nominated. In addition, it was decided that the seminars in Tashkent shall be held 3 times a week from 2:00 p.m. to 6:00 p.m. The schedule of the Seminar was planned as shown in [Table 2-1].

[Table 2-1] Schedule of Seminars (Operation Planning)

Contents	Date	Hours
Tashkent		**(60)**
Outline of Transportation Planning	Feb./4,6,8	12
Time, Speed & Load, Allocation Plan of Rolling Stock, Allocation plan of Drivers, Train Operation Facilities	Feb./18,20,22,25,27, Mar./1	24
Train Running Curve, Train Diagram, Other Scheduling	Mar./25,27,29, Apr./1,3,5	24
Karshi		**(60)**
Outline of Transportation Planning	Feb./11,12	12
Time, Speed & Load, Allocation Plan of Rolling Stock, Allocation plan of Drivers, Train Operation Facilities	Mar./4-7	24
Train Running Curve, Train Diagram, Other Scheduling	Apr./8-11	24
Termez		**(60)**
Outline of Transportation Planning	Feb./14,15	12
Time, Speed & Load, Allocation Plan of Rolling Stock, Allocation plan of Drivers, Train Operation Facilities	Mar./18-21	24
Train Running Curve, Train Diagram, Other Scheduling	Apr./15-18	24

The name, division, position and assignment of the participants, who have attended until the last seminar at each place, are shown in [Table 2-2].

[Table 2-2] List of Participants (Operation Planning)

Name	Organization	Position	Duty
Tashkent			
Muhamedov Rustam	Strategic Development Department, Operation Control Center	Head/ Acting head of UTY's Operation Control Center	Supervision of train operation planning, train operation
Sagdullaev Bekzod	Operation Control Center	Train dispatcher	Control of train operation
Gaipnazarov Haitbai			
Matyakuboc Shuhrat			
Zainutdinov Nosir	Locomotive Repair Division Locomotive Operation Department Repair Division	Engineer	Supervision and control of locomotive repair schedule
Nabijanov Alisher			
Berdikulov Uchkun	Operation Control Center	Leading engineer of UTYs OCC	Drafting of train schedule
Hamzaev Farruh	Locomotive Operation Department	Deputy Head	
Abduramanov Azam	Tashkent RRB Train Operation Division	Deputy section manager of Freight train operation	Control of loading/unloading operations
Muhamedaliev Surat	PIU - Electrification project	Locomotive expert, PIU-Electrification, UTY	Supervision of train operation, training control
Karshi			
Mizaev Mansur	Train Operation Division Karshi RRB	Deputy Head of transportation division	Control of loading/unloading operations
Berdiev Akmal	Buzahur station	Head of station	Transportation Control
Islomov Bahrom	Repair depot Karshi	Chief machinist	Instruct other machinists
Yakubov Akbar			
Musaev Hamza		Machinist	Train operation between Karshi-Samarkand
Kamolov Kamol		Assistant machinist	Assist in train operation
Radjabov Muzaffar	Chashmaihafizan station	Assistant station official manager	Control of train operation
Ziyatov Saidulla	Karadahna station	Head of station	
Samadov Askar	Dehkanabad station	Deputy Head of station	
Ziyamov Tulkin	Karshi RRB administration	Procurement manager	Supervision of materials and finance procurement onto the Karshi region
Termez			
Hudoiberdiev Davron	Darband station	Head of station	
Hujamov Abdukodir	Tangimush station	Head of station	
Nusratullaev Husnuddin	Train Operation Division Termez RRB	Leading transportation specialist	Guidance to station workers
Aliev Farhod	Train Operation Division Termez RRB	Deputy Head of Transportation division	Control of loading/unloading operations

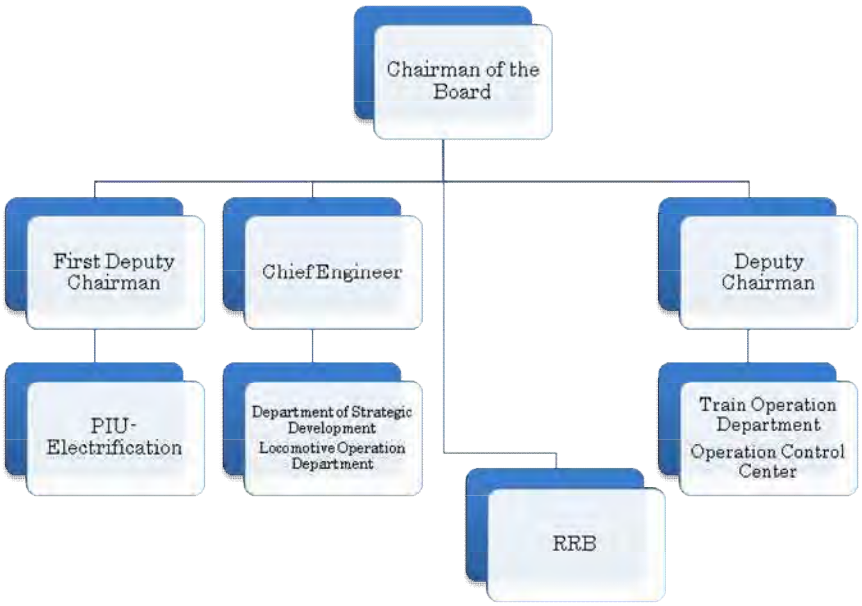
The schedule was designed to consist of three stages as shown in [Table 3-1]. “Outline of transportation planning” as the 1st stage was first conducted in Tashkent, Karsh, Termez, then 2nd and 3rd stages were conducted in each place respectively. The number of participants in each place and each stage is shown in [Table 2-3].

[Table 2-3] Number of Participants (Operation Planning)

Place	1st day of 1st series	1st day of 2nd series	1st day of 3rd series
Tashkent	11 (incl. 1 PIU-E member)	10 (incl. 1 PIU-E member)	10 (incl. 1 PIU-E member)
Karshi	12 (incl. 1 PIU-E member)	8	6
Termez	15	4	4

The organization which the participants belong to is shown in [Fig. 2-3]. Regarding the UTY departments related to train operation planning, the deputy chairman supervises electrification project, and the chief engineer supervises technical department and strategic planning department. The strategic planning department is in charge of technical planning, formulation of technical standards, international affairs, etc. The departments related to train operation planning is in charge of freight transportation, centralized train control, wagon operation including special-purpose vehicles, international freight transportation under the deputy chairman’s supervision.

Each Regional Railway Branch (RRB) is supervised by the board which is composed of the board members including the Chairman.



[Fig. 2-3] Outline of Organization regarding Train Operation Planning

The participants for the seminars are graduated from Railway University or Railway College, some of them have Master degree, and the level of their technical skills is high.

We initially planned to implement the seminars for 4 days at 1 time in Karshi and Termez after the 2nd stage of the seminar. However, a lot of participants for the seminars in both of the places were forced to participate from distant places and the burden in terms of time and expense was too much, and then we shortened the number of days by 1 day in order to reduce the burden, by omitting basic subjects which were already known to the participants. There was no influence to the contents of teaching and we recognized that the initial objectives were achieved.

At the end of seminar, we asked the participants to submit written feedback of the seminar's impression.

The schedule of the lecture and practice were modified and the actual date of the seminars at each place are shown in [Table 2-4].

[Table 2-4] Results of the Seminar (Operation Planning)

Contents	Date	Hours
Tashkent		**(53)**
Outline of Transportation Planning	Feb./4,6,8	12
"Time, Speed & Load", "Allocation Plan of Rolling Stock", "Allocation plan of Drivers", Train Operation Facilities	Feb./18,20,22,27, Mar./1	20
Preparation of Train Running Curve, Preparation of Train Diagram. Preparation of Allocation Plan	Mar./25,27,29, Apr./1,3,5	21
Karshi		**(48)**
Outline of Transportation Planning	Feb./11,12	12
"Time, Speed & Load", "Allocation Plan of Rolling Stock", "Allocation plan of Drivers", Train Operation Facilities	Mar./4,5,6,(7)	18
Consideration of Train Diagram, Preparation of Allocation Plan, Consideration of Yard Work Plan	Apr./8,9,10	18
Termez		**(44)**
Outline of Transportation Planning	Feb./14,15	14
"Time, Speed & Load", "Allocation Plan of Rolling Stock", "Allocation plan of Drivers",, Train Operation Facilities	Mar./18-20	15
Consideration and Evaluation of Train Diagram, Preparation of Yard Work Plan	Apr./22-24	15

It was agreed with PIU-E that the participants of the training in Japan to be conducted in June 2013 in the second Phase of this Project would be selected by Expert among the participants of the seminar in Uzbekistan and recommended to UTY side, counting the performance in the seminar. Considering the schedule of application procedure for the training in Japan, experts had selected seven candidates at the end of March, and they were recommended to UTY by the letter from the Expert team. Details will be described later.

2.1.3. Contents of Seminars in Uzbekistan

Seminar was designed to begin with "Outline of Transportation Planning" as a basic knowledge, however, most of the participants are graduated from Railway University or Railway College and the level of their technical skills is high, therefore these subjects were enough just reviewing. As the following subjects, practical works to be done by participants themselves were emphasized according to the flow of Operation Planning method.

(1) Planning of Electrification Transportation Plan

UTY is implementing the electrification project on the target section. Although the purpose of the electrification project is to increase the transportation capacity in accordance with the transportation demand which is forecasted that it will increase, it is necessary to consider the traffic volume etc, and formulate proper transportation plan in order to deal with the transportation demand accurately and improve the efficiency.
The works which are shown below were implemented in order to formulate the transportation plan.

1) We assumed that the predicted value of demand in 2017 is 12,000,000 ton per year as the traffic volume of freight transportation (Transportation items) based on "F/S on Marakand – Termez electrification Project (October, 2010)".
2) We assumed that Tractive Load is 2,200 t per 1 set of train based on the traffic volume and formulate the train operation planning.

In accordance with the abovementioned works, we classified the types of freight to container, oil, construction material, agricultural product, others and assumed the traffic volume by each type (refer to [Table 2-5]). However, these traffic volumes were set as a model and were not picked up from the actual data. Number of wagons without indication of "Type of freight car" is empty returning wagons.

[Table 2-5] Transportation Demand for Seminar and Model of the Number of Train-set

	Tashguzar - Kumkurgan							Kumkurgan - Tashguzar						
Type of freight car	Volume of traffic (ton)		Number of containers/ 40ft	Number of wagons/day	Total weight	Number of trains	Time, Speed & Load	Volume of traffic (ton)		Number of containers/ 40ft	Number of wagons/day	Total weight	Number of trains	Time, Speed & Load
	per year	per day					2,200t	per year	per day					2,200t
Container	2,000,000	6,944.4	174	174	10,417	4.7		2,000,000	6,944.4	174	174	10,417	4.7	
Fuel	2,000,000	6,944.4		116	9,259	4.2			0.0		0	0	0	
Construction materials	2,000,000	6,944.4		116	9,259	4.2			0.0		0	0	0	
Farm products	1,000,000	3,472.2		58	4,630	2.1		1,000,000	3,472.2		58	4,630	2.1	
Other	1,000,000	3,472.2		58	4,630	2.1		1,000,000	3,472.2		58	4,630	2.1	
											116	2,320	1.1	
	8,000,000	27,778.0	174	521	38,194	17		4,000,000	13,889.0	174	405	21,996	10	

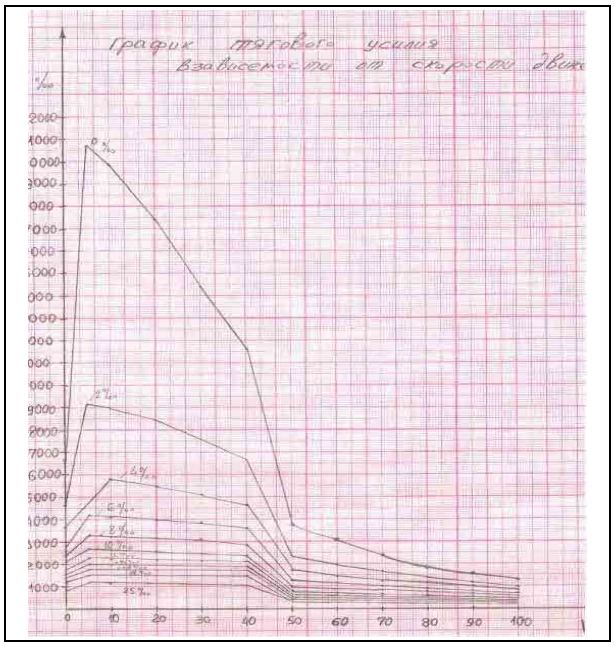
(2) Planning of Rolling Stock Plan

Although specific train operation planning shall be formulated based on the transportation plan prepared above, the precondition which is the required performance for the locomotives used on the project area shall be analyzed and Allocation Plan of Rolling Stock and maintenance planning which are suitable for the section

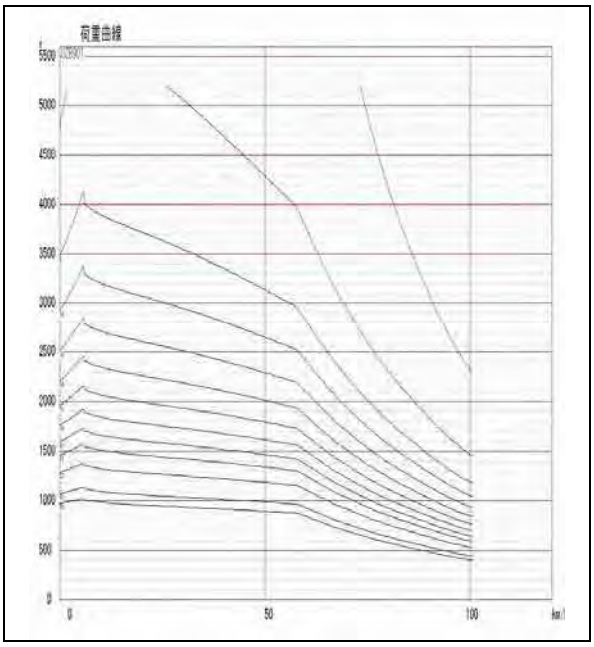
shall be formulated. UTY has already ordered to develop a new type of locomotives to a Chinese manufacturer which will be operated at the target section, however, as the details of the performance of new locomotive was not clear, the technical staff of UTY's locomotive department calculated Traction Force and Tractive Load by each grade referring performance curve of the Japanese EF500 type locomotive, which has almost same performance as the newly introduced electric locomotive for UTY (refer to [Table 2-6]).
In addition, analysis with train operation simulation was done using Japanese simplified software in order to check the validity of formulated rolling stock plan (refer to [Table 2-7]).

According to the results of analysis, we confirmed that the Load Curve prepared by C/P and the Load Curve prepared by the simulation corresponded to the balancing speed 53 km/h with 3,200 t Tractive Load with 2 locomotives in the section 18 ‰, which were the precondition UTY requested for the newly developed electric locomotive to be introduced to the mountain section.
We decided to use the data calculated by C/P as the performance data of locomotives which were inputted to the software to prepare Train Running Curve based on the abovementioned results.

[Table 2-6] Load Curve by Participants



[Table 2-7] Load Curve by Simulator



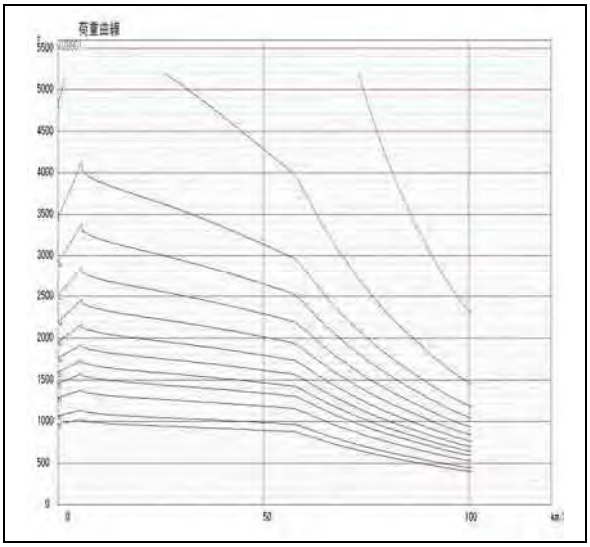
(3) Planning of Train Operation Plan and Operation Facilities Plan

Planning of train operation plan and operation facilities plan are related to Train Running Curve prepared with various driving condition, and the work volume of manual preparation of Train Running Curve is too much. Therefore, it is necessary to utilize the software for preparation of Train Running Curve. The under mentioned works were implemented and train operation plan and operation facilities plan were formulated.

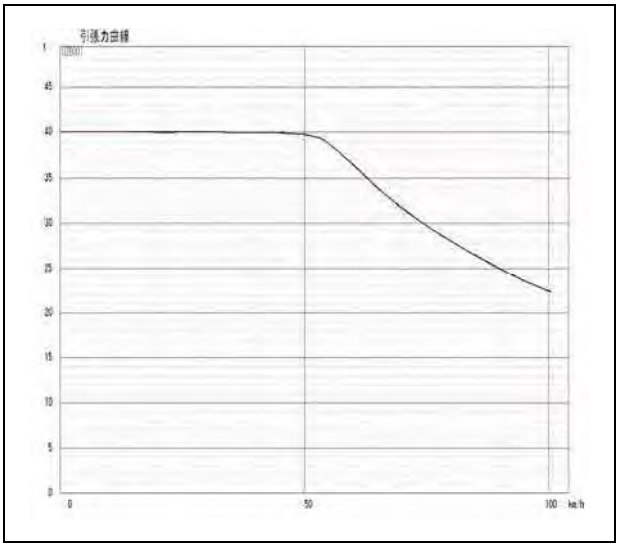
1) We collected and prepared information related to performance such as notching curve, performance curve etc, and requested C/P of UTY to calculate the data which shall be inputted to the software for preparation of Train Running Curve.

2) We inputted the data calculated in advance to the software and prepared locomotive performance curve such as Load Curve, Traction Force Curve, etc. (refer to [Table 2-8] and [Table 2-9]).

[Table 2-8] Load Curve



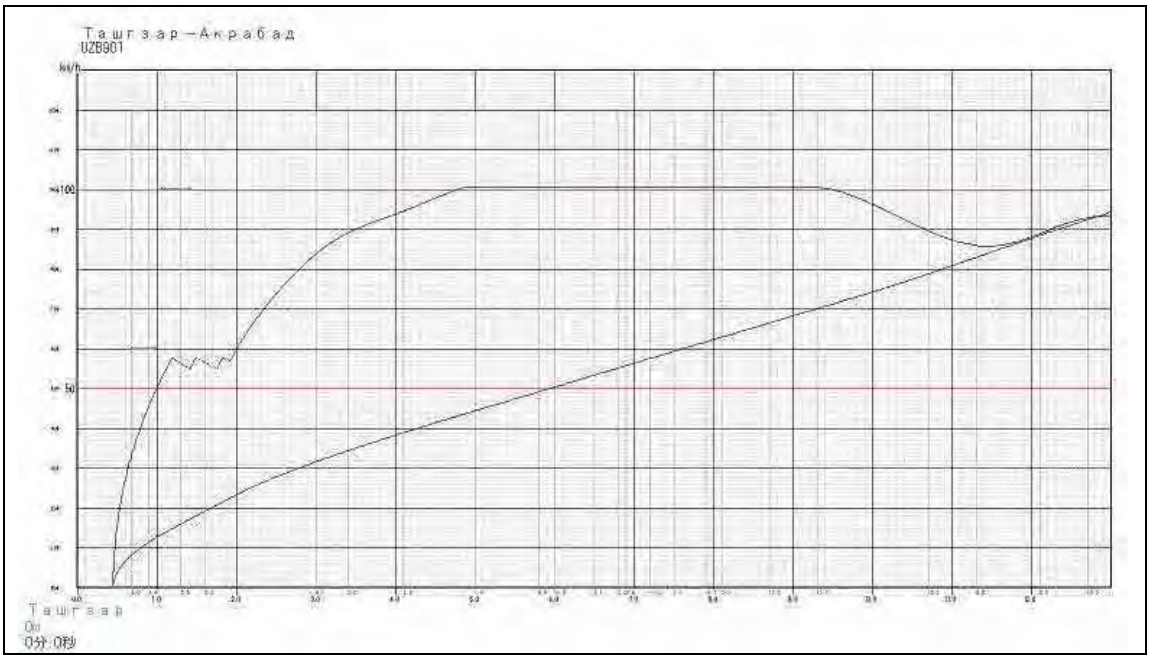
[Table 2-9] Traction Force Curve



3) We evaluate Tractive Load and Balancing Speed of locomotives to be newly introduced based on the Load Curve, and set the Time, Speed & Load as 3,200 ton.

4) We prepared train running curve of 3,200 ton Tractive Load with electric locomotive on Tashguzar - Kumkurgan railway line utilizing the software to prepare train running curve (refer to [Table 2-10]).

[Table 2-10] Train Running Curve (One Case)



5) We prepared the tables of Time, Speed & Load and Minimum Train Running Time based on each Train Running Curve which was prepared (refer to [Table 2-11]).

[Table 2-11] Minimum Train Running Time (One Sample)

Train operation schedule

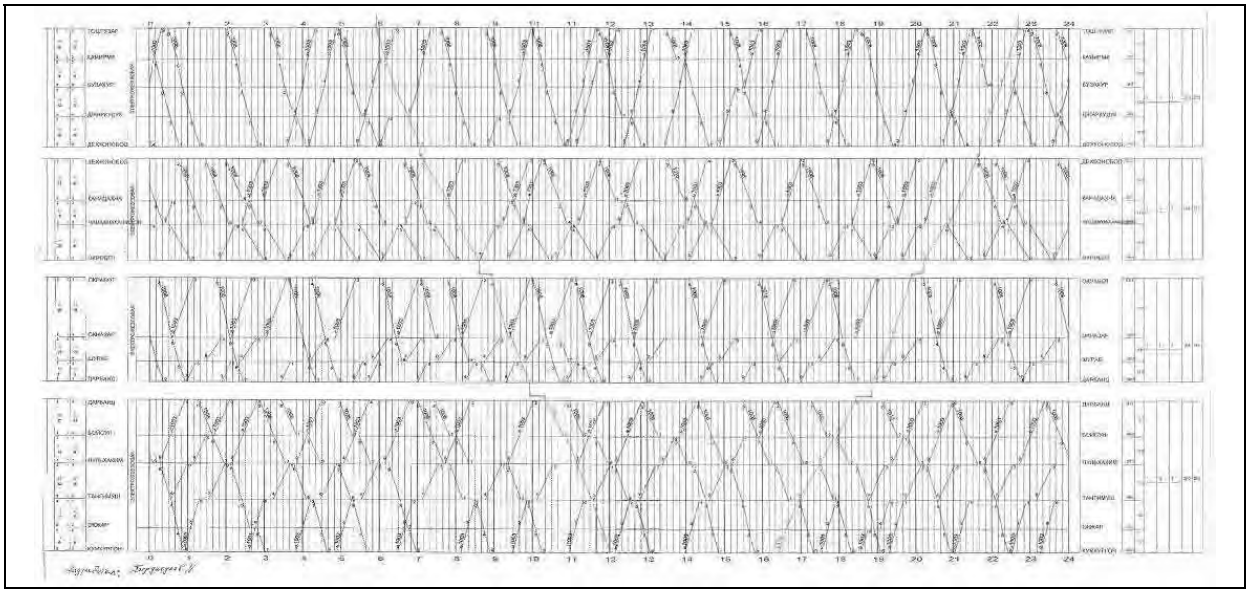
(1)UZB901 Tashguzar - Akrabad

Locomotive (1)

Station	Distance (m)	Pass time	Time between stations	Running time	Sum of running time	Cumulative time incl. stop	Speed between stations (km/h)	Average (km/h)
Tashguzar								
Kairma	16,391	0:11:32	11:32	12:00	12:00	12:00	85.3	85.3
Buzahur	29,046	0:19:43	8:11	8:30	20:30	20:30	92.8	88.4
Jarkuduk	44,684	0:32:45	13:02	13:30	34:00	34:00	72.0	81.9
Dehkanabad	57,184	0:43:43	10:58	11:00	45:00	45:00	68.4	78.5
Karadahna	80,980	1:05:41	21:58	22:00	1:07:00	1:07:00	65.0	74.0
Chashmaihafizann	90,010	1:14:41	9:00	9:00	1:16:00	1:16:00	60.2	72.3
Akrabad	109,623	1:38:43	24:02	24:30	1:40:30	1:40:30	49.0	66.6

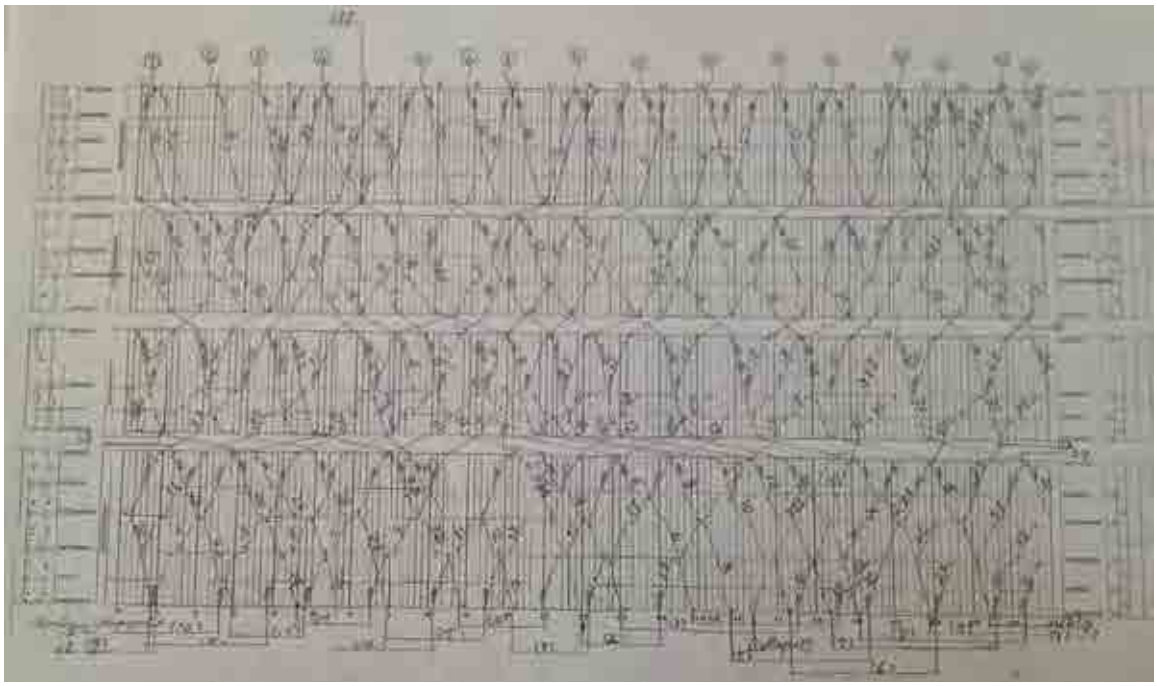
6) We prepared train operation diagram on the section based on the Minimum Train Running Time utilizing UTY's train operation diagram system (refer to [Table 2-12]).

[Table 2-12] Model of Train Operation Diagram



7) The locomotive operation diagram was prepared by C/P in Karshi region based on the abovementioned train operation diagram (refer to [Table 2-13]).

[Table 2-13] Locomotive Operation Diagram



8) Usually, reviewing train operation facilities such as depot, station, signaling system etc, based on the abovementioned results are followed in the flow of train operation planning. However, these tasks will be examined in the electrification project under the Yen Loan and it may cause some confusion, therefore the following task as the evaluation of line capacity through the target section was replaced to the above task (refer to [Table 2-14]). We requested C/P in Termez region to evaluate the practical validity of train operation diagram prepared by C/P in Tashkent.

[Table 2-14] Line Capacity Comparison

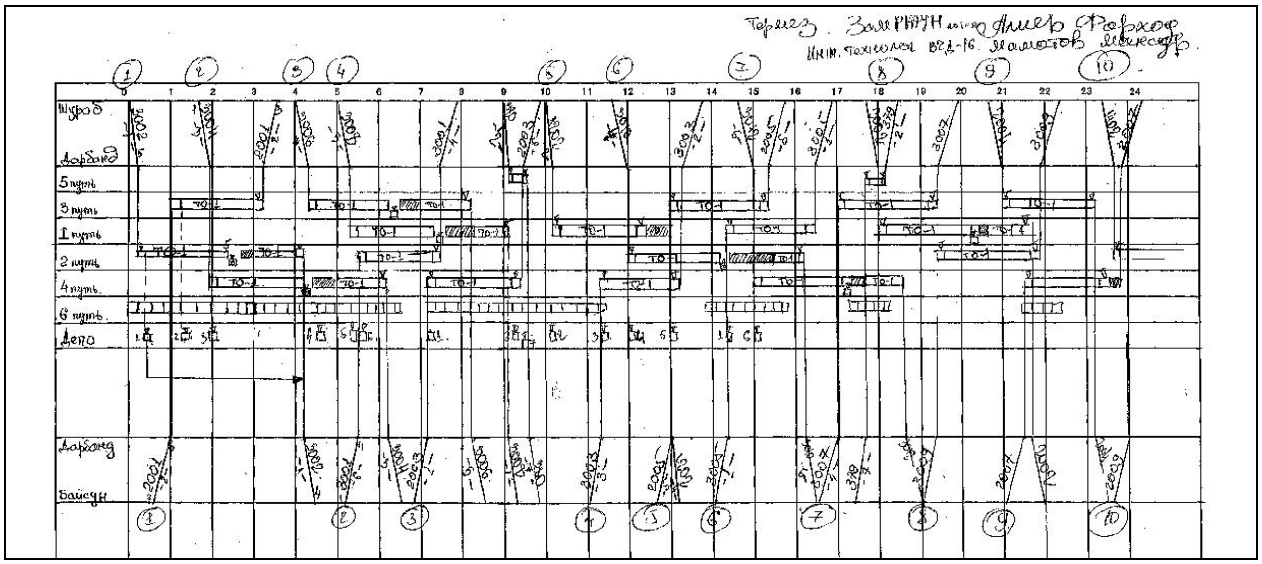
Minimun Train Running

Speed	Stop	Max. grade ‰	UZB901	km	Max. grade ‰	stop	speed	Line capacity A		speed	Line capacity B	Number of train C	− + A−C	− + A-B
82.0	12.00	0.5	Tashguzar											
				16.4	7.7	10.30	93.7	62.8	13.4	73.4	54.3	34.0	20.3	28.8
86.7	8.30	14.8	Kairma											
				12.7	4.8	8.00	95.3	80.4	8.6	88.6	77.8	34.0	43.8	46.4
69.3	13.3	22,1	Buzahur											
				15.6	9.1	12.30	74.9	65.2	13.5	69.3	54.0	34.0	20.0	21.7
65.2	11.30	17.6	Djarkuduk											
				12.5	7.6	10.00	75.0	65.2	13.6	55.1	53.7	34.0	19.7	31.2
63.4	22.30	18.6	Dehkanabad											
				23.8	18.5	19.30	73.2	36.8	23.7	60.3	33.0	34	−1.0	2.8
56.8	9.30	18.5	Karadahna											
				9.0	10	8.30	63.5	75.1	11.8	45.8	60.4	34	26.4	41.1
48.0	24.30	20.4	Chashmaihafizan											
				19.6		22.00	53.5	33.6	30.3	38.8	26.3	34	−7.7	−0.4
54.3	19.00		Akrabad											
				17.2	18.4	21.30	46.9	38.0	26.7	38.7	29.6	34	−4.4	4.0
60.6	10.00		Aknazar											
				10.1	17.8	12.00	50.5	64.0	17.6	34.4	43.0	34	9.0	30.0
50.5	9.30		Shurab											
				8.0	18.5	9.30	50.5	72.0	13.2	36.4	55.0	34	21.0	38.0
59.7	20.30		Darband											
				20.4	18.6	9.30	50.5	72.0	13.2	36.4	55.0	34	21.0	38.0
52.6	15.30	16.7	Boisun											
				20.4	18.6	20.30	58.5	37.6	24.1	50.8	32.5	34	−1.5	3.6
75.9	15.30		Pulhakim											
				13.6		17.00	52.6	46.1	18.3	44.6	41.5	34	7.5	12.1
84.6	9.30		Tangimush											
				19.6	18.3	17.30	75.9	45.5	22.8	51.6	34.2	34	0.2	11.5
56.5	8,30	6,8	Akja											
				13.4	18.4	10.30	84.6	69.1	12.5	64.3	57.6	34	23.6	35.1
			Kumkurgan											
				8.00	18.4	8.00	60.0	80.4	10.4	46.2	67.0	34.0	33.0	46.4

9) We requested C/P in Termez to prepare the basic yard operation plan of Darband Station (refer to [Table 2-15]).

Basic yard operation plan is used for effective utilization of track layout inside yard, consideration of work time in yard, validity of departure and arrival time of train operation diagram, etc.

[Table 2-15] Operation Plan inside Yard of Darband



2.1.4. Achievement of Seminars in Uzbekistan

The seminars on train operation planning have been implemented from the beginning of February to the middle of April in Tashkent, Karshi and Termez. The seminars were implemented for 53 hours in Tashkent (10 participants at the end), 48 hours in Karshi (6 participants), 44 hours in Termez (4 participants) as shown in [Table 2-3] and [Table 2-4]. These seminars were not only classroom lecture but including practical works by the participants and evaluation of the results. The summary of the results of the seminars are shown below.

(1) Implemented Works

1-1 Data of track on Tashguzar – Kumkurgan was prepared, and it was imputted to the software to prepare Train Running Curve.

1-2 Performance data of locomotives was prepared.

- Traction Force was calculated based on the assumption of performance of locomotives.
- The calculated Traction Force was inputted to the system.
- Traction Force Curve and Load Curve were prepared with the system to prepare Train Running Curve.
- Load Curve was manually prepared using Traction Force Curve.

1-3 Train Running Curve and Minimum Train Running Time when the new electric locomotives are operated on the section were prepared using Japanese system to prepare Train Running Curve.

1-4 Train operation plan was prepared.

- Transportation plan was made assuming that annual traffic volume on the new line would be 12,000,000

ton, and required number of trains and wagons were calculated.

- Train operation diagram was prepared with UTY's computer system of train diagram.
- Average running time on sections, average speed, line capacity were calculated using the train diagram which was prepared in advance.

(2) Conclusions

2-1 It was confirmed that traction capacity and running speed would be increased when new electric locomotives are introduced on the new line. Therefore, it is proved that electrification of the new line is significant.

2-2 Track rectification work is required because running speed decreases on the section with steep grade.

2-3 In addition, it is required to try to adjust to the designed alignment on the section with sharp curve.

Although these works were considered assuming electric locomotives to be introduced in future, we explained at seminars that the abovementioned works can be applied for the existing electric locomotives or diesel locomotives, if relevant data of their performances are available.

We asked the participants to write feedback of the seminar's impression at the end. Some of them are shown in [Table 2-16].

[Table 2-16] Descriptions of the Seminar's Impression (Selected)

Participants in Tashkent	
1	During the seminar we received very interesting information about Japan's railway and railway companies, their work, yard operations, locomotives. So, we had an opportunity to make a comparison.
2	During the seminar we did calculation of hauling capacity, traffic capacity of Tashguzar – Kumkurgan track and prepared a train operation schedule for this line. I learned many new things which were needed for development of UTY and for electrification of Tashguzar – Kumkurgan line. Besides, I received useful information and I myself calculated a hauling capacity of electric locomotives, which are going to be used after Tashguzar – Kumkurgan line is electrified. I learnt how to calculate traffic capacity and the formula used for such calculation. We also studied how to make a train operation schedule and who makes these schedules. All these issues where explained to us in a very simple and understandable way. The whole seminar was held on a high level.
3	I liked very much and was surprised at the way the Japanese railway operates. Especially, its punctuality. This is a point which not each country pays attention to. This is important, because it directly relates to safety of trains operation and satisfaction of needs for passenger and freight transportation. As a train dispatcher, I got better understanding of complexity of locomotive driver's work after studying such topics as "Hauling capacity", "Outlines of the theory of motion", "Friction force", "Resistance of the train", "Braking systems". I was interested in practical lessons, during which we calculated traffic capacity of some sections and volume of traffic for 1 year. So I was able to get basic skills for calculating traffic capacity.
4	During the seminar we studied logistics, train control systems with the help of advanced technologies as well as how to make transportation plans, train operation schedules, passengers and freight transportation plans. In making transportation plans, all possible options are to be reviewed to increase traffic capacity of the tracks and stations. Work of locomotive crews is strictly organized according to the schedule. We calculated running time of trains on Tashguzar – Boysun – Kumkurgan line. I was interested in preparing the train operation schedule for this line, which I made myself, based on the results of calculation we had done earlier.
5	We reviewed data on Tashguzar – Kumkurgan line, and then input them into Japanese soft, which draws time – distance graphs. We calculated hauling capacity of new locomotives by using the Japanese soft for drawing time – distance graphes.
6	In the seminar held by Mr. Miura we studied the ways to improve traffic capacity of Tashguzar – Boysun – Kumkurgan line, the Japanese experience in arrangement of high – speed freight and passenger trains operation and others. We learnt a lot about the Japanese railway, its occupancy, technological level of development etc.
Participants in Karshi	
1	We have got full answers to many questions we asked. Many questions and large part of discussion were related to an electrification new railway line which is going on now. I learnt that Japanese train operation schedule is different from our train operation schedule. I also learnt that Japanese railway pays more attention to speed and effectiveness.
2	It was very interesting to know that in Japan a train operation schedule is also prepared for freight trains. It allows to organize train operation more efficiently. The program of seminar which was held by Mr. Mura was very interesting. I think that such seminars should be held more often, because they give a chance to exchange opinions and experience.
3	It was useful to know that Japanese passenger and freight railway companies carry cargo and passengers to a destination point on time and in a safe way. I think that such seminars should be frequently held, because they are interesting and useful for us, young specialists.
Participants in Termez	
1	I learnt much about Japanese technology, services of high quality and that passengers and freight traffic is carried out on time and in a safe way. I was very impressed by this information. I express my gratitude for organizing this seminar.
2	I think that learning Japanese advanced railway technology and working process as well as sharing of experience will be of benefit to UTY in the future.

The purpose of this project is “capacity development on upgrading on train operation planning, track rectification planning, locomotive maintenance planning”. We set up seminars to work out Minimum Train Running Time and Time, Speed & Load in Phase 1 based on the purpose. We understand that UTY technical staff could well conduct works under the guidance of the Expert.

2.1.5. Training Program in Japan

As a part of this Project, a training program in Japan for UTY’s C/Ps in operation planning (theory and practice) was conducted. The outline of the training program is as follows:

(1) Objectives of Training

[Train Operation Planning]: The training is targeted to the UTY staff in relation with Train Operation Planning, which are focused on the overview and procedure of Train Operation Plan and Scheduling Plan. Specifically, it will include regulations in operation theory, rolling stock scheduling, crew allocation, maintenance of electric locomotive, etc.
[Observation tour]: Freight terminal, depot, etc.

(2) Target Group of Training

Seven participants were selected among UTY staffs in charge of Train Operation Planning, who had participated in the seminar conducted by Mr. Miura in Uzbekistan.
In the initial plan, 10 C/Ps in Operation Planning were to be invited to Japan, however, as the need for training in Japan in Track Maintenance field had been recognized in 2012, after consultation with UTY and JICA, 3 participants were transferred to the field of Track Maintenance training and the number in Operation Planning was reduced to 7.
It had been agreed with PIU-E that the participants of the training in Japan would be selected by Expert among the participants of the seminar in Uzbekistan and recommended to UTY side. Considering the schedule of application procedure for the training in Japan, in which the deadline of submission of A23 form should be two months before the commencement of training, the Expert team recommended seven candidates to UTY by the letter dated on March 29, 2013 (refer to [Table 2-17]).

[Table 2-17] List of Participants for Training in Japan (Operation Planning)

No.	Name	Position	Organization
1	Muhamedov Rustam	Head of Department, Acting head of Operation Control Center (OCC)	Department of Development Strategy, Operation Control Center (OCC)
2	Sagdullaev Bekzod	Train dispatcher	OCC
3	Zainutdinov Nosir	Engineer	Locomotive Repair Division, Locomotive Department
4	Berdikulov Uchkun	Engineer	OCC
5	Muhamedaliev Surat	Engineer of locomotive	PIU electrification project
6	Mizaev Mansur	Deputy Head (Deputy manager of freight section)	OCC (Operation department of Karshi RRB)
7	Aliev Farhod	Deputy Head	Transportation Division of Termez RRB

(3) Facilities to be used for Training Program

a) JICA Tokyo International Center was in charge of implementation of this program, and seminar room, accommodation and other related facilities were used.

b) As for the facilities to observe, locomotive depot, freight terminal and repair workshop of JR Freight Railway Company were arranged. Recently in Japan, most of the passenger trains are operated by Electric Multiple Unit and electric locomotives are used only for freight trains. JR Freight is almost only railway operator which is managing operation and maintenance of electric locomotives in Japan.

(4) Schedule and Contents of the Training Program

The participants arrived in Japan on Wednesday, June 12, 2013, and the program began by “Briefing by JICA” in the morning of June 13. The last session was “Reporting” at JICA Tokyo International Center on June 20, and they left Japan on June 21, 2013.

Contents of the Training Program is shown in [Table 2-18] and [Table 2-19].

[Table 2-18] Contents of Training for Operation Planning in Japan (1)

Day	Time	Place, Lecturer	Title and Summary
Jun 13 (Thu)	9:30 ～	JICA Tokyo Int'l Center (TIC)	JICA Briefing
	13:30 ～ 15:00	Meeting room of Ministry LIT	Outline and feature of railway in Japan (Authority and facility of freight transport)
		Mr. Oda (Railway Bureau, MLIT)	Explained current condition of railway freight transport, history, mode, JR Freight co. and private operator, etc.
Jun 14 (Fri)	9:30 ～ 12:00	JICA TIC	Characteristic of railway in Japan
		Mr. Miura (JTC)	Explained: Passenger is majority in Japan, electrified section is dominant, all trains are operated according to the train diagram.
	13:30 ～ 15:00	JICA TIC	Operation Plan in Japan – Locomotive Maintenance Plan
		Mr. Jonishi (JR Freight Co.)	Policy of rolling stock maintenance in JR Freight co. Outline of facilities of workshop, depots, staff, budget, practices
Jun 17 (Mon)	9:30 ～ 11:30	Shin-tsurumi Depot	Observation of Depot for electric locomotives
		Mr. Ito (Shin-tsurumi Depot, JR Freight Co.)	Explain outline of Shin-tsurumi Depot, observation inside depot.
	14:00 ～ 16:00	Tokyo Freight Terminal, Training Center	Observation of freight terminal
		Mr. Katayanagi (Tokyo Freight Terminal), Mr. Tanabe (Training Center)	Explain outline of Tokyo Freight Terminal, Observation of terminal yard. Observation of Central Training Center of JR Freight co. and experienced driving simulator of locomotive crew.


Shin-tsurumi Depot


Tokyo Freight Terminal

[Table 2-19] Contents of Training for Operation Planning in Japan (2)

Day	Time	Place, Lecturer	Title and Summary
Jun 18 (Tue)	9:30 ～ 12:00	Omiya Workshop, JR Freight Co.	Observation of Repair workshop
		Mr. Sugano (Omiya Workshop)	Explain outline of Omiya Workshop, Observation of facility.
	14:30 ～ 16:00	JICA TIC	Operation Plan in Japan – Mobilization Plan of Locomotive and Crew
		Mr. Arai (JR Freight Co.)	Explain outline of facilities relating to mobilization planning, basic knowledge of mobilization plan for locomotive and crew.
Jun 19 (Wed)	9:30 ～ 10:30	JICA TIC	Operation Plan in Japan – Introduction of Train Operation Theory
		J Mr. Kawakami (JR Freight Co.)	Explain basic knowledge of Minimum Running Time, Tracitive Load and operation theory.
	After 10:30	JICA TIC	Preparation for reporting session
Jun 20 (Thu)	9:30 ～ 11:30	JICA TIC	Reporting session
		Mr. Suhara (JICA TIC), Mr. Okamoto, Mr. Miura (JTC), Ms. Kojima (CDN)	Reporting from participants by power point presentation and video file, explaining outline of UTY and the result of training program in Japan. Question and answers by the attendants followed.

For acceptance of this training, JTC has carried out the following works.

a) Promote preparing application forms of candidate by UTY
b) Prepare curriculum and training schedule
c) Arrange lecturers and observation sites
d) Prepare teaching materials including translation into Russian
e) Implement lectures and visit

In the training schedule, it was planned to visit Tokyo Operation Control Center of JR East Japan Railway Co., Ltd. (at Tabata) in the afternoon of June 18, thereafter to visit Freight Control Room of JR Freight which is located in the same place, but the permission was not granted and we had to adjust schedule.
In the Questionnaires submitted by the participants at the end, several comments were written as the function of the commander of operation control center would be a training item to be added in the future. It was unlucky that the observation could not be realized.

2.1.6. Follow-up of Training Program in Japan and Wrap-up of Project Activities

In July 2013, Expert for Operation Planning conducted follow-up activities in Uzbekistan. If the performance of the new electric locomotives, which will be introduced into the target section, is available, it was possible to update operation planning methods using this information, but it was not available yet at this time, and the activities were not more than re-confirmation of planning method by considering the knowledge gained in the training in Japan. In addition, since the construction project of a new railway line connecting the Tashkent and Fergana region of northern area had started, many engineers and staff in UTY had begun to be assigned to this project, and meeting with the ex-participants on a regular basis at the same time were not easy.

In order to summarize the achievement of Operation Planning field of this Project, Wrap-up Seminar was condected for disseminating the result to the staff of other specialties in UTY. In the seminar, Expert and C/Ps were planned to give presentation respectively, and the materials were prepared by confirming each other.

The Wrap-up Seminar was held on August 5, 2013, 14:30. From UTY side, 24 persons have attended headed by Mr. Djalalov, as Project Director, and other representatives from not only the departments of Train Operation but also from Track Facility, Locomotive Operation and Tashkent Workshop. From JICA Uzbekistan Office, three officers headed by Mr. Shikano, Chief Representative, attended.

The presentation from C/Ps was composed of subjects learned and practiced during the seminars conducted in Uzbekistan from February to April this year, and the contents of Training Program in Japan in June, with photos. Expert has reported by using power point presentation also, starting from facts of current situation of UTY, and then the contents of seminar and the output of practical work done by C/Ps in Uzbekistan, showing diagram and tables.

On the day, as the Project Completion Meeting was held after the Wrau-up Seminar, there was no question or comment on the presentation, while the Head of Operation Control Center mentioned his comment after the Project Completion Meeting.

After the Seminar, certificate for the participants of seminars in Uzbekistan were presented by Expert, Mr.Miura. This certificate was issued to the participants whose attendance ratio exceeded certain criteria, and it was handed over to Mr. Muhamedov Rustam representing all the participants.

2.2. Track Rectification Planning (Alignment Plan)

2.2.1. Confirmation of Current Condition of Target Railway Section

The activities of this Project in this approach depend on the accurate data of existing track condition of the target section including curve radius and gradient. The Track Profile of the target section which illustrates the horizontal and vertical track alignment was examined during the experts dispatched by JICA in 2010, but there was information that UTY has updated them depending on a recent survey.
The latest revision of the Track Profile was finally obtained as a result of the meeting with Chief Engineer of the Track Department on June 28, 2012. However, since essential data such as the chainage of BTC, BCC, ECC, ETC, BIT, BRT, EIT, ERT as well as a detailed ledger of TCL and CL were not available, the actual track alignment had to be confirmed by examining the records of the track inspection car which is operated every month. The Track Profile and chart were compared and analyzed and it was found that further confirmation of accuracy is required due to the following factors:

- There is a discrepancy in chainage for about 1km.
- There are locations where the Track Profile shows a simple curve but the chart shows a combination of large and small curves.
- In the chart, there are some locations with a continuous shift in the base line as well as continuous cant setting even along straight sections.

Experts decided to measure the actual track alignment on site in order to compare it with the Track Profile data. This manual survey was carried out on July 6, 2012 where there is a compound curve between Chashmaihafizan and Akrabat to confirm the accurate curve radius by measuring with a 10m string (the measurements covered the 94km570 - 95km500 and 95km795 - 96km175 sections).

Manual Measurement by 10m String

Track Conditions near Chashmaihafizan St.

[Fig. 2-4] Location of Curve Measurement

The Track Profile obtained from UTY listed the curve radius of the section starting at 94km570 as R=301m, while the line side curve post indicated it was R=320m. The manual measurements confirmed that the section

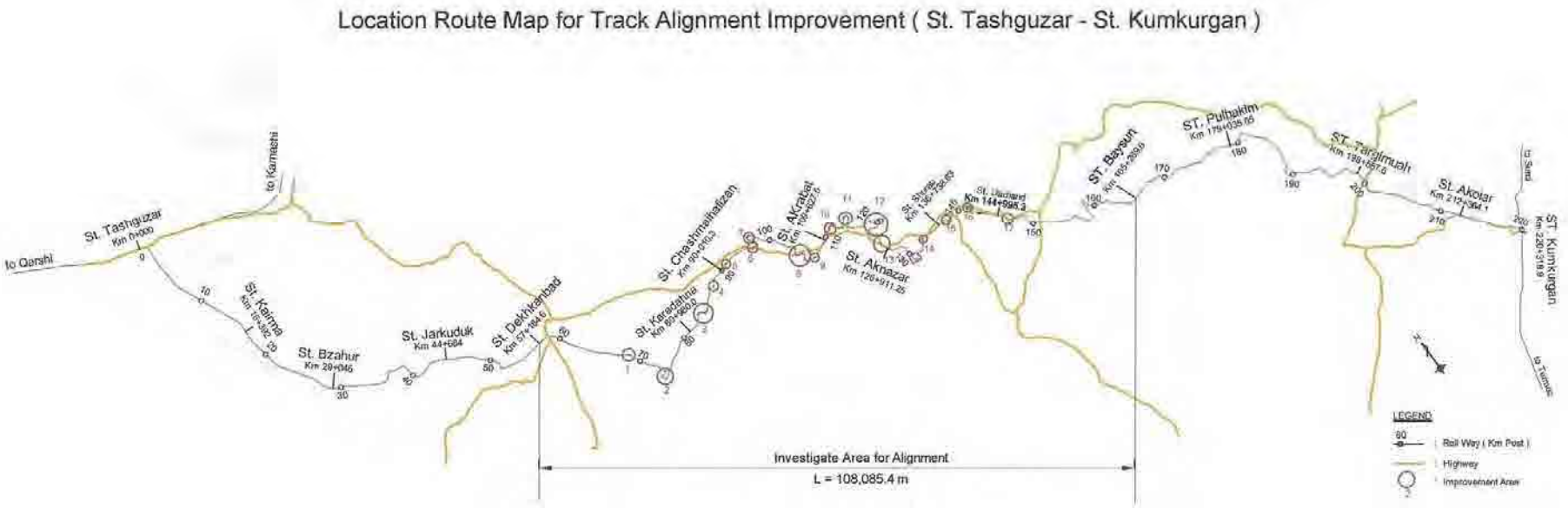
actually consisted of a compound curve with radius of R=190 - 257 - 138 - 141 - 150m.
The measurement results showed that the records of the track inspection car were similar to the manual measurements which mean that the recorded chart is useful for the assessment of actual track conditions. However, it was also found that there is a significant difference between the curve radius and the data calculated from Versine 20m string of records of the track inspection car, and it is therefore necessary to examine the cause.
In any case as it was found that existing Track Profile did not necessarily represent precisely the current condition of the track, the necessity for re-confirmation by survey through the target line under a sub-lcontract in the Project was recognized.
It was recognized in the field on July 6, curve post and km post were set up, but the value of radius and cant indicated in the curve mark did not correspond to the value of Track Profile. Also, it was found that gradient post or cant reduction post was not set up along the track.

2.2.2. Preparation of Alignment Improvement Plan (First Draft)

During the first activities in Uzbekistan in June 2012, Expert in charge of Alignment Plan had reproduced plane drawing of the track based on the existing Track Profile data obtained from UTY. In the section classified to a middle class with freight trains of 2,000 tons (over 30 wagons), it is not allowed that a sharp curve with a radius less than 200m exist nor continuous location of compound curve and sharp curves. Expert team has obtained a curve ledger of the section during the site visit in June, 2012. According to this document, there is a sharp curve with R=146m on the main line, however, in the reproduced plane drawing by the Expert, rather sharp curve less than that was supposed to exist.
In order to eliminate these sharp curves, the civil work volume for the realignment work must be huge in the section with cut and embankment, and it will need a large amount of budget. Therefore we may have to reach a compromized recomendation to realize alignment with R=250m, not more than R=300, for example.

Information of the current condition of the track, which is used for the activities of this Project, shall be based on the Track Profile, which is made depending on the result of survey. However, during the first activities in Uzbekistan when it was not available, Expert had specified 17 locations requiring improvement of the horizontal alignment along the section between Dehkanabad and Boysun where the survey work was under way (refer to [Fig. 2-5]). These locations were extracted based on criteria where sharp curves less than R=300m exist. This recommendation was a result of a desk study based on the existing Track Profile. More accurate locations shall be specified after the survey work deliverables are submitted and more accurate current track conditions can be confirmed. The locations of the 17 points mentioned above were reported to PIU-E.

After the reproduction of plane drawings, the expert confirmed the vertical alignment conditions. By reviewing the existing Track Profile, it was found that the vertical alignment is concave on some high embankments with drainage culverts underneath. This is likely due to consolidation settlement which has occurred over several years after construction.



The Area of Horizontal Alignment Improvement		
1. Km 68+350 - Km 68+560	8. Km 103+050 - Km 106+400	15. Km 137+300 - Km 138+590
2. Km 73+850 - Km 74+970	9. Km 106+980 - Km 107+360	16. Km 140+900 - Km 141+650
3. Km 83+200 - Km 84+500	10. Km 110+770 - Km 112+040	17. Km 146+350 - Km 146+800
4. Km 87+700 - Km 88+000	11. Km 114+100 - Km 115+240	
5. Km 90+700 - Km 91+100 Note : No Curve Data of Inspection Car	12. Km 118+050 - Km 124+170	
6. Km 94+400 - Km 95+800	13. Km 125+770 - Km 126+100	
7. Km 96+590 - Km 97+560	14. Km 133+800 - Km 134+500	

The Area of Vertical Alignment Improvement
4. Km 87+700 - Km 88+000
7. Km 96+590 - Km 97+560

[Fig. 2-5] Locations Requiring Realignment

2.2.3. Survey for Obtaining Accurate Alignment

Based on the examination results mentioned in section 2.2.1., it was observed that the existing track alignment on site did not fully correspond to the existing Track Profile or the records of the track inspection car. JTC therefore contracted with the Design Institute to carry out a survey in order to obtain the accurate track alignment.

For the purpose of preparing accurate horizontal and vertical track alignment drawings as well as cross-sections of the section between Dekhanabad and Boysun, and then developing a track rectification plan, surveys on traverse, track center, horizontal and vertical alignment as well as cross-sections were conducted. The prepared Track Profile based on this survey will be utilized for track maintenance work. Originally it was expected to be used for the practical work of Operation Planning, however it was not available before the commencement of the said practical work due to the delay of survey, then it was not used for the purpose.

During the field work by the expert, Mr. Horiuchi, in June 2012, the TOR of the survey work was explained to two candidate contractors to bid, however it took time for them to understand the level of works required by JTC. Therefore only the components of Control survey (GPS traverse), Control leveling and Traverse survey (TS traverse) were decided to be separately contracted as PK1, because the contract with whole components may have resulted in a serious delay.

After the expert was mobilized again in July, he had a series of negotiations with the Design Institute "Boshtransloyiha" (hereinafter referred to as "Bosh") and JTC contracted with them at the end of July as PK1. After that the next selection procedure of the contractor of the following series of survey components as Track center survey, Profile leveling, Cross section survey and Create drawings were executed as PK2. At the end of September JTC contracted with "Bosh" again for PK2.

As a result of price negotiations, the budget allocated for the survey remained, then additional work to add 20m intervals on some sections with curves in order to capture more accurate vertical alignment was agreed on and contracted as PK2-Add.

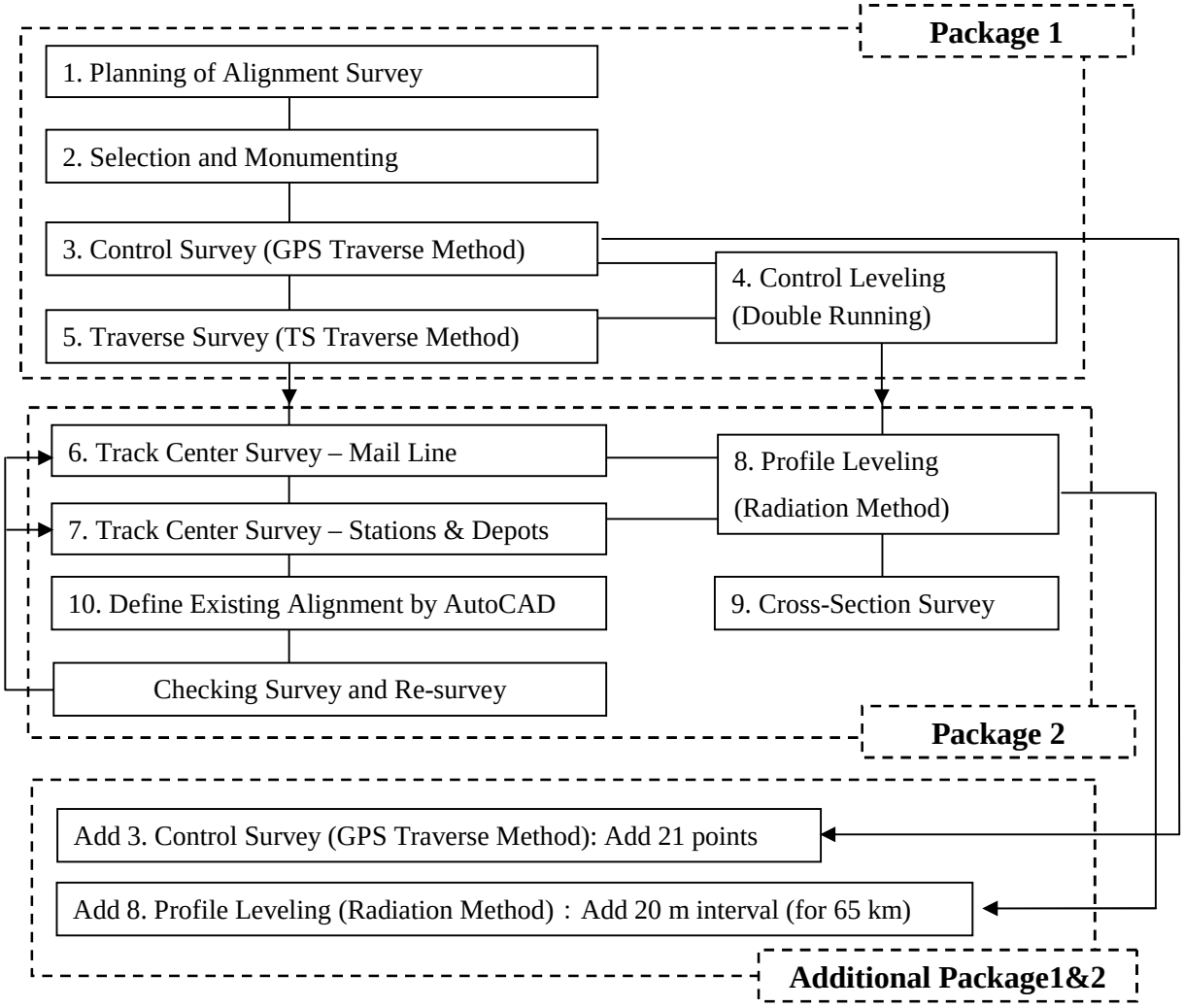
[Fig. 2-6] Site Visit before Survey Work

Although the expert gave practical advice to the "Bosh" engineers, the survey work suffered from a

substantial delay and was completed at the end of March 2013 due to inefficient working methods. As for the deliverables, the Track Profile showing the plan and vertical alignment of the main line was completed during February.

2.2.4. Implementation of Alignment Survey

The survey work was supervised by the expert in charge of the survey. The purpose of the alignment survey was to gather accurate data on the existing track's centerline alignment and prepare horizontal and vertical alignment drawings in AutoCAD. The survey covered locations between Dehkanabad and Boysun on the main line about 100km on a mountain section, as well as the tracks in eight (8) stations and depots.
The items of the railway alignment survey and the work flow are shown in [Fig. 2-7].



[Fig. 2-7] Items of the Railway Alignment Survey and Work Flow

The outline of methodologies of the railway alignment survey works are as follows:

3. Control Survey (GPS Traverse Method)

New survey control points shall be established along the existing track about one (1) point per km. More than one (1) point per location in Station & Depot areas shall be established as survey base points. Each adjacent control point shall be taken visibility for next stage of TS traverse survey back sight.

4. Control Leveling

Differential leveling shall be performed with double run observation along the GPS control points and TS traverse points and tied to the National Bench Mark.

5. Traverse Survey (TS Traverse Method)

The traverse points shall be distributed at 200m - 300m intervals along the existing track between GPS control points. These traverse points should be used as the base for the track center survey (TS radiation observation method).

6. Track Center Line Survey for Main Line

It is necessary to know the tangent line intersection points (IP) of the existing track alignment and elements of curve BTC, BCC, ECC, ETC for preparation of maintenance work, but there are no marks on the railway site. This survey should therefore establish the existing track alignment. The track center shall be observed at intervals of 100m on straight sections and 20m on curved sections in order to define the track alignment.

7. Track Center Line Survey for Station & Depot

Tracks in the Station & Depot shall be confirmed together with the main line. The Station & Depot line shall be observed from the lead track turnout, crossings and end point buffer stops and all concerned facilities.
Track centers with small curve radii inside the depot area shall be observed at 1m - 2m intervals. Turnout beginning and end points shall be observed and adjoining small radius curves observed at short distance intervals including beginning, mid and end points.

8. Profile Leveling

Profile leveling shall be performed by differential leveling to find the vertical alignment of the existing track and prepare profile drawings. On sections with cant, the lower rail level (horizontal inner curve) should be adopted for the vertical alignment elevation. Profile leveling shall be performed at the same time and at the same locations with the TS traverse team and recorded with the same observation number.

9. Cross-Section Survey

The cross-section survey shall be performed at some selected locations where re-alignment is considered for the track rectification or the track bed is too narrow. Cross-section data shall be used to estimate the rectification earth work volume. Expert of Track Maintenance Planning had examined the photos of track of the target section, confirmed landform beside the track, and selected applicable spot. As measurement points,

31 locations were specified (200 points in total at 50m intervals) and instructed to “Boshtransloyiha” on December 3.

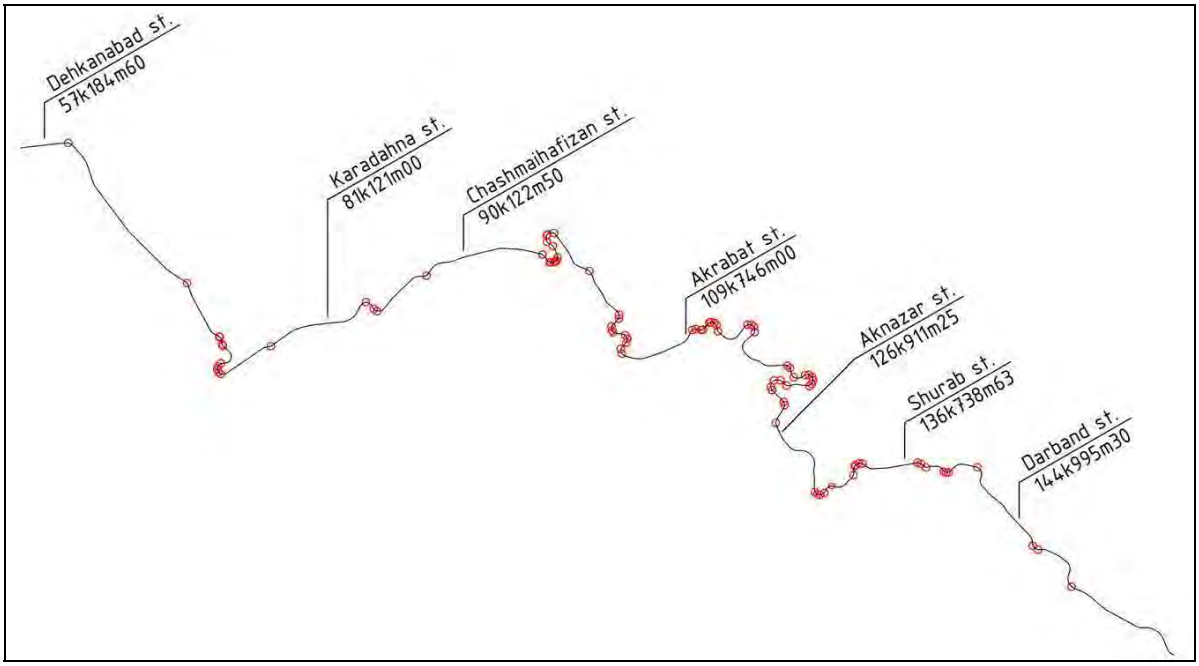
10. Finding Track Alignment (Existing Alignment Plan & Profile)

The existing track alignment shall be defined using computer AutoCAD trial work by inserting existing track center coordinates which have been surveyed as part of this survey work to produce plane drawings. The horizontal track alignment consists partly of tangent line, circular curves and connecting transition curves in-between. In case the track center coordinate point does not meet on the line after trial work with confirmed parts of alignment, the computational data shall be checked or re-survey field observations shall be performed. After confirming current horizontal alignment, the existing vertical alignment shall be defined using existing rail top elevation data at the new horizontal track chainage.

2.2.5. Preparation of Alignment Improvement Plan

(1) Condition of the New Railway Line according to Data obtained from the Survey

According to the result of the Survey by this project, 48% of the surveyed Dehkanabad-Boysun railway section (approx. 100.9 km in length) is consisting of curves. The characteristic feature of this section is the dominant of U-shaped curves with wide crossing angle and compound curves. There are 89 curves with radius less than 300m., out of them 10 curves are with radius less than 200m and the minimum curve radius is 145m. Such sharp curves with radius less than 300m are concentrated on the railway sections with U-shaped curves and at track sections with compound curves. The lengths of these sharp curves are not more than 100m. Location of sharp curves with radius less than 300m on the surveyed railway section is shown on [Fig. 2-8] and in [Table 2-20] and [Table 2-21].



[Fig. 2-8] Location of Curves with Radius less than 300 m on the Map

[Table 2-20] Curvilinear Items of Curves with Radius less than 300 m (1)

No	Station	Chainage			Curve Radius	Length
	Dehkanabad	57k184m00				
1		58K427M288955	to	58K503M884356	243.153994	76.595401
2		68K383M907384	to	68K521M666888	240.000000	137.759504
3		71K843M199898	to	71K891M555781	280.000000	48.355883
4		71K891M555781	to	71K933M525856	240.000000	41.970075
5		72K300M860787	to	72K375M338510	-250.000000	74.477723
6		72K389M671435	to	72K461M373189	-270.000000	71.701753
7		73K874M916983	to	73K987M659823	-240.000000	112.742840
8		74K095M523866	to	74K189M045817	-210.000000	93.521951
9		74K307M719175	to	74K331M484929	-165.000000	23.765753
10		74K465M083801	to	74K521M566718	-260.000000	56.482917
11		74K601M768340	to	74K699M190879	-260.000000	97.422539
12		77K721M391793	to	77K813M225115	-270.000000	91.833321
	Karadahna	81k091m10				
13		83K559M289164	to	83K685M016111	200.000000	125.726947
14		84K175M771695	to	84K230M336998	-240.000000	54.565304
15		84K338M638900	to	84K495M722541	-275.000000	157.083641
16		87K766M818262	to	87K879M064415	-250.000000	112.246153
	Chashmaihafizan	90k122m50				
17		94K405M600071	to	94K474M561477	240.000000	68.961407
18		94K949M371379	to	95K059M145688	-230.000000	109.774309
19		95K059M145688	to	95K097M598390	-290.000000	38.452702
20		95K204M640977	to	95K299M706107	-270.000000	95.065130
21		95K299M706107	to	95K336M551674	-225.000000	36.845567
22		95K336M551674	to	95K451M917892	-245.000000	115.366218
23		95K531M075108	to	95K621M666118	-240.000000	90.591009
24		96K225M222947	to	96K277M138605	-240.000000	51.915657
25		96K599M118838	to	96K673M583821	145.000000	74.464984
26		96K935M400257	to	96K997M705731	260.000000	62.305474
27		97K020M772949	to	97K082M072380	160.000000	61.299431
28		97K192M245609	to	97K304M076122	280.000000	111.830514
29		97K395M543865	to	97K470M532431	165.000000	74.988566
30		100K255M727015	to	100K340M968627	260.000000	85.241612
31		103K154M770822	to	103K209M810896	270.000000	55.040074
32		103K347M477808	to	103K418M907737	210.000000	71.429929
33		103K875M168092	to	104K039M406550	-240.000000	164.238458
34		104K124M794566	to	104K204M048945	-160.000000	79.254378
35		104K228M790179	to	104K341M998537	-275.000000	113.208358
36		104K908M793624	to	104K993M948815	160.000000	85.155191
37		105K111M102457	to	105K206M079958	160.000000	94.977502
38		105K341M389544	to	105K421M901037	200.000000	80.511493
39		105K770M005719	to	105K890M765350	-200.000000	120.759631
40		106K039M702955	to	106K119M933781	-175.000000	80.230826
	Akrabat	109k746m00				
41		110K392M093801	to	110K474M332542	200.000000	82.238741
42		110K575M480540	to	110K670M016000	260.000000	94.535461
43		110K881M029165	to	110K966M632492	-230.000000	85.603326
44		110K967M537794	to	111K075M513699	-260.000000	107.975905

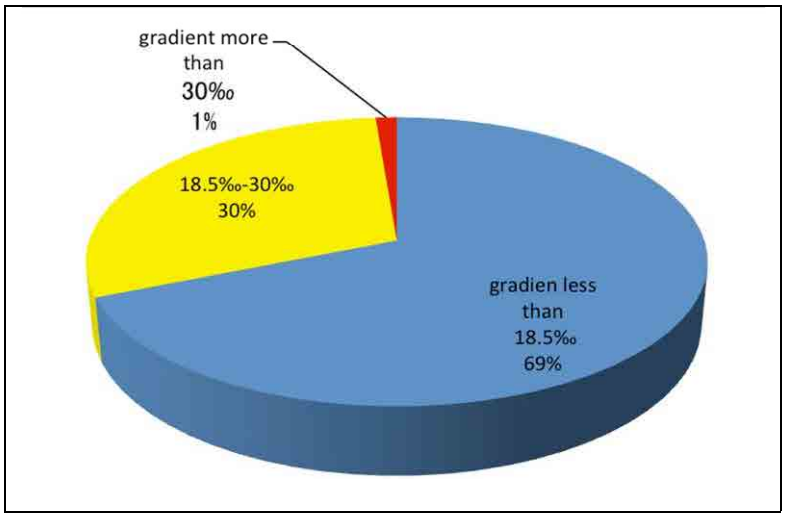
Note: Curves with radius less than 200m are marked in yellow.

[Table 2-21] Curvilinear Items of Curves with Radius less than 300 m (2)

No	Station	Chainage			Curve Radius	Length
45		111K474M673091	to	111K567M485446	240.000000	92.812355
46		111K567M485446	to	111K663M974746	260.000000	96.489300
47		111K750M325909	to	111K845M130465	240.000000	94.804556
48		111K933M402250	to	112K016M495011	265.000000	83.092761
49		112K256M941718	to	112K338M566025	-250.000000	81.624307
50		114K333M786908	to	114K383M480314	230.000000	49.693406
51		114K507M108738	to	114K622M798420	260.000000	115.689682
52		114K674M120522	to	114K787M089792	255.000000	112.969270
53		114K979M581957	to	115K090M035105	210.000000	110.453148
54		118K885M439860	to	118K982M736967	230.000000	97.297107
55		119K068M940224	to	119K167M483241	220.000000	98.543016
56		119K630M085132	to	119K685M718225	-190.000000	55.633093
57		120K266M247587	to	120K365M894316	290.000000	99.646729
58		120K473M183140	to	120K565M979818	270.000000	92.796678
59		120K714M355979	to	120K779M078874	230.000000	64.722895
60		120K874M989616	to	120K983M861180	250.000000	108.871564
61		121K082M651182	to	121K167M634318	245.000000	84.983135
62		121K167M874414	to	121K423M329460	285.000000	255.455046
63		122K458M937954	to	122K577M937518	230.000000	118.999565
64		122K917M140769	to	122K988M152899	-260.000000	71.012130
65		123K256M844535	to	123K366M312498	-250.000000	109.467962
66		123K668M017253	to	123K754M219742	-240.000000	86.202489
67		123K850M509682	to	123K942M817392	-280.000000	92.307711
68		124K755M536093	to	124K821M132777	250.000000	65.596684
69		124K915M878751	to	125K018M058688	240.000000	102.179937
70		125K980M472397	to	126K086M973711	-220.000000	106.501314
	Aknazar	126k911m25				
71		130K790M735356	to	130K900M039134	-240.000000	109.303778
72		130K954M222937	to	131K091M104323	-275.000000	136.881386
73		131K114M550392	to	131K237M525449	-270.000000	122.975057
74		131K354M979692	to	131K471M862726	-225.000000	116.883034
75		133K378M886870	to	133K493M253253	-235.000000	114.366383
76		133K864M293539	to	133K944M551349	270.000000	80.257811
77		133K945M395386	to	134K028M835312	280.000000	83.439926
78		134K124M146383	to	134K275M440118	275.000000	151.293734
79		134K364M435886	to	134K416M203928	230.000000	51.768042
	Shurab	136k738m63				
80		137K406M069506	to	137K471M193464	270.000000	65.123958
81		137K626M109793	to	137K653M697587	250.000000	27.587795
82		137K899M940702	to	138K031M843888	-185.000000	131.903186
83		138K957M957510	to	139K112M892945	-290.000000	154.935436
84		139K122M466754	to	139K231M970451	-280.000000	109.503697
85		139K245M735686	to	139K336M273679	-240.000000	90.537993
86		140K955M392940	to	141K057M333968	280.000000	101.941028
	Darband	144k995m30				
87		146K325M191748	to	146K473M852943	-285.000000	148.661194
88		146K720M151785	to	146K782M204604	-250.000000	62.052819
89		149K866M806815	to	149K979M536857	-270.000000	112.730042

Note: Curves with radius less than 200m are marked in yellow.

It should be noted that 69% of target section have gradients of less than 18.5‰, which conform to the norms, however the remaining 31% lies with gradients of more than 18.5‰ (refer to [Fig. 2-9]). This proportion is shown in [Fig. 2-9].The length of such sections with steep gradients are only between 20m and 50 m. Basically steep gradients are observed on sections with water discharge culverts constructed under high embankments. It is assumed that consolidation settlement of roadbed have caused concave vertical alignment.



[Fig. 2-9] Vertical Gradients at Dehkanabad - Boysun Section
(Total Length of the Section is 100.9 km)

(2) Counterpart Representatives for Track Rectification Planning (Alignment Plan)

UTY was requested to specify the Department responsible for preparation and execution of the existing Track Rectification Plan and assign counterparts(C/P) to participate capacity development seminar and joint work with Expert. In December, 2012, four C/P were nominated.

As it is shown in [Table 2-22], two out of four C/P are UTY employees and two remaining C/P are the employees of Design Institutes.

[Table 2-22] Counterparts for Track Rectification Plan (Alignment)

No.	Name	Position	Organization
1	S.H. Saidmuratov	Deputy Head, Track Inspection Station	UTY Track Facility Department
2	A.P. Bazarov	Chief Work Planner Engineer, Construction Operations	UTY Capital Construction Directorate
3	V.G. Bankov	1st category Engineer, Railway Track Design Team	"Toshtemiryolloyiha" Design Institute
4	G.G. Tsoy	Head of the Track Department	"Boshtransloyiha" Design Institute

Track Maintenance Department, where Mr. Saidmuratov works, is controlling all track facilities and is responsible for track maintenance. Mr. Saidmuratov is in charge of track condition inspection especially cant,

curve radius etc. depending on data received from Track Inspection Station. If there is some data which imply trouble are received, Mr. Saidmuratov will make track alignment calculations, and instruct the required realignment parameters specifying the critical location on site. After the completion of realignment work on site, he checks conformity with the indicated parameters.

Capital Construction Directorate, where Mr. Bazarov works, is dealing with arrangement of construction works, curve rectification works etc. Mr.Bazarov is in charge of supervision works including instruction to the contractors on site.

Toshtemirlloyiha Design Institute, where Mr. Bankov works, is 100% funded by UTY and included in the UTY group. The Institute is dealing with the design of railways as becomes clear from its name. The Institute is executing UTY's orders on railway line planning and design together with Boshtransloyiha Design Institute. Mr. Bankov is in charge of track alignment design using AutoCAD program.

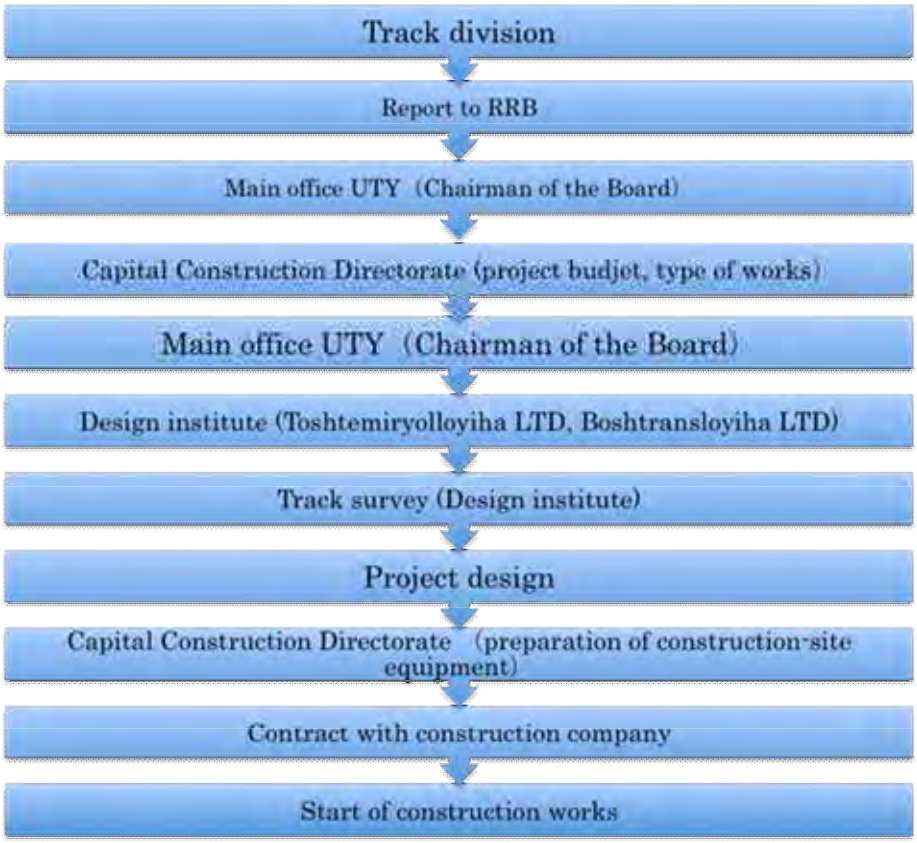
Boshtransloyiha Design Institute, where Mr. Tsoy works, is a design-and-survey institute and is 51% financed by UTY. This Institute, contrary to Toshtemirloyiha Design Institute, is offering wide range of services for making the design of not only railways but also the design of roads and civil structures. Currently, Mr. Tsoy is assigned as the leading position of the Track Department in Boshtransloyiha.

Participation of Design Institute employees directly involved in track alignment planning to this capacity development seminar and joint work helped greatly learning the railway alignment technology and method of Track Rectification Planning in Uzbekistan.

(3) Flow Chart of UTY Track Rectification Planning

During the joint work of Expert and C/P, the process of construction was summarized as in [Fig. 2-10], which is applicable when UTY carries out alignment improvement work.

If track rectification works in a small scale are required, such works will be carried out by RRB itself (within RRB budget). However, if large scale rectification works are required, RRB will forward the request to UTY.



[Fig. 2-10] Flow Chart of Track Rectification Planning

(4) Schedule and Results of Training Program in Uzbekistan

Under prescheduling of training session, it was planned that training would be conducted through a combination of lectures and practical training twice a week on Tuesdays and Thursdays from 2:00 p.m. to 6:00 p.m. The planned schedule is described in [Table 2-23].

[Table 2-23] Planned Schedule of Training Program (Alignment)

Subject	Date	Hours
1. Basics of alignment planning, Curve drawing method	Mar/14,19,21,26	16
2. Alignment rectification planning		
・Standard of rectification, Confirmation of current condition, Identification of critical point	Mar/28, Apr.2,4	12
・Site observation of target section	The week from Apr.8	8
・Rectification plan for horizontal alignment	Apr/16,18,23,25	16
・Rectification plan for vertical alignment	Apr/30, May/2,7,9	16
・Cross section planning (Preparation of cross section plan at critical points)	May/14,16,21,23	16
	Total	84

In the progress of training session, it became clear that the participants had high level of proficiency and that the design methods of track plan, vertical alignment plan and cross section plan are similar in Uzbekistan and in Japan. Therefore the Schedule of Training program was changed as shown in [Table 2-24].

[Table 2-24] Results of Training Program (Alignment)

Subject	Date	Hours
1. Basics of alignment planning, Curve drawing method	Mar/14,19,26,29 4/2	15
2. Alignment rectification planning		
・Standard of rectification, Confirmation of current condition, Identification of critical point	Apr.4,9,11,16	10
・Rectification plan for horizontal alignment (outline)	Apr/19,23	6.5
・Site observation of target section	Apr/25, 26	12
・Rectification plan for horizontal alignment (in detail)	Apr/30, May/3,7,17,21,23	15
	Total	58.5

(5) Contents of Training Program

5-1) Basics of Alignment Planning, Curve Drawing Method

Technical assistance was carried out through comparison of technical norms for basic items of rectification planning, which are shown below, established in Uzbekistan and in Japan. While introducing the norms of Japan, the norms currently used in Uzbekistan was confirmed. The technological level and capability of C/Ps were also confirmed.

1. Classification of railway lines
2. Types of curves in horizontal plane
3. Transition curve
4. Cant
5. Gradient and vertical curves
6. Vehicle gage, construction gauge
7. Distance between centers of adjacent tracks
8. Formation level width
9. Turnouts
10. Restrictions of alignment planning
11. Transition curve drawing methods
12. Idea and drawing method of intermediate transition curve

In the course of training session, the following facts were found:

- Railway construction methods in Uzbekistan are based on the Russian railway engineering methods. Basic concepts of cant and transition curve are similar to those applied in Japan.
- During the training session, C/Ps showd the initial design drawings of track plan, track profile and cross sections of the New Railway Line in the design stage and no deviations were found neither in track plan nor in track profile. In the plan, there was no compound curve which is currently observed on site and it was designed only with single curves. Moreover, the gradient change points of the vertical alignment were not shown in every 100m interval as shown in the existing track profile. It was the same method as track profile currently designed in Japan. Now, the compound curves which exist on site are not based on the initial design, but are considered to be caused by construction and track

maintenance method.

- Each specialist is well acquainted with the alignment planning and has high level of proficiency.

Since both of the specialists and railway construction methods in Uzbekistan were recognized as high level of proficiency and development respectively, the training contents had to be modified. Then, the training after this was changed into the training with emphasis on "Recognition of present condition of horizontal alignment in the target section" and "Modification of horizontal curve using the intermediate transition curve which is not used in Uzbekistan."

5-2) Alignment Rectification Planning (Standard of Rectification, Confirmation of Current Condition, Identification of Critical Points)

Technical standards for alignment rectification planning were specified by joint work with C/P. These standards were identified on the basis of norms used for the target railway section [belonging to the 2nd category] as well as the standards used for the construction of the new railway lines ("Tashguzar-Kumkurgan New Railway Construction Project"). Standards to be applied to this alignment rectification planning are given in [Table 2-25].

[Table 2-25] Technical Standards for Alignment Rectification Planning

Indicator Name	Indicators	Notes
Railway line category	II	
Maximum design speed	120 km/h	
Minimum curve radius	300 m (250m)	Basically the reinforced concrete sleepers are used. However at sections with curve radius 250 m the wooden sleepers shall be used
Maximum gradient	1.5 ‰ (2.5‰) – at stations 9 ‰ (18.5‰) – at sections between stations	at 18.5‰ multiple traction gradient (when a number of locomotives are coupled) elimination of gradient (700/R) shall be carried out depending on resistance to curve
Vertical curve radius	10000m (5000m)	
Road bed width	out of normal soil: 7.0 m out of rock soil: 6.0 m	
Rail type	R65	
Depth of ballast section	broken stone: 25cm sand cushion:20cm	
Width of ballast section	3.20 m	
Straight line length between curves	at uni-directional curves: 50m at reverse curves: 30 m	
Length of circular curve	over 10m	by default

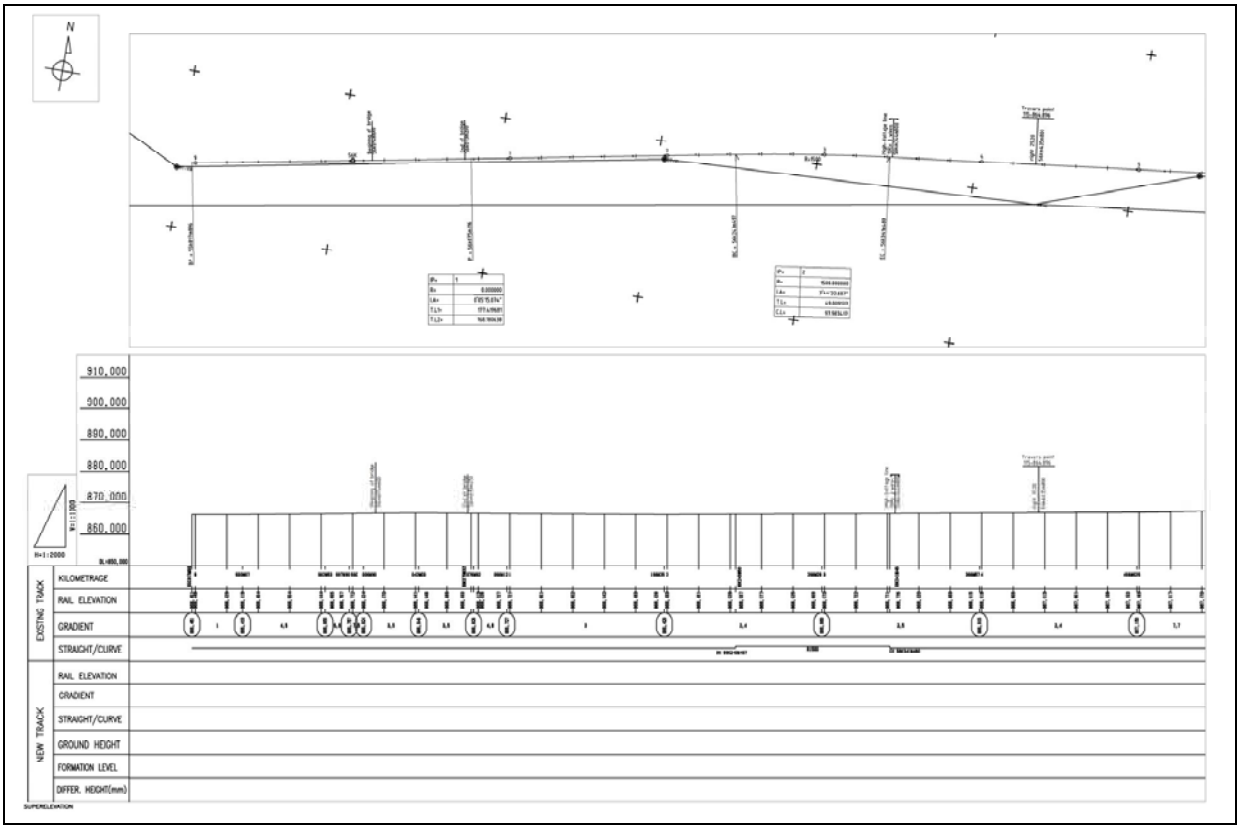
Note 1: KMK 2.05.01-96:" Building Code for Railway Design. Track Design Standards. KMK 2.05.01-96 State RUz Architectural and Construction Committee, Tashkent 1998"
Detailed Design: "New Guzar-Boysun-Kumkurgan Railway Line"
Note 2: parameters indicated in brackets ( ) are to be used in supersevere conditions

Based on technical standards for alignment rectification plan and under the assistance of C/P, the track sections which needs realignment were selected examining horizontal alignment and vertical alignment

drawings (with R ≤ 300m and gradients of more than 18.5‰).

As stated in item (1) "Condition of the New Railway Line according to Data obtained from the Survey", selected sections reached 89 horizontal curves with 31 km in accumulated length. However, there are some steep gradients with concave shape resulting from the road bed settlement. Realignment of such sections shall be carried out under the title of "road bed repair" but not under the title of "track profile alignment", therefore further rectification planning was carried out only for horizontal alignment.

A sample of the survey track profile of existing line used for this training seminar is shown in [Fig. 2-11]. This is the outputs of the survey work done by this Project, and expresses the approximate figure of the existing track condition (plane curve, gradient) at the end of last year. Plane is indicated in the upper part of a figure, and Profile and Details are indicated in the lower part.



[Fig. 2-11] Track Profile of Existing Line compiled by the Survey

5-3) Rectification Plan for Horizontal Alignment (Outline)

Rectification Plan for Horizontal Alignment was prepared in AutoCAD program on the basis of survey data. Such plan was prepared together with training seminar participants by means of connection of Mr. Bankov's computer to the projector. The works were performed in AutoCAD program and the participants were able to observe the process on the screen. Rectification Plan for Horizontal Alignment was prepared under the following policies:

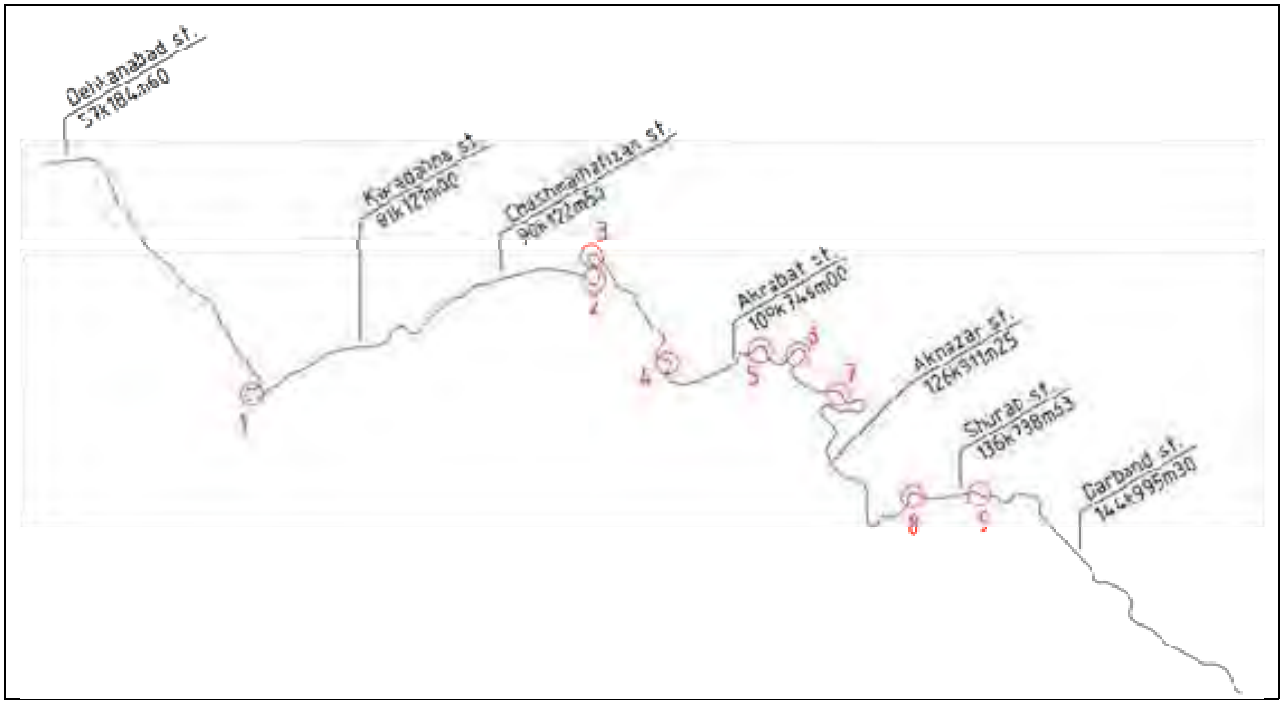
- Extension of curve radius from less than 300m to more than 300m (in exceptional circumstances with topographiceal conditions and such extension of radius is not possible, the extension of radius to more

than 250m shall be carried out).

- Together with extension of curve radius, compound curve formed at the site is improved into simple curve, or the number of compound curves is reduced as much as possible.
- Under Rectification Plan of Horizontal Alignment, the “Draft Ideal Rectification Plan” with the idea of extension of simple curve radius up to 300m and “Draft Actual Rectification Plan” with the idea of rectification of railway line considering minimum shifting of track on curves shall be prepared. Then the most suitable draft rectification plan shall be selected based on site observation, comparison of pictures taken on site and cross section survey data.
- In the Rectification Plan of Horizontal Alignment (Outline) , recommended plan is prepared only with simple curve without transition curve. Thereby it was examined whether curve 300m in radius can be inserted or not, and the approximate value of track shift is confirmed

5-4) Site Observation of Target Section

Out of sections which needs alignment improvement in accordance with the Rectification Plan for Horizontal Alignment (Outline), 9 sections with the biggest track shift value as well as sections with man-made structures i.e. bridges etc. were selected. The Expert and C/P visited these 9 sections indicated in the [Fig. 2-12] on April 25th and 26th, 2013, and observed actual situation of the sites.



[Fig. 2-12] Site Observation of Target Sections

5-5) Rectification Plan for Horizontal Alignment (in detail)

The possibility of curve rectification was most thoroughly studied together with C/P considering “Draft Ideal Rectification Plan” and “Draft Actual Rectification Plan” based on site observation, comparison of pictures taken on site and cross section survey data.

Following the results of study, it was concluded that rectification of curves is not possible on 6 out of 89 sections due to flyover bridges founded there and also due to the fact that parts of some curves passed over the steel bridges located on these target sections. As for the rest of 83 sections a plan for extension of curve radius to more than 300m was prepared (in exceptional circumstances, where the track shift would be too large, the extension of radius more than 250m was applied). The contents of Draft Rectification Plan are shown in [Table 2-26] and [Table 2-27].

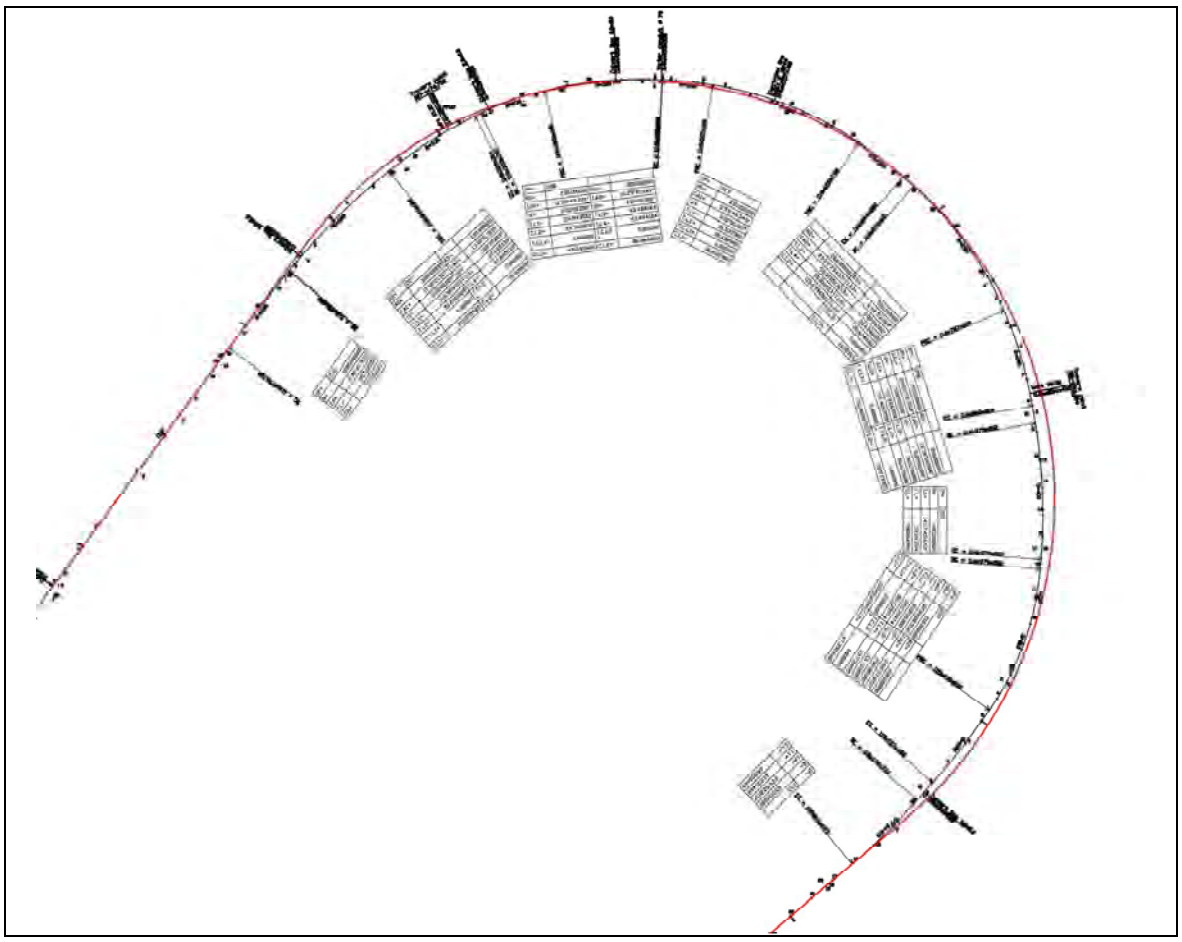
[Table 2-26] Contents of Alignment Rectification Plan (1)

No	Curve location	Curve radius		Description
		before	after	
1	58k427m – 58k503m	243m	—	Rectification is impossible due to the bridge found at the end joint of curve
2	68k383m – 68k521m	240m	300m	
3	71k843m – 71k891m	280m	300m	Combination of two curves in one
4	71k891m – 71k933m	240m		
5	72k300m – 72k375m	250m	300m	Combination of two curves in one
6	72k389m – 72k461m	270m		
7	73k874m – 73k987m	240m	300m	Multi-radius/compound curve is located at the railway section covering distance from 73k805m to 74k987m Replaced by the curve with one radius for the purpose of rectification
8	74k095m – 74k189m	210m		
9	74k307m – 74k331m	165m		
10	74k465m – 74k521m	260m		
11	74k601m – 74k699m	260m		
12	77k721m – 77k813m	270m	300m	
13	83k559m – 83k685m	200m	250m	If radius is 300m the shift is increasing
14	84k175m – 84k230m	240m	300m	Combined with the adjacent curve as one curve
15	84k338m – 84k495m	275m	—	Rectification is impossible because the bridge is located at the end joint of curve
16	87k766m – 87k879m	250m	300m	Multi-radius/compound curve is located at the railway section covering distance from 87k706m to 88k027m Replaced by the curve with one radius for the purpose of rectification
17	94k405m – 94k474m	240m	300m	
18	94k949m – 95k059m	230m	300m	Combination of two curves in one
19	95k059m – 95k097m	290m		
20	95k204m – 95k299m	270m	250m 300m	6-radii curve is located at the railway section covering distance from 95k204m to 95k716m. It was replaced by 2 radii curve.
21	95k299m – 95k336m	225m		
22	95k336m – 95k451m	245m		
23	95k531m – 95k621m	240m		
24	96k225m – 96k277m	240m	300m	
25	96k599m – 96k673m	145m	300.5 m	11-radii compound curve is located at the railway section covering distance from 96k599m to 97k589m. The compound curve was replaced by 1-radius curve for its rectification. Bridge is located at the beginning of curve joint. Fractional numbers were used in order to rectify curve without bridge infringement.
26	96k935m – 96k997m	260m		
27	97k020m – 97k082m	160m		
28	97k192m – 97k304m	280m		
29	97k395m – 97k470m	165m		
30	100k255m – 100k340m	260m	300m	
31	103k154m – 103k209m	270m	300m	
32	103k347m – 103k418m	210m	300m	Curve concentration is carried out together with an adjoining 400m curve and 300m curve.
33	103k875m – 104k039m	240m	—	Rectification is impossible because the bridge is located at 103k950m.
34	104k124m – 104k204m	160m	250m	Connection of two curves in one.
35	104k228m – 104k341m	275m		
36	104k908m – 104k993m	160m	250m	Combination with the adjacent 300m radius curve.
37	105k111m – 105k206m	160m	250m	Three curves with radius 160m, 370m and 200m are connected in one curve.
38	105k341m – 105k421m	200m		
39	105k770m – 105k890m	200m	250m	At 105k900m there is a bridge therefore it is impossible to extend curve radius up to 300m.
40	106k039m – 106k119m	175m	250m	Due to the fact that the bridge is constructed at 106км050m, 106k150m it is very difficult to extend curve radius up to 300m.
41	110k392m – 110k474m	200m	300m	5-radii compound curve is located at the railway section covering distance from 110k232m to 110k670m. The compound curve was replaced by 1-radius curve for its rectification.
42	110k575m – 110k670m	260m		
43	110k881m – 110k966m	230m	300m	4-radii compound curve is located at railway section covering distance from 110k798m to 111k211m. The compound curve was replaced by 1-radius curve for its rectification.
44	110k967m – 111k075m	260m		

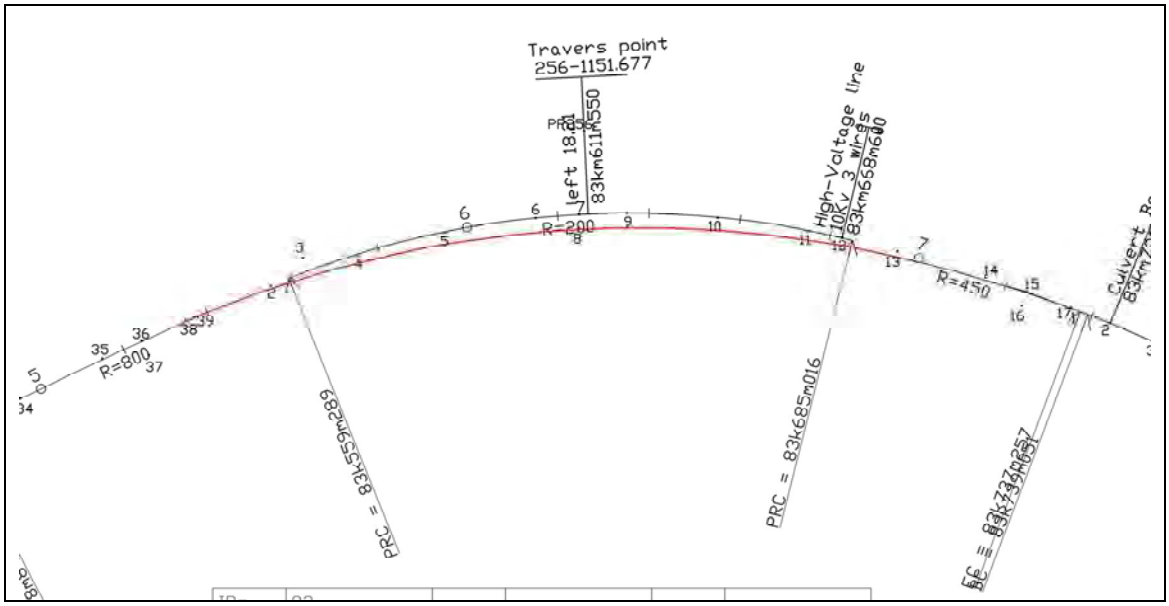
[Table 2-27] Contents of Alignment Rectification Plan (2)

No	Curve location	Curve radius		Description
		before	after	
45	111k474m – 111k567m	240m	295m	8-radii compound curve is located at railway section covering distance from 111k278m to 112k064m. The compound curve was replaced by 1-radius curve for its rectification. Curve radius to comply with minimum track shifting was chosen.
46	111k567m – 111k663m	260m		
47	111k750m – 111k845m	240m		
48	111k933m – 112k016m	265m		
49	112k256m – 112k338m	250m	300m	
50	114k333m – 114k383m	230m	305m	14-radii compound curve is located at railway section covering distance from 114k079m to 115k241m. The compound curve was replaced by 1-radius curve for its rectification. Curve radius to comply with minimum track shifting was chosen.
51	114k507m – 114k622m	260m		
52	114k674m – 114k787m	255m		
53	114k979m – 115k090m	210m		
54	118k885m – 118k982m	230m	295m	4 curves with radius 230m, 400m, 220m and 450m are connected in one curve.
55	119k068m – 119k167m	220m		
56	119k630m – 119k685m	190m	300m	
57	120k266m – 120k365m	290m	300m	11-radii compound curve is located at railway section covering distance from 120k266m to 121k525m. The compound curve was replaced by 1-radius curve for its rectification.
58	120k473m – 120k565m	270m		
59	120k714m – 120k779m	230m		
60	120k874m – 120k983m	250m		
61	121k082m – 121k167m	245m		
62	121k167m – 121k423m	285m		
63	122k458m – 122k577m	230m	300m	
64	122k917m – 122k988m	260m	351m	12-radii compound curve is located at railway section covering distance from 122k787m to 123k92m. The compound curve was replaced by 1-radius curve for its rectification. Curve radius to comply with minimum track shifting was chosen.
65	123k256m – 123k366m	250m		
66	123k668m – 123k754m	240m		
67	123k850m – 123k942m	280m		
68	124k755m – 124k821m	250m	300m	
69	124k915m – 125k018m	240m	300m	
70	125k980m – 126k086m	220m	300m	
71	130k790m – 130k900m	240m	300m	8-radii compound curve is located at railway section covering distance from 130k651m to 131k471m. The compound curve was replaced by 2-radii curve for its rectification.
72	130k954m – 131k091m	275m		
73	131k114m – 131k237m	270m		
74	131k354m – 131k471m	225m		
75	133k378m – 133k493m	235m	300m	
76	133k864m – 133k944m	270m	300m	Connection of two curves in one.
77	133k944m – 134k028m	280m		
78	134k124m – 134k275m	275m	—	Curve rectification is not possible due to the bridge located at the end of curve joint.
79	134k364m – 134k416m	230m	250m	It is difficult to extend curve radius up to 300m due to the bridge located at the beginning of curve joint.
80	137k406m – 137k471m	270m	350m	5-radii compound curve is located at railway section covering distance from 137k347m to 137k726m. The compound curve was replaced by 1-radius curve for its rectification. Curve radius to comply with minimum track shifting was chosen.
81	137k626m – 137k653m	250m		
82	137k899m – 138k031m	185m	250m	Track shifting is increased substantially at 300m curve radius.
83	138k957m – 139k112m	290m	—	Rectification is impossible due to the flyover bridge located at 139k100m.
84	139k122m – 139k231m	280m	—	Rectification is impossible due to the flyoverbridge located at 139k100m.
85	139k245m – 139k336m	240m	300m	
86	140k955m – 141k057m	280m	300m	
87	146k325m – 146k473m	285m	335m	5-radii compound curve is located at railway section covering distance from 146k325m to 146k836m. The compound curve was replaced by 1-radius curve for its rectification. Curve radius to comply with minimum track shifting was chosen
88	146k720m – 146k782m	250m		
89	149k866m – 149k979m	270m	300m	

[Fig. 2-13] is the example which improved compound curve to simple curve, and [Fig. 2-14] is the example which improved sharp curve with radius of 200m to curve radius 300m.



[Fig. 2-13] The Example of Horizontal Alignment Improvement Plan (1)
(Red line shows alignment after improvement.)

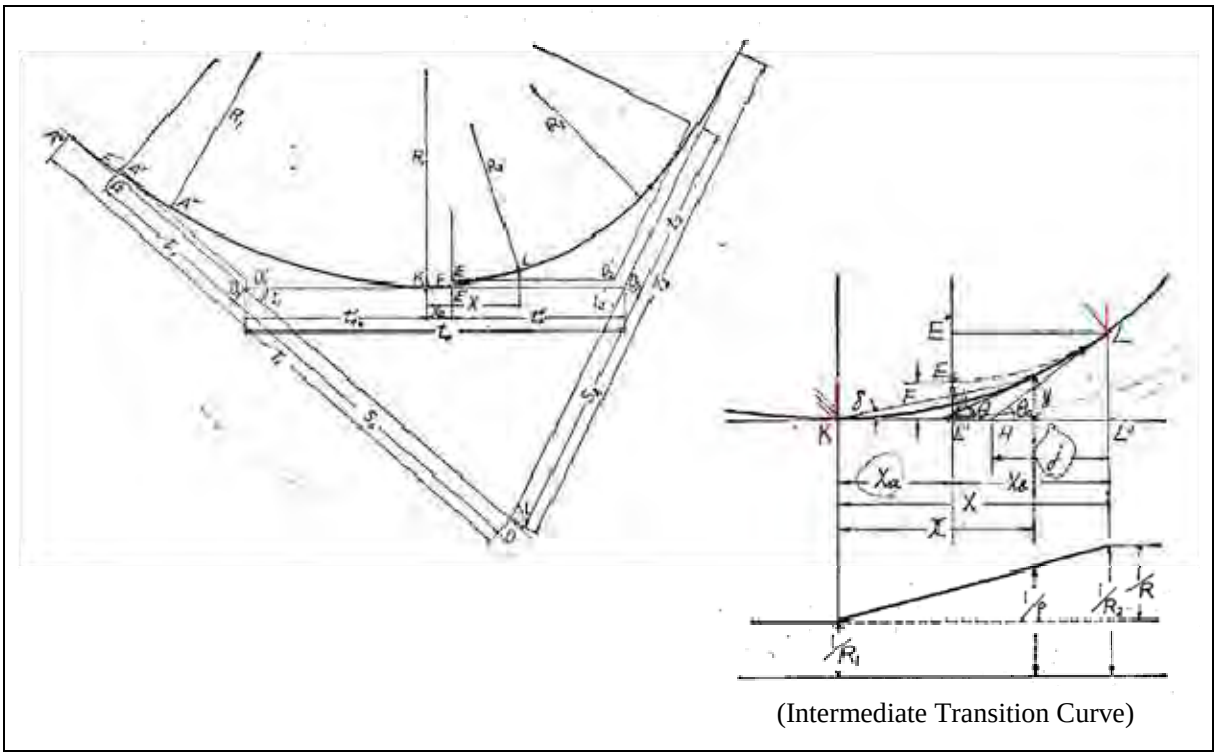


[Fig. 2-14] The Example of Horizontal Alignment Improvement Plan (1)
(Red line shows alignment after improvement.)

Next, the transition curves and intermediate transition curves were introduced for rectification of the given sections. Since there are no standards for intermediate transition curves in current standards used in Uzbekistan, the circular/simple curves located at sections with compound curves are connected directly. If train speed is 20km/h, it is not necessity to introduce intermediate transition curves. However, when the train speed is increased after electrification, the necessary to introduce intermediate transition curves will increase proportionally. Therefore, it was decided to present the method of introduction of intermediate transition curves.

Software made in Japan was not used in training seminars this time, but only AutoCAD program was applied for plotting of intermediate transition curve. Such manual curve plotting method is considered to be "old fashioned one" and unsuitable for exact positioning of railway line coordinates. However, during the training session, such method was taken, because it allowed understanding relative position between the curve and transition curve, curve shift value and to introduce the concept of intermediate transition curve.

After the participants of training seminars prepared tables for calculation of intermediate transition curve length using Excel program, which were required for preparation of the given curve drawing, they practiced the curve plotting mode in AutoCAD program. [Fig. 2-15] shows the concept of intermediate transition curve currently used in Japan, and it was introduced to C/P how to apply this idea.



[Fig. 2-15] Intermediate Transition Curve within Compound Curve Section

(6) Results of Training Seminars in Uzbekistan

The purpose of this project is capacity development of UTY in the field of train operation planning, track rectification planning and track maintenance planning for railway sections located in mountain areas. In the course of training seminars, the appropriate level of technologies applied by UTY and Design Institutes in the field of railway design theory and practice was confirmed. Critical sections of target railway line currently appeared on the track plane and profile were assumed as a result of urgent construction works or during the track maintenance work thereafter, and not during the design stage.

After the electrification, the speed of trains passing along this railway line will be increased, therefore it will be required to carry out track rectification works adjusting to return to the originally designed track plane and profile of this railway line. The method of insertion of intermediate transition curve into the compound curve, which is new for Uzbekistan, will be one option before the completion of such works.

2.3. Track Maintenance Planning

2.3.1. Confirmation of Current Condition of Track Maintenance

The original work plan included observation from the driver's cabin or a maintenance service car together with video shooting of current track conditions. Based on the observation results, it was planned to point out sections requiring special consideration for the improvement of roadbed or line side facilities. However, this observation was not realized.

The expert who supervised the survey work done by the Design Institute had taken a number of photos along the line before the commencement of the survey work, and these photos are now valuable for the confirmation of the current conditions of the target section together with the existing Track Profile and the records of the track inspection car.

The cross-section drawings which are part of the Design Institute's survey deliverables are to be used for calculating the volume of civil works of the re-alignment plan. The target locations for the measurement of cross-sections were selected based on the photos mentioned above, and then decided and instructed to the Design Institute on December 3.

On January 12, a special train used to observe track conditions was operated from Karshi to Termez and a video camera was fixed behind it to record the track conditions on the route. The electronic data of video recording was provided by UTY to the team of experts. As this video was shot in winter and in some section track were coverd by snow. Also track side km post could not be read off and chainage of the scene could not be identified, therefore utilization of this information was limited.

The photos of existing track which show rail laying beside the track after replacement and before transportation to storage indicate that track maintenance work is concentrated mainly on rail replacement. (According to reports, 30km of rail were replaced in 2011 and 37km are to be replaced in 2012.) This amount of replacement is very unusual for the section considering only about four years has passed since the opening of the new line. It is advisable to re-align the track in order to eliminate sharp curves and to introduce head hardened rail on sections with a curve radius of less than 600m. During construction of the new line, a portion of the budget of the Japanese ODA loan was allocated for the procurement of DHH rail made in Japan, but most of the sections were layed using normal Russian made rail.

The track maintenance conditions are better on the section after Akrabat and there are many locations with added ballast in contrast to the section before Akrabat where very few such locations can be found. Most of the track maintenance work on the section will most likely have to consist of disaster recovery work or track realignment work.

	
Shurab Station	120km+500m

[Fig. 2-16] Location with Replaced Ballast

The current track maintenance framework was found to be as follows:

(1) The target section of this Project is divided into 2 administrative sections. The No.12 Track Distance at Karshi controls the section before Akrabat, and the No.15 Track Distance at Termez controls the section after Akrabat.

(2) On the section before Akrabat, the line is divided among 2 Chief Track Masters (CTM) for control and after Akrabat among 3 CTMs. Under the CTMs, a Track Master controls each approximately 20km long section and Track Maintenance Gangs (TMG) composed of 7-8 staff members are in charge of actual maintenance work on each about 6km long section. The recorded chart of the track inspection car is sent to the foreman of the TMG and daily maintenance work is carried out in accordance with the chart.

2.3.2. Current Track Condition according to the Result of Survey

The track survey, which started in August 2012, was being carried out with considerable delay from the original schedule. The results of works (plane and longitudinal profile of main line) were submitted to JTC as a Track Profile in February 2013. We compared this Track Profile with the recorded chart by a track inspection car in the same section on March 20, 2013, in order to confirm the current state of the track. Besides, as it was mentioned in the section 2.2 above, Expert Mr. Horiuchi took photo survey of each 100 m of the track before the beginning of the survey, from Dehkanabad station to Boysun station (target section), while he walked through the whole section. These photos were also used as reference materials, which illustrate the state of railway track as of July - August 2012. Having summarized these results, we can describe the current state of track in the target section as follows:

- All curves in this section are not simple curves but compound curves, which are composed of several curves with different radius one after another, which make track maintenance work difficult.
- There are many sharp curves.
- There are some sections with steep gradients exceeding 30‰.
- In the section where the roadbed was built by infilling of deep gully, there appears subsidence by a consolidation settlement and lateral movement of the track toward gully.

- There are some places, where a subsidence of backfill of abutment of bridges took place.
- Simplified approaches to setting cant are applied in which the cant value is fixed following that of adjoining sharp curves.

According to Track Profile, which was compiled based on the survey, there are 35 sharp curves with their radius less than 250m in Dehkanabad – Boysun section, the length of which are less than 100m. Total accumulated length of these sharp curves is 3,045 m. The sharpest curve is 145m in radius. Information about these sharp curves is shown in [Table 2-28].

At the planning stage of this new line, maximum gradient was planned as 18.5‰. However, according to the Track Profile prepared by the results of the survey, there is a curve with 250 radius, as an example, which is a short 60 m section and with the gradient of 39‰. When we take into account the curve resistance, the practical gradient is assumed as 42‰.

[Table 2-28] Sharp Curves with a Radius of less than 250 m

(Section: 55 km 893 m – 156 km 811m. Period of the survey execution: November 2012)

Km		Length (m)	Radius (m)	Radius of adjoining curve	
				Preceding curve	Following curve
68.383	68.521	138	240		
71.891	71.933	42	240	280	320
73.874	73.987	113	240		520,280
83.559	83.685	126	200	800	450
84.175	230	55	240	900	310,350
95.299	366	67	225		
366	451	85	245		500
531	621	90	240		370
96.225	277	52	240	600	500
96.599	673	74	145		530
97.021	82	61	160		330,280
97,395	470	75	165		350,800
103,343	418	75	210	400	300
103,875	104,039	164	240	400	
104,908	993	85	160	300	
105,341	421	80	200		
105,770	890	120	200	500	
106,039	119	80	175		350
110,392	474	82	200		
110,881	986	105	230		260,330
111,474	567	93	240		260
111,750	845	95	240	330	
114,979	115,090	111	210		600
118,885	982	97	230		400
119,068	167	99	220		450
120,714	779	65	230	300	300
121,082	167	85	245		285
122,458	577	119	230		450
123,668	754	88	240		500,280
124,915	125,018	103	240		
125,980	126,086	106	220	400	
130,790	900	110	240		400,275
134,364	426	62	230	400	400
137,899	138,031	132	185	350	300
139,245	336	91	240		
Total /35 places		3045			

(Source: prepared by Expert)

2.3.3. Track Rectification Work by UTY

UTY's Track Facilities Department has a maintenance division which is in charge of taking measures to improve track condition. We have received the results of work which has recently been done in target section. This section is divided into Tashguzar – Akrabat line, which is under the authority of Karshi RRB's Track

Distance No.12, and Akrabat – Kumkurgan line, which is under the authority of Termez RRB's Track Distance No.15. The results of work done by Track Distance No.12 is shown in [Table 2-29] and [Table 2-30]. This section covers line from Tashguzar station (0km +000m), a starting point of the new line, to the highest point of target section: Akrabat station (109km+746m). From October 13, 2012 to March 6, 2013, 37 sections have already been executed among 87 places to be rectified.

[Table 2-29] Works UTY has done to Improve the Track Condition (1)

No.	Chainage	Date of work execution	Radius after work was executed (m)	Shifting of outer rail (mm)	Shifting of inner rail (mm)	Number of points (Note)	Progress of work
1	0km+681	13.10.2012	469	858	953	73	Executed
2	2km+830		3,960	58	115	69	
3	6km+490		1,951	114	92	75	
4	14km+980		1,439	143	141	65	
5	15km+890		6,284	18	19	29	
6	16km+180		5,000	41	48	29～54	
7	17km+860		1,561	180	268	49	
8	19km+440		1,973	131	269	8～40	
9	21km+740		486	238	401	36	
10	26km+150	12.02.2013	1,085	151	251	6～32	Executed
11	27km+810	12.02.2013	1,055	162	226	63	Executed
12	29km+060	15.02.2013	1,039	88	101	7～35	Executed
13	30km+400	15.02.2013	1,255	192	216	34	Executed
14	30km+810	20.02.2013	603	390	517	56	Executed
15	31km+480	18.02.2013	499	285	380	52	Executed
16	32km+010	07.02.2013	681	399	841	43	Executed
17	32km+830	24.01.2013	3,344	76	81	30	Executed
18	33km+200	04.02.2013	1,613	57	93	28	Executed
19	33km+640	30.01.2013	817	134	115	5～31	Executed
20	34km+080	30.01.2013	1,411	195	390	48	50%
21	34km+790	21.12.2012	847	256	521	44	50%
22	35km+590	06.03.2013	580	247	313	64	Executed
23	36km+290	21.12.2012	447	442	779	88	Executed
24	37km+220	21.02.2013	706	219	323	52	Executed
25	38km+170	05.03.2013	444	531	594	4～72	Executed
26	39km+910		451	363	769	48	
27	40km+410	01.02.2013	619	407	265	59	50%
28	41km+720	07.02.2013	1,457	71	94	44	50%
29	42km+230		604	392	336	48	
30	43km+230		1,611	158	256	52	
31	45km+240		3,476	46	41	17	
32	45km+450		811	145	236	26	
33	46km+680		1,663	156	474	123	
34	50km+690	20.01.2013	508	426	428	41	Executed
35	54km+130		1,085	149	108	54	
36	55km+130		1,804	65	63	20	
37	58km+065	15.11.2012	491	388	859	66	Executed
38	59km+330	15.11.2012	1,646	165	166	72	Executed
39	60km+700		1,406	203	378	57	
40	63km+880		1,481	165	196	29	

(Note): 10 m long tape is used during the work in the field. So, length of the section to be rectified can be calculated by multiplying 10 m to this figure.

(Source: UTY's Track Facilities Department)

[Table 2-30] Works UTY has done to Improve the Track Condition (2)

No.	Chainage	Date of work execution	Radius after work was executed (m)	Shifting of outer rail (mm)	Shifting of inner rail (mm)	Number of points (Note)	Progress of work
41	66km+790		2,012	104	104	60	
42	68km+160		315	628	650	31	
43	68km+980		2,714	78	195	54	
44	71km+000		644	272	386	51	
45	71km+600		305	369	273	46	
46	72km+070		302	255	292	36	
47	72km+680		819	278	404	80	
48	73km+670	06.02.2013	301	447	581	121	Executed
49	77km+090		616	347	344	34	
50	77km+416		506	429	640	31	
51	78km+850		1,192	224	367	49	
52	79km+490		4,613	47	42	50	
53	80km+060		1,125	59	63	21	
54	81km+550		1,050	210	453	47	
55	81km+650		903	65	60	17	
56	81km+820		1,004	215	440	101	
57	83km+040		379	872	727	91	
58	85km+280		1,262	176	231	19	
59	86km+780	06.12.2012	616	370	692	59	Executed
60	87km+410	06.12.2012	623	370	695	59	Executed
61	88km+000		808	273	374	80	
62	88km+840		1,908	72	101	8	
63	89km+070		1,010	203	147	30	
64	91km+780		858	205	283	37	
65	92km+880		1,004	104	224	25	
66	94km+044	07.11.2012	471	474	696	43	Executed
67	94km+530	07.11.2012	309	729	662	100	Executed
68	95km+690	07.11.2012	524	496	608	49	Executed
69	96km+250	01.11.2012	309	655	1074	119	Executed
70	98km+270		1,812	73	87	46	
71	98km+990		448	298	530	46	
72	99km+810	08.11.2012	564	394	744	69	Executed
73	100km+640		601	226	446	26	
74	101km+010		3,488	23	22	12	
75	101km+280		968	150	216	40	
76	101km+810		614	263	480	39	
77	102km+590		355	503	690	75	
78	102km+350		1,625	103	115	22	
79	103km+520	15.11.2012	316	720	953	90	Executed
80	104km+420	19.11.2012	328	981	1091	83	Executed
81	105km+300	22.11.2012	329	784	976	85	Executed
82	106km+270	26.11.2012	723	127	177	19	Executed
83	106km+560	12.02.2013	1,003	171	240	20	Executed
84	106km+827	07.02.2013	600	284	315	26	Executed
85	107km+088	13.11.2012	1,919	86	68	26	Executed
86	108km+122	13.11.2012	1,565	77	70	27	Executed
87	110km+220		313	405	410	54	

(Note): 10 m long tape is used during the work in the field. So, length of the section to be rectified can be calculated by multiplying 10 m to this figure.

(Source: UTY's Track Facilities Department)

Having received this material above, we reconfirmed the recorded chart of the track inspection car on March 20, 2013, regarding location and radius of sharp curves in the target section (55km+893m-156km+811m). Then we were able to confirm that only 7 curves with a radius less than 250m as shown in [Table 2-31]. Besides, some discrepancies in chainage were found between the table prepared by UTY's specialists and the recorded chart of the track inspection car. Comparison of the abovementioned record of work done by UTY and the recorded chart of the track inspection car has not been done.

[Table 2-31] Location of Sharp Curves Defined by the Chart of the Track Inspection Car

(Survey Date: 20.03.2013)

Km	Radius of curve (m)
97km400m	200
97km840m	235
98km200m	235
105km720m	210
105km920m	215
106km120m	240
118km560m	230
Total: 7 places	

(Source: prepared by Expert)

It was confirmed that UTY has been executing track maintenance work and rectification work to improve track alignment. However, according to the chart of the inspection car, many compound curves have remained and it is desirable to continue taking measures aiming at "simplification" as well as realignment of existing curves.

Improvement works on the curves have been done by using multiple tie-tamper, track liner and ballast regulator which are stationed in Buhara Track Maintenance Machines Depot during the period from October 2012 to April 2013. However, they have been mobilized to Tashkent - Samarkand line, where a high-speed "Talgo" train is operated, therefore, they can not be used after that in the target section of the Project.

2.3.4. Use of Track Master

Track Master is equipment which can measure level difference of two rails, curvature, gauge and other parameters of the track. In Japan it is used for easy evaluation of track condition before and after the maintenance work is done. In the Terms of Reference (TOR) of this Project announced by JICA, it was mentioned that this equipment would be used for measuring condition of current track of the target section. An option was considered in which this equipment would be procured and provided for the Japanese experts to use for their activities. However, having considered the period required for the procurement and custom clearance of this equipment, it would not have enough time for the first on-site work of Experts. Besides, taking into account the total cost of the Project, it was decided not to provide this equipment as Expert's equipment and confirmed in IC/R.

In line with this Project, JICA was planning to propose equipment which have close relation with the purpose

of this Project and PIU-E had submitted a wish list of the equipment to be donated. In June, 2012, PIU-E withdrew its original request as track maintenance machines and submitted a new request of track equipment called “Track Master”. In the second half of 2012, JICA Uzbekistan Office started necessary procedures to comply with this request.

If “Track Master” had been delivered to Uzbekistan when Experts were working on-site, we could have organized practical trainings for UTY’s staff that would have allowed to use it effectively in daily maintenance work, as it is being done in Japan now. As a result of a tender which was held in January, 2013, at JICA in Tokyo, this equipment was delivered to Tashkent by air on March 26, 2013. However, a revised customs procedure of the Government of Uzbekistan was enacted on April 1, 2013, some of the necessary documents could not be prepared by the supplier, and as of end of May “Track Master” could not be delivered to UTY. The assignment of Japanese Experts has ended by the end of May.

As it is shown in [Fig. 2-17], “Track Master” is easy-to-use device, which can be moved over rails by pushing by hand. Its weight is 39 kg (with a type for 1067 mm gauge). It is equipped with a function to measure radius of curve in real time, immediately calculate shifting value of right and left rails required for realignment into simple curves, and this data appears on the display. Therefore, it is possible to effectively carry out track maintenance work.

[Fig. 2-17] Appearance of «Track Master» (a type for 1067mm gauge)

2.3.5. Review of Regulation regarding Track Maintenance

The rules regulating track maintenance in Uzbekistan are stipulated in ”The instruction for Track Maintenance“ enacted in 2003 by the Bureau of Supervision of Railway Traffic Safety in the Republic of Uzbekistan. The document contains almost all necessary norms regulating track maintenance given below.

- Formula for calculation of cant value.
- Formula for calculation of average speed.
- Length of transition curve: 1000 × cant value (speed <120km/h、applying cubic parabola).
- Method of gradual decrease of cant, if a length of straight between two curves of one direction is more than 25 m; the case if a length of straight is less than 25m; slack and cant setting method at a contact point of compound curve; ensuring of 15m straight between curves of different directions and gradual decrease of cant.

- Slack value at curves: 10 and 15 mm (0 slack is allowed for PC sleepers).
- Insertion of vertical curve with a radius of 10,000 m into a gradient changes point.
- There is no regulation for installation of signposts at gradients change point.

Although UTY has worked out rules regulating track maintenance work, actual works have not been done in conformity with the rules at many places regarding cant or vertical curves. Therefore, relevant track maintenance works are required.

2.3.6. Seminar related to Track Maintenance in Uzbekistan

Having studied current condition of track in mountain area, it was decided to conduct seminars in Uzbekistan to help to improve track maintenance work in the future.

(1) Purpose

To deepen understanding of necessity in developing measures aiming at improvement of track maintenance management system as well as specific measures to rectify track of the target section and maintain them in a good condition.

(2) Participants

The participants of the seminars were nominated from the staff of UTY's Track Facilities Department and relevant divisions of Termez RRB and Karshi RRB who are in charge of track maintenance control on the target section.

As regards Karshi and Termez, we decided to mainly invite the people who are responsible for management of track maintenance at Track Distance No.12 (Karshi RRB) and Track Distance No.15 (Termez RRB), which are similar organization to the track maintenance office in Japan. Through our C/P we asked PIU-E nominate participants of the seminar.

(3) Counterparts (C/P)

The C/P are Mr. Kunanbaev B.B., First Deputy Head and Mr. Otakulov R., Chief Engineer of UTY's Track Facilities Department,. They supported for selection of the participants.

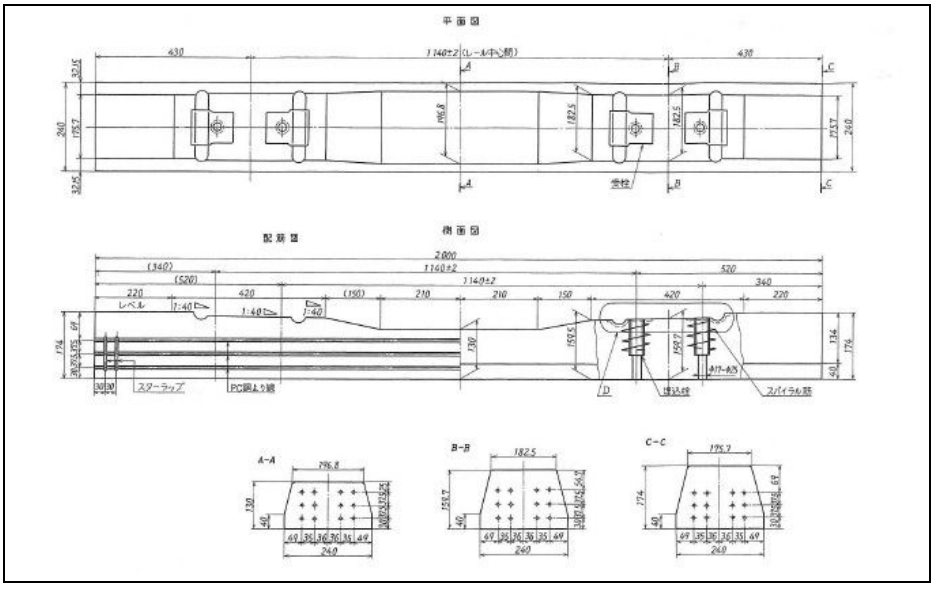
(4) Seminars, which were held at UTY

7 seminars were held on March 28, April 2, 5, 9, 12, 25 and 26. Each one lasted 2.5 hours, from 10:00 to 12:30.

The following topics were the contents of the seminars.

- Introduction, the purpose of the seminars, particularly understanding of current condition of the target line and necessity of taking appropriate measures.
- Evaluation of track by measuring 10m string, application of "Track Master", norms for quick repair of track.

- Necessity to use equipment for replacement of rails, work manual of rail replacement, DHH rails (Head Hardened rail), necessity of expansion joints.
- Standard for track rectification considering passengers' comfortability, Standard of finishing level after track maintenance work.
- Norms for rectification of complexed track irregularity, use of locomotives favorable for track (replacement of currently used Co-Co wheel configuration to Bo-Bo-Bo).
- Various problems concerning curved sections: introduction of PC sleepers adjustable for slack, calculation formula of cant, calculation formula for correct cant on compound and transition curve, avoidance of overlap of curve and gradient, elimination of discrepancies between cant and transition curve.
- Mechanism of interaction between the behavior of rolling stock and derailment, application of L-shape guard as a preventive measure against derailment.
- Transition from currently used track maintenance system, under which maintenance works are done by track gangs of UTY, to a system to entrust works to private companies possessing high professional skills.
- Application of level crossings which allow easy track maintenance.
- Application of solid rectangular PC sleeper for long rail sections, which ensure stability and prevent buckling incidents. [Fig. 2-18] shows a type of such sleeper used in Japan.



[Fig. 2-18] PC Sleeper Type 3

(5) Seminars at Termez RRB and Karshi RRB

The seminars were held in Termez (14 May: from 09.00 to 16.00 and 15 May: from 09.00 to 14.00) and Karshi (16 May: from 09.00 to 16.00 and 17 May: from 09.30 to 14.00), two days in each place. Duration of seminars was 12 hours each.

Contents of the seminars are almost the same as those which were held at UTY, Tashkent.

(6) Participants of the Seminars

Participants of this seminar are shown in [Table 2-32].

[Table 2-32] Participants of Seminar (Track Maintenance)

Place and date	Work unit in which participant belongs to	Number of participants	Total, man-day
UTY's Track Facilities Department 14 and 15 May	Executive position	1	1
	Track maintenance control	3	8
	Track construction control	3	9
	Track inspection control	11	35
	Total	18	53
Track Distances in Karshi RRB and Termez RRB 16 and 17 May	Track Distances #12 and #15 serving the target section of the Project	4	8
	Track Distances #13 and #14, is not serving the target section of the Project	4	8
	Total	8	16

(7) Impressions of the Participants (Extract)

- During the seminar, the following topics were especially useful: improvement of curves condition, installation of the device that prevents derailment on curves, installation of signposts on gradients. It was also interesting to discuss an issue concerning "Track Master" which allows to measure track condition by 7 parameters. I think that this is very convenient equipment. Besides, it was very interesting to learn about concrete block, which is used on level crossings in Japan.
- The most interesting topic during the seminar was information that track maintenance in Japan is being done by private companies which possess necessary equipment. It was also useful to know about a device that is installed on curve sections to prevent derailment, as well as about installation of signposts on gradients. It would be good for UTY to introduce such devices and practice. "Track Master" is very convenient equipment. It is suitable to apply not only on Tashguzar - Kumkurgan line, but on other UTY's sections as well.
- It is necessary to use RC blocks at UTY' level crossings. UTY's staff should be trained how to use" Track Master". It is used in daily track maintenance work. Besides, I think it is effective to install a guard for derailment prevention at curves, high embankments and at places, where gradients and curves overlapped. Also, I would like to take part in seminars conducted for introduction of electronic devices and software for calculation of curves parameter.
- For me the most interesting topic was regarding curved sections. Much more maintenance work must be done at the curved section, which under the authorities of our Track Distance, however old equipment are still used. I think that if new equipment is purchased then we will be able to increase work efficiency. The Government of Japan gave us "Track Master", which we want to introduce as soon as possible. I would like to learn in the next seminars at for about new technology and equipment.

2.3.7. Training Program in Japan

As part of this Project, a training program in Japan in the field of "Track Maintenance and Rectification Planning in the Mountainous Area" was conducted. This program was not included in the original plan of activities, however, after confirming current situation of track maintenance of UTY and considering the effectiveness of this Project, the need for training in Japan in track maintenance field had been recognized. After consultation with UTY and JICA in 2012, 10 trainees in the field of "Train Operation Planning" were split and 3 persons were decided to be appropriated for this filed. Outline of the training is as follows:

(1) Objectives of Training

The objectives of this program are to introduce the track structure and maintenance system of mountain railway line in Japan, and deepen their understanding of the significance and effectiveness of the track rectification planning and improvement of track maintenance activities recommended by the project.

(2) Target Group of Training

Three participants are nominated who have position as decision maker in UTY when the rectification plan of the target railway section is planned and implemented. Those persons are representative from UTY headquarters, Karshi RRB and Termez RRB.

It was agreed that the candidates would be nominated in consultation between Expert and PIU-E. Although the deadline of submission of Application Form (A23 form) was two months before the commencement of the program, the letter from the Project team to UTY recommending 3 candidates were issued on May 2, 2013.

[Table 2-33] List of Participants for Training in Japan (Track Maintenance and Rectification Planning)

No.	Name	Position	Organization
1	Kunanbaev B.B.	Deputy Director	Department of Track Fcilities
2	Eshmanov N.A.	Chief of Department	Department of Track Maintenance Facilities, Karshi RRB
3	Normamatov K.	Chief of Track Distance	Track Distance No.15, Termez RRB

(3) Facilities to be used for Training Program

a) JICA Tokyo International Center was in charge of implementation of this program, and seminar room, accommodation and other related facilities were used.
b) Lecturer was assigned from Japan Railway Track Consultants Co., Ltd. and a meeting room of the company was used for some lectures. This company is executing track maintenance work ordered by JR East (East Japan Railway Company).
c) Facilities of JR East for observation
d) Facilities of Railway Technical Research Institute for observation
e) Facilities of Kaneko Corporation for observation.

(4) Schedule and Contents

The participants arrived in Japan on Sunday, June 17, 2013, and the program began by "Briefing by JICA" in the morning of June 18. The last session was "Reporting" at JICA Tokyo International Center on June 25, and they left Japan on June 26, 2013.

Contents of the Training Program is shown in [Table 2-34] ~ [Table 2-36].

[Table 2-34] Contents of Training for Track Maintenance and Rectification Planning in Japan (1)

Day	Time	Place, Lecturer	Title and Summary
Jun 18 (Tue)	9:30～	JICA Tokyo Int'l Center (TIC)	JICA Briefing
	13:30 ～ 17:00	JICA TIC	Outline of railway in Japan
		Mr. Murao (JRTC)	Explained current condition of railway network, rules and regulations in Japan etc.
Jun 19 (Wed)	9:30 ～ 12:00	Meeting room of JRTC	Structure and mechanism of track maintenance work
		Mr. Murao (JRTC)	Explained structure of track maintenance in JR East, and details of track maintenance work.
	15:00 ～ 17:10	Ride on an Inspection car of Shinkansen (Tokyo – Sendai)	Work flow of track inspection by the inspection car called "East i" (Dep. from Tokyo 15:16, Arr.at Sendai 17:08)
		Mr. Kataoka (JR East)	Explained outline of track inspection work showing real data in the monitor in the car.
	17:30 ～	Travel back to Tokyo by a Shinkansen train (Sendai – Tokyo) (Dep.from Sendai 17:41, Arr.at Tokyo 19:24)	
	 Lecture in JICA TIC		 Lecture in JRTC
	 Shinkansen Inspection car "EAST i"		 Inside the EAST i
Jun 20 (Thu)	9:30 ～ 12:00	Meeting room of JRTC	Framework of track inspection and maintenance
		Mr. Murao (JRTC)	Explained criteria and method of track maintenance.
	13:30 ～ 16:00	ditto	ditto
		ditto	ditto

[Table 2-35] Contents of Training for Track Maintenance and Rectification Planning in Japan (2)

Day	Time	Place, Lecturer	Title and Summary
Jun 21 (Fri)	10:00 ～ 12:00	JR East, Ohmiya Shinkansen Track Maintenance Center	Maintenance system of Shinkansen
		Mr. Inoue (JR East)	Explained Maintenance system to control train operationa and power supply for the maintenance work of track, power, signal and telecommunication.
	12:00 ～ 13:00	Railway Museum	Exibition of rolling stock,facility and system of Railway in Japan
		Mr.Takino and Mr Murai (CDN) attend	Observed Railway Museum in the vicinity of above Track Maintenance Center
Jun 21 (Fri) To Jun 22 (Sat)	23:30 ～ 01:30	JR Narita Line Shimousa Kouzaki-Ooto	Observation of track maintenance work at night (Replacement of sleepers)
		Mr. Ootake (JR East)	During the windowtime from 23:19 for 5 and half hours, 51 wooden sleepers were replaced by PC sleepers.
	After	JICA TIC	Perparation for reporting session
	 Observation of maintenance work		 Railway Technical Research Institute
Jun 24 (Mon)	10:00 ～ 12:00	RTRI	Outline of Railway Technical Research Institute (RTRI)
	14:00 ～ 17:00	Kaneko Corporation	Introduction of track maintenance mashineries manufactured by Kaneko
		Mr. Shibazaki (Kaneko Corporation)	Guidance for the participants how to use Track Master, which was donated to UTY by JICA. Introduction of various machineries and equipment regarding track maintenance
	 Track Master at Kanako Corp.		 Reporting session at JICA TIC

[Table 2-36] Contents of Training for Track Maintenance and Rectification Planning in Japan (3)

Day	Time	Place, Lecturer	Title and Summary
Jun 25 (Tue)	9:30 ～ 12:00	JICA TIC	Preparation for reporting session
		Expert Mr.Takino Mr.Murai (CDN)	Hearing of impressions from participants
	14:00 ～ 15:30	JICA TIC	Reporting session
		Mr. Imai (JICA HQ,) Mr. Okamoto, Mr.Ishiuchi (JTC) Expert Mr. Takino, Mr. Murai (CDN)	Impression of the training program was collected from the participants and translated into Japanese by CDN. Mr.Imai led the meeting and question and answers by the attendants followed.

In the training schedule, riding observation on a track inspection car in the mountainous section of the conventional line was desirable, however, track inspection cars of JR East were not operated during the week. Therefore shinkansen inspection car was arranged.

Also, it was planned to visit Maintenance Control Center of JR East, but the permission was not granted and we had to adjust schedule to arrange visit to Ohmiya Shinkansen Track Maintenance Center.

For the observation of track maintenance work at night, it was not easy to confirme in advance whether any work would be carried out on the desired date, but it could be possible at night on Friday as a result.

The Track Master, which were donated by JICA to UTY, were handed over in Tashkent in the same week of this training, and an engineer of the manufacturer performed an operation guidance at RRB Tashkent. Three participants of this training in Japan were able to receive a direct explanation from Mr. Shibasaki while they visited the factory of Kaneko Corporation. Mr. Shibazaki is the engineer who conduted guidance at Tashkent and has just returned to Japan.

In addition, participants could observe "L-shape guard for prevention of derailment" and various rail fastening devices, which Expert Mr.Takino has introduced in the seminar in Uzbekistan, during the visit to the Railway Technical Research Institute, then this training program in Japan was fruitful.

2.3.8. Recommendations for Improvement of Track Maintenance Work

We have examined current condition of the track in the target section of the Project and confirmed the existing maintenance control system under which work is being done. So, we propose the following items to improve track maintenance work.

(1) Introduction of a Device for Detection of Track Inspection Car's Location

Track gangs are doing their maintenance work using data obtained by the track inspection car. However, in some cases there are discrepancies between the chart of the track inspection car (km) with actual location of the track. In the chart we received, such discrepancy at Akrabat station was 800m. In Japan, a special device is equipped under the car, which can identify the position of the car by contactless communication with another device placed near rails. So, we think it is desirable to introduce such special device into the system of track inspection car used by UTY. An example of how this device is used in Japan is shown in [Fig. 2-19].

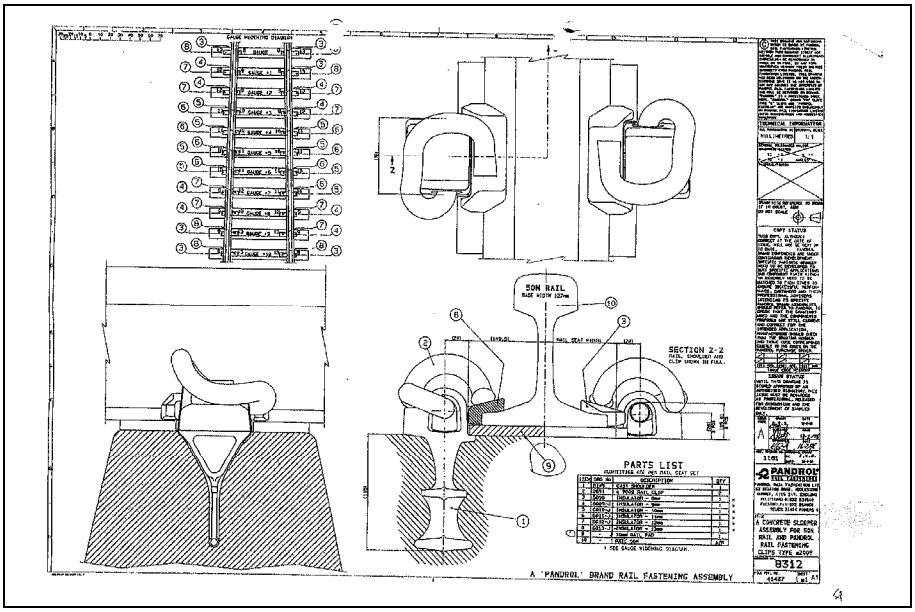
(Source: Web page of «Tokyo Keiki Rail Techno Inc.»)

[Fig. 2-19] Track Inspection Car / Device for Identification of Chainage

(2) Installation of Device on PC Sleepers, which allow to change slack value

For smooth passing of wheel pair through the curved sections, track gauge is expanded as so-called slack. However, in case of PC sleepers, UTY applies a rule which allows 0 value of slack, because rail fastening method which can adjust slack value is not practically used. Currently, a test of PC sleepers with 10 mm slack is being conducted, but it is unknown when it can be authorized.

However, if the slack value is not enough, severe wear of rails and wheel pairs take place in the section of sharp curves. So, we think it is desirable to set up required value of slack. In Japan, a fixing device has been developed, which is applicable to gradually adjust value of slack and it is desirable to introduce it. A sample of this device is shown in [Fig. 2-20].



[Fig. 2-20] Device which Allows to Change Slack Value

(3) Level-crossings with Less Technical Maintenance Work

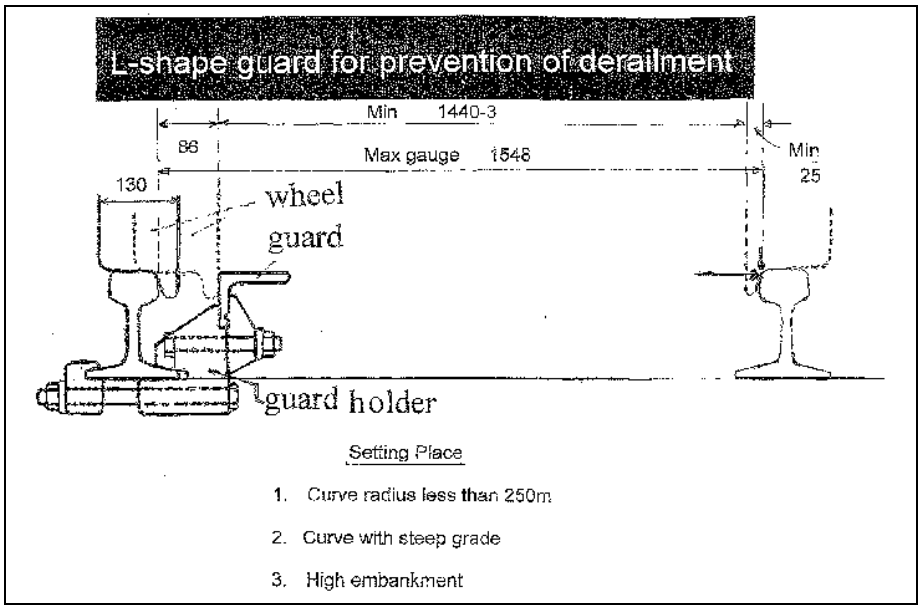
Since 45 years ago, Japanese railways started not to use sleepers on level-crossings with a high traffic level. Instead, we started introducing solid concrete blocks tied with steel rods and place them on strengthened layer of road bed. The purpose is to reduce an amount of track maintenance work. We consider it desirable to build such kind of level-crossings.

(4) Installation of Signposts at the Beginning and the End of Gradients

UTY does not have rules regulating installation of signposts at the beginning and at the end of gradients. In order to execute effective track maintenance and train operation, it is desirable to establish a regulation for installation of signposts at gradients.

(5) Installation of L-shape Safety Guard for Prevention of Derailment

In Japan, L-shape guards for prevention of derailment are installed on specific curves. As it is shown in [Fig. 2-21], L-shape steel device is fixed to inside part of rails, parallel to the inner rail of the curve. If there happens a situation when wheel pairs are going to derail, inside part of wheel flange touches the steel device and it prevents derailment. It is desirable to rectify track in the sections with sharp curves located in the target section. However, taking into account a local topography, a large-scale civil work must be done and it will take time. Therefore, we consider it desirable to install this L-shape guard on such specific sections as sharp curves with a radius less than 250m, overlapping of sharp curve and steep gradients, as well as high embankments etc., where this countermeasure is necessary.



[Fig. 2-21] L-shape Guard for Prevention of Derailment

(6) Entrusting of Track Maintenance Work to Special Companies Dealing with Track Maintenance

In the past, Japanese railway organizations used to do track maintenance work by using their own staff, but recently this work is entrusted to private companies, which have necessary equipment for track maintenance and have enough capacity to execute it effectively. As a result, condition of track has been improved and maintenance costs have been reduced. We consider it desirable for UTY to consider introducing it to improve the track maintenance system.

2.4. Electric Locomotives Maintenance Planning

2.4.1. Confirmation of Current Condition of Target Railway Section

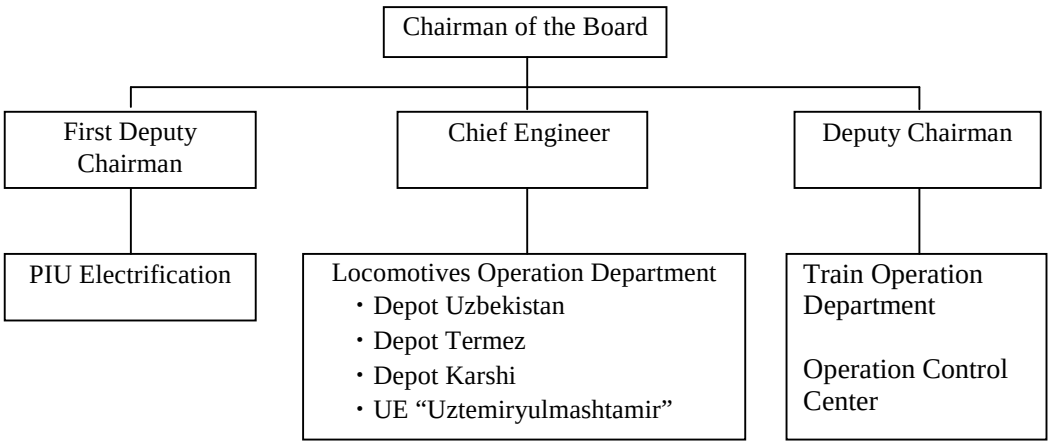
The activities of this Project in Uzbekistan in the field of Train Operation Planning and Track Rectification Planning had commenced from June 2012. The activity of Electric Locomotive began on November 11, 2012, almost half year later by dispatching Expert Mr. Funaki.

The engineering service of "Karshi – Termez Railway Electrification Project (UZB-P10: L/A signed on February 2012) had commenced a little while before.

(1) Overview of Organization

Depots where regular inspections and maintenance work are carried out are under the control of Locomotive Operation Department and supervised by the Chief Engineer of UTY together with the Unitary Enterprise "Uztemiryulmashtamir" (hereinafter UE "Uztemiryulmashtamir") where general overhaul is carried out.

Overview of organizations related to locomotive and train operation is shown in [Fig. 2-22].



[Fig. 2-22] Overview of organizations for locomotive and operation in UTY

(2) Classification of Locomotive Inspection in UTY

Classification of locomotive inspection works carried out in UTY is given in [Table 2-37] for electric locomotive and [Table 2-38] for diesel.

[Table 2-37] Inspection Cycles for Electric Locomotive

Inspection type		TO-2	TO-3	TR-1	TR-1r	TR-3	TR-4	KR-1	KR-2
2VL60K	Period	48 hrs	15 days	30 days	60 days	24 months	400,000 km	600,000km or 6 years	2,100,000km or 12years
	Hrs/Day	2 hrs	12hrs	48 hrs	72 hrs	8 days	10 days	15 days	17 days
3VL 60k	Period	72 hrs	20days	40 days	80 days	24 months	720,000 km	800,000 km or 6 years	2,400,000km or 12years
	Hrs/Day	3 hrs	14hrs	28 hrs	38 hrs	9 days	10 days	21days	24 days
VL60K	Period	48 hrs	10 days	20 days	40 days	24 months	400,000 km	600,000 km or 6 years	2,100,000km or 12years
	Hrs/Day	2 hrs	8 hrs	22 hrs	32 hrs	5 days	6 days	15 days	17 days
$VL80^S$	Period	72 hrs	15 days	30 days	60 days	24 months	720,000 km	800,000 km or 6 years	2,400,000km or 12years
	Hrs/Day	2 hrs	8 hrs	18 hrs	28 hrs	5days	5 days	15 days	18 days
EL Uzbekistan (passeng.)	Period	48 hrs	25 days	100,000 km	400,000 km	600,000 km		2,000,000 km	
	Hrs/Day	2.5 hrs	12 hrs	40 hrs	4 hrs	10days		-	
EL Uzbekistan (freight)	Period	72 hrs	25 days	100,000 km	400,000 km	600,000 km		2,000,000 km	

(Source: UTY)

[Table 2-38] Inspection Cycles for Diesel Locomotive

Inspection type		TO-2	TO-3	TR-1	TR-1r	TR-3	KR-1	KR-2
3TE10M /2TE10M	Period	48 hrs	17 days	50,000 km	200,000 km	400,000 km	800,000km	1,600,000km
	Hrs/Day	3 hrs	21 hrs	60 hrs	6 hrs	12 days	22 days	24 days
2TE10M	Period	24 hrs	17 days	50,000 km	200,000 km	400,000 km	800 ,000km	1,600,000km
	Hrs/Day	2 hrs	14 hrs	50 hrs	4 days	8 days	18 days	20 days

(Source: UTY)

(3) Observation of Workshop and Depot of UTY

Expert Mr. Funaki visited following facilities of UTY regarding locomotive inspection and maintenance, for the purpose of confirmation of current situation of machinery, equipment and mechanism of works.

3-1) UE "Uztemiryulmashtamir"

a) Observation Purpose

The workshop was established in 1900 for executing general overhauls (KR-1 and KR-2) for Diesel and Electric Locomotives. Expert, Mr. Funaki, visited there on 29 November, 2012, with examination purpose before replacement of equipment under the electrification project.

b) Conducted Works

The workshop conducts general overhaul of body of electric locomotive and diesel locomotive, as well as spare parts and auxiliary equipment such as AC/DC motors etc. Generally the working places were found in a good condition, and any disturbances to the working process was not noticed. The employee workmanship is high, many kinds of visual aids presenting work process or structure of machines are raised on the wall, and willingness of employees to keep high standards of quality seemed to be very strong.

	
Old type wheel re-profiling (grinding) machine. There are many other old types.	Visual aids for quality control in the wheel bearing section
	
Test machine for pneumatic brake valve constructed by the employees themselves, which demonstrates inventiveness and workmanship of the employees.	Electric wiring installation section. Basic skills for electric works are proved to be a certain level.

[Fig. 2-23] Results of Observation at UE "Uztemiryulmashtamir"

3-2) Depot Uzbekistan

a) Observation Purpose

Depot Uzbekistan is located within 40 minutes driving distance south of Tashkent, where inspection works for electric locomotives are conducted basically. Light inspection works are carried out like the locomotive depot in Japan. Expert, Mr. Funaki, visited this depot on 3 December, 2012, to conduct a seminar for the staff working there as well as to observe current situation there.

b) Conducted Works

All working places were found in good condition, and neither oil nor dirt or other mess was noticed which is generally found in this kind of sites. Besides, the space in the working site was found not tight, and several good results of employees' inventiveness and device were seen. In every section visual aids showing work processes were presented on the wall, which proved efforts of staff on keeping high quality of works.

	
Re-profiling wheels as it is equipped with the rolling stock	Metal cutoff remained after re-profiling of wheel sets. Problematic view.
	
Necessary tools are stored in order.	Presentation of structure of pneumatic (air) brake control valve

[Fig. 2-24] Results of Observation to Depot Uzbekistan

3-3) Depot Termez

a) Observation Purpose

Depot is located in the south of Uzbekistan and basically engaged in general maintenance of electric and diesel locomotives which serve freight transport to/from Afghanistan and neighboring countries. Expert, Mr. Funaki, visited Depot Termez on 5 December, 2012, with a purpose to see and to become aware of actual maintenance works conducted there.

b) Conducted Works

Depot is engaged in the inspections and maintenance of diesel locomotives at present. We can notice traces of diesel oil at working site, however, good attitude of staff as a group to become a base of locomotives in future was impressive. This depot covers the section as far as Darband sub-depot located about 149 km away from here.

	
Workshop conducting dismantled inspection of main motor components	Wheel re-profiling machine as it is equipped with the rolling stock. It was done wheel by wheel.
	
Administrative building in Depot was renovated by own staff. Educations of employees are done adequately.	Scaffold of this workshop are planned to be renovated for technical maintenance work on the roof of electric locomotives.

[Fig. 2-25] Result of Observation to Depot Termez

3-4) Sub-depot Darband

a) Observation Purpose

Sub-depot Darband is located about 149 km to the north of Depot Termez. Considering that even after completion of electrification project the depot will conduct maintenance of diesel locomotives, because at least one diesel hauled train per week is planned to be operated, Expert, Mr. Funaki, decided to visit this Depot to observe its current condition.

b) Conducted Works

Currently this depot is executing maintenance work of diesel locomotives at TO-2 level. The dimension of workshop is 18m × 90m and two pitted tracks for locomotive inspection and maintenance was provided. Besides, there is a container for sand storage with drying equipment.

	
Diesel locomotive under the inspection type TO-2	Entrance to the workshop for repair and maintenance

[Fig. 2-26] Results of Observation to Depot Darband

3-5) Depot Karshi

a) Observation Purpose

Depot Karshi is located in the middle of Tashkent and Termez and is in charge of locomotive operation at Samarkand-Karshi, Karshi-Buhara and Karshi-Darband sections as a core base. Currently all the allocated locomotives are diesel, however, after the completion of electrification project, this depot will conduct maintenance of new electric locomotives to be in operation at Marakand-Termez mountain section. Therefore, Expert, Mr. Funaki, visited this depot on 2 May, 2013, for the purpose of conducting a seminar for the depot staff as well as examining current situation of maintenance work.

b) Conducted Works

This depot is engaged in the inspections and maintenance of only diesel locomotives at present. We can notice traces of diesel oil at working site, however, good attitude of staff as a group to become a base of locomotives in future was impressive.

External view of workshops

Cylinder liner

Crankshaft

Wheel re-profiling machine in the old depot

[Fig. 2-27] Results of Observation to Depot Karshi

2.4.2. Preparation by UTY for the Electrification

The target section of this project is an electrified railway in mountainous area, which is a new practice in Uzbekistan. UTY has developed a new series of electric locomotive designed for operation in the mountain section together with Chinese manufacturer. The outline of this new locomotive was gradually known to Expert, and during the training program for UTY's technical staff in the field of technical inspection and maintenance of locomotives conducted by Expert, Mr. Funaki, from April, 2013, one of the local engineer of the electrification project financed by JICA joined as a lecturer and explained a part of the technical specification of the new locomotive. Technical specification of this newly introduced electric locomotive is shown below in [Table 2-39].

The rated output of 6000kW of this locomotive is equivalent to that of EF500 type of Japan Freight Railway Co., Ltd, which.was developed for freight transportation, and as it was mentioned in 2.1.3.(2) of this report, we used the performance curve of EF500 type locomotive for practical training of Operation Planning.

[Table 2-39] Specification of the New Locomotive for Operation in the Mountain Section

Locomotive Type	AC electric locomotive by inverter traction system		
Electricity system	AC 25kV (50 Hz)	Axle Configuration	Co - Co
Weight	138 ton	Maximum speed	120 km/h
Length	21170 mm	Width	3100 mm
Height	4100 mm	Distance between axles in the bogie	4250 mm
Distance between bogies	10200 mm	Rated output	6000kW
Tractive effort	450 kN	DC voltage	2800 V
Control system	PWM voltage - inverter		
Main converter	Voltage source PWM converter – inverter system using IGBT (4500V, 900A)		

New electric locomotive of “Uzbekistan” series have been introduced in UTY in 2003. Initially this series had intended for freight transportation, and equipped with electronic component "GTO", as well as Bo-Bo-Bo axle configuration. In 2010 the new model of “Uzbekistan” series was introduced intending for passenger transportation and equipped with “IGBT” electronic component as well as Co-Co axle configuration. Since 1980 IGBT and GTO have been utilized as electronic device for rolling stock, because they are free of continuous maintenance work. Initially they were developed as maintenance free electronic components but cases of their failure and malfunction have been observed recently in Japan. Particularly, IGBT failure and malfunction period falls on the 16th year of electric locomotive operation corresponding to execution of “general overhaul” in Japan, therefore countermeasure is considered to replace them in Japan.

2.4.3. Training Program for Leading Staff in the Locomotive Depot and Workshop

Depot Karshi and Termez are currently dealing with maintenance of only diesel locomotives, but after the electrification project is completed they have to establish the maintenance system for electric locomotives. Besides, UE “Uztemiryulmashtamir” will undertake maintenance of newly introduced electric locomotives to be operated in the mountain section. Depending on the assessment on the current status of locomotive maintenance facility and system through the abovementioned visit by Mr. Funaki, on-site training program was planned to be conducted for about one month from the end of April, 2013. This program was aiming at suggesting improvement of locomotive maintenance work by introducing practices applied in Japan for reference.

In the latter half of April, teaching material was prepared, then the trainings in Termez and Karshi were conducted in the week from 29 April, and the trainings in Tashkent were from the week of 7 May at each workshop.

(1) Training Schedule

Schedule of training session is shown in [Table 2-40]. In each training session, a specialist for locomotives Mr. Ziyamuhamedov Akil, who is an engineer of Karshi – Termez Electrification Project, introduced outline of

the new electric locomotive to be operated in the target section.

In Karshi and Termez, Expert visited the venue and conducted training there, therefore the session was scheduled as consecutive two days with the period from 10:00 a.m. to 16:00 p.m., total 12 hours each.

In Tashkent, training was conducted at UE "Uztemiryulmashtamir" (Tashkent Workshop), and Depot Uzbekistan, with the period from 14:00 a.m. to 17:00 p.m., two days and total 6 hours each.

Depending on the request from the participants in UE "Uztemiryulmashtamir", additional training on May 21 was scheduled, but, due to another sudden arrangement happened on the same day in UE "Uztemiryulmashtamir", our training was cancelled.

[Table 2-40] Training Schedule for Locomotive Specialists

Date	Place	Time	Contents
29.April (Mon)	Depot Termez	10:00～16:00	
30. April (Tue)	Depot Termez	10:00～16:00	Including Explanation of new locomotive (By Z. Akil)
2. May (Thu)	Depot Karshi	10:00～16:00	
3. May (Fri)	Depot Karshi	10:00～16:00	
7. May (Tue)	UE "Uztemiryulmashtamir"	14:00～17:00	Including Explanation of new locomotive (By Z. Akil)
14. May (Tue)	UE "Uztemiryulmashtamir"	14:00～17:00	
16. May (Thu)	Depot Uzbekistan	14:00～17:00	Including Explanation of new locomotive (By Z. Akil))
17. May (Fri)	Depot Uzbekistan	14:00～17:00	

(2) Selection of Training Participants

The participants of training course were duly selected among the staff of each depot and workshop, and decided to be persons who are playing the role of core function as well as who would be able to use the obtained knowledge in their future work on electric locomotives maintenance and repair. The Expert asked PIU-E to nominate middle standing staff from depots and workshop with the relevant duty in charge. When the lists of participants were presented by PIU-E, it was further examined and approved by a professor of Railway College to be appropriate. The lists of participants were finally confirmed just three days before the training program at Termez began.

(3) Preparation of Contents of Lectures

The contents of the lectures were duly examined, while the participants were nominated. At first, Mr. Funaki exchanged information with Mr. Z.Akil about current situation of locomotive inspections and maintenance works in UTY. Several days were required for receiving all necessary information, but they were very useful and, utilizing the received information, Expert prepared a presentation by Power Point software. Topics of contents were selected by following view points:

- New information which is not available in UTY.
- Information which will contribute reviewing current situation of works in UTY.

- Information which could be used for education purpose in UTY.
- Information which are useful even in Japan.

(4) Contents of Teaching Material

As the teaching material, Power Point presentation with 109 training slides was prepared. Titles of each slide are shown in [Table 2-41].

[Table 2-41] Titles of Slides used in Presentation

No	Description	No	Description	No	Description
1	Contents	38	Materials control factors	74	Environment
2	Purpose of training	39	Request for materials	75	Icing and prevention methods
3	Freight trains Container-cars	40	Production of materials	76	Rail surface freezing
4	Freight trains Tank-cars	41	Stock management	77	Sand effect
5	Passenger trains	42	Number of spare parts in the warehouse	78	Need for anti-skid system (ABC)
6	Electrical multiple unit trains	43	Concept of cost estimate	79	Oxygen concentration influence
7	Diesel locos	44	Table “Anticipated Expenditures”	80	Influence of IGBT cooling system
8	Electric locos	45	Preliminary work for preparation of Table of materials	81	Conversion diagram
9	Freight electric multiple-unit train	46	Preliminary works	82	Host transducing device (1)
10	Extra-fast service train «Shinkansen»	47	Preparation of Table of spare parts and materials	83	Host transducing device (2)
11	Number of railway transport per day	48	Table “Utilization and purpose of costs”	84	Cooling module
12	Traffic volume	49	Situation with diesel locos	85	Inverter
13	Freight train traffic	50	Function of stabilized speed of EH500 electric loco	86	Trend of GTO and IGBT failures (1)
14	Freight traffic control system (Container-cars)	51	EH500 dynamic braking	87	Trend of GTO and IGBT failures (2)
15	Container-car loading /unloading works	52	EH500 braking power	88	Actual trouble spot
16	Works executed with a help of computer	53	Application of dynamic braking for deceleration of EH500	89	Productivity of spare parts replacement
17	Accidents occurring during railway maintenance/operation	54	Combined effect of dynamic braking	90	Complete overhaul period (KR) in Japan
18	Breakdown of freight trains	55	Air brake system of UTY freight car	91	Number of days required for complete overhaul of EH500 EL
19	Electric locos・Freight trains	56	Air brake system of freight car in Japan	92	Number of days required for complete overhaul of EH500 EL
20	Failure detection	57	Configuration of freight car brake equipment in UTY	93	Cleaning of printed-circuit card (1)
21	Troubleshooting	58	System of freight car brake equipment in Japan	94	Cleaning of printed-circuit card (2)
22	Technical Maintenance	59	Brake-block used in UTY	95	Cleaning of printed-circuit card (3)
23	Technical maintenance system	60	Brake-block used in Japan	96	Complete overhaul at KR1 level
24	Comparison between preventive and post factum maintenance	61	Complex brake-block used in Japan	97	Problems appearing during complete overhaul at KR2 level (1)
25	Quality control definition	62	Flange lubricator	98	Problems appearing during complete overhaul at KR2 level (2)
26	Basic skills	63	Wheel climb deterrent effect	99	EL «Uzbekistan»
27	Achievement of quality	64	Example of liquid flange lubricator (1)	100	Results of procurement of EL «Uzbekistan»
28	Operating standards	65	Example of liquid flange lubricator (2)	101	EL “Uzbekistan” (1)
29	Activation at the working place	66	Possibility of loco failures reduction	102	EL “Uzbekistan” (2)
30	Sample of operating standards	67	Alternating-current motor	103	Twin-screw compressor
31	Transportation means inspection plan	68	AC motor and VVVF (varying voltage variable frequency) under inverter control	104	Wheel tire wear control (1)
32	Simultaneous inspection	69	Configuration of AC VVVF converter	105	Wheel tire wear control (2)
33	Standard inspection	70	GTO	106	Wheel tire wear control (3)
34	Examples of standard inspections	71	Characteristic of IGBT (1)	107	Pantograph meter (1)
35	Maintenance log-book TU 28	72	Characteristic of IGBT (2)	108	Pantograph meter (2)
36	Spare parts for control system	73	Three-phase alternating current and AC motor	109	Pantograph meter (3)
37	Control and maintenance system management				

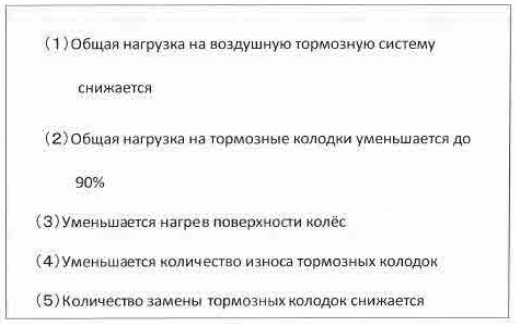
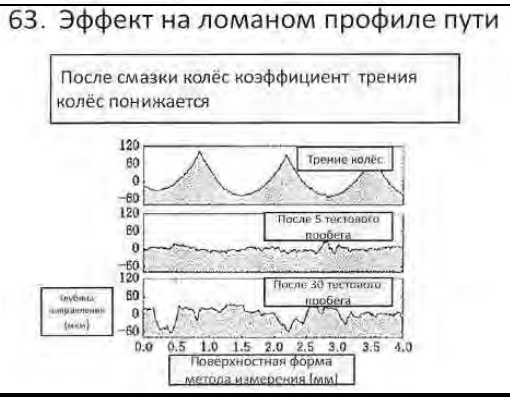
Initially it was planned to show all of the 109 slides and it was done at Depot Termez and Depot Karshi. However, it was noticed that the type of maintenance works carried out in depots and workshop are different and all of the topics were not necessarily practically useful for all the participants of the training seminar. Therefore, for the training at UE "Uztemiryulmashtamir" and Depot Uzbekistan, the contents of presentation were adjusted to each loco maintenance facility.

Main topics (slides) of presentation and summary of explanation are shown in [Table 2-42] ~ [Table 2-45].

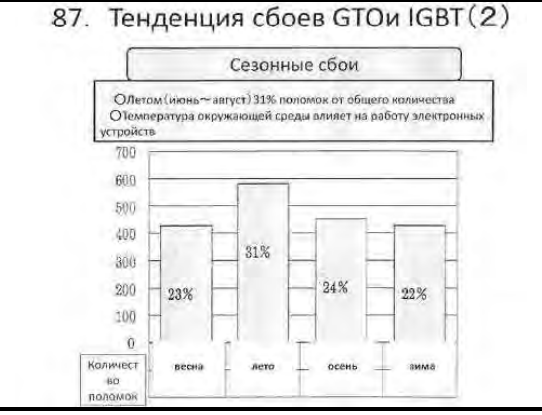
[Table 2-42] Main Teaching Material (Slides) and Explanation (1)

Contents of slide	Summary of explanation
	Introduction of log-book is required in order to meet the operational standards. This log-book shall contain required information about basics of works, limits, standards, figures etc.
	Information of respective locomotive with regard to operated km, inspection/mainte- nance record, parts replaced record, etc., shall be shared by all depots and workshop for efficient maintenance work. Maintenance Management System has a system server in the Information System Center, and each depot and workshop needs to input data of their work.
	This is a table of expenditures anticipated for inspection and maintenance of locomotives..

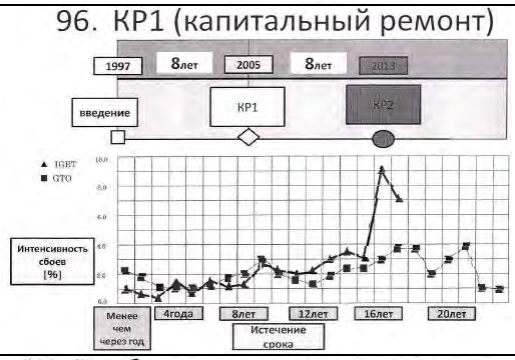
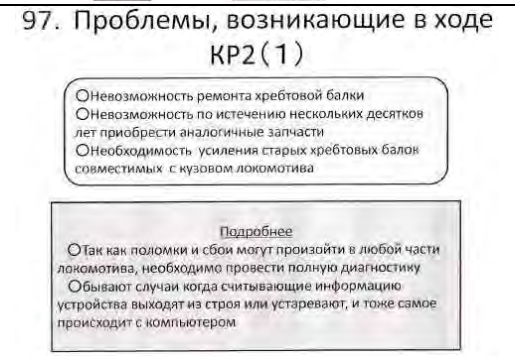
[Table 2-43] Main Teaching Material (Slides) and Explanation (2)

Contents of slide	Summary of explanation
	The slide shows the principles of dynamic braking system equipped with the EH500 type electric locomotive in Japan. There are two purposes of this system: one is for train stop and the other is speed reduction when driving at down gradients.
	Heating of wheel surface and break shoe is lower under application of dynamic braking.
	The slide explains the effect of flange lubricator application.
	Flange lubricator application prevents not only wheel rolling surface erosion but also the rail surface damage and derailment.

[Table 2-44] Main Teaching Material (Slides) and Explanation (3)

Contents of slide	Summary of explanation
	The slide tells about conversion of the alternative current into a three phase one. Converters GTO and IGBT are chosen as example. Both of them are used in electric locomotives of “Uzbekistan” series of UTY.
	The slide shows icing phenomenon of the overhead catenaries system.
	The slide shows the trend of GTO and IGBT failure. Failures happened on 22 000 locomotives are given as an example. The peak of IGBT failures falls on the 15th year of its use.
	Influence of seasons on failures is shown on this slide. Most of failures in Japan fall on summer season.

[Table 2-45] Main Teaching Material (Slides) and Explanation (4)

Contents of slide	Summary of explanation
	In Japan cleaning of printed circuit cards is mainly conducted during general overhaul at KR1 level. The slide shows how this work is carried out.
	In Japan replacement of IGBT happens at a time of general overhaul at KR-2 level. Principle of replacement is shown on this slide in detail.
	The slide shows the examples of problems appearing in the course of general overhaul at KR-2 level. One of the biggest problems is to procure similar outdated spare parts after several dozens of years.
	Some other problems arising during the general overhaul at KR-2 level were described as well as methods of preparation to the appearance of such problems.
	As the general overhaul at KR-1 level for electric locomotive “Uzbekistan” series are to be conducted 12 years after their procurement, such overhaul will be conducted in 2015. Most probably replacement of IGBT will be accounted for this period as well.

(5) Training Session in Depot Termez

a) Participants

9 out of 10 participants were present on April 29, and 7 trainees were present on April 30.

b) Q&A in the Session

[Table 2-46] Q&A in the Session (Depot Termez)

Participants		Expert Funaki
When speaking about a transported freight volume, the figure of ton-km shall be referred.	>>	We shall take it into consideration in the future.
In which country locomotives operating in Japan are manufactured?	>>	All of them are made in Japan.
Why there is no train formation (coupling and uncoupling of wagons) en route in Japan?	>>	Train set is consisting of max. 20 wagons, and trains are operated strictly in accordance with the train schedule which is very accurate, therefore loss of time is avoided by train re-formation.
There is such trend about diesel locomotives that there is not enough power due to the lack of air, and a lot of smoke is coming out.	<<	Is there any effect of low atmospheric pressure?
According to this slide great number of failures is falling on summer period and make up 31% out of total number of failures. In case of Uzbekistan this figure might be 50%.	<<	This probably happens because the heat has influence on operation of IGBT equipment.
In which part of locomotive the printed-circuit card is used?	>>	There are more 200 pieces of such cards are used in different parts of locomotive.

c) Extracts from Recorded Impressions about Training Session

I am the employee of Depot Termez. Lectures were very interesting and useful. We received a lot of information about electric locos, braking system, compressors and motors. These subjects were the most interesting for us.

d) Results Received in the Course of Training

- At the beginning of training session, Mr. Z. Akil presented information about newly introduced electric locos and participants listened to it eagerly, because they are not acquainted with the electric locomotives itself.
- In the course of training session, brief explanations about electronic parts of electric locomotives were referred but it might be rather good to make more detailed explanation to depot employees. As the teaching materials were prepared targeting to the workshop staff, some of the contents are too difficult for depot staff and some others are contrary.
- The participants were listening lectures very attentively and they seemed to be they were thinking about what kinds of work they would have to face in the future.
- After completion of electrification project all diesel locos will be taken out of operation, however depot needs to conduct inspection of diesel locomotives for only one train a week. Depot staffs are

required to learn from basic issues of electric locomotives, because they have no experience for the maintenance of them.

- All the staff in the depot seemed to be tackling with preparation for electrification.

(6) Training Session in Depot Karshi

a) Participants

7 out of 10 participants were present on May 2, and 6 trainees were present on May 3

b) Q&A in the Session

[Table 2-47] Q&A in the Session (Depot Karshi)

Participants		Expert Funaki
When you talk about traffic volume per day, do you mean per 24 hours? Why the amount of passenger traffic per day is so big?	>>	I mean 24 hours. Passenger use trains from suburbs to their work and back.
What kind of breakdown most commonly happen with freight locomotives?	>>	Control system in the case of electric locomotives and generator and motor in the case of diesel locomotives.
The final stage of inspection in Japan shall be carried out by the independent third party. In UTY it is done inside the team.	>>	There are small differences in inspection system.
Are all locomotives operating in Japan were manufactured in Japan?	>>	Initially foreign electric locomotives were imported and imitating them, locomotives were manufactured in Japan. Currently all electric locomotives are produced in Japan.
Why is the formation of train set not changed en route?	>>	Because the length of the train set are limited by the effective length of stations.
It isn't used.	<<	Is the dynamic brake equipped with diesel locomotives not used?
It isn't used.	<<	Is the electronic-magnetic air brake system not used in UTY?
It happens rather often. In such cases we usually clean the sand supply pipe. Usually it happens in winter period or when the sand in the feeder becomes wet.	<<	Are there any cases when the sand can not be supplied from the sand feeder?
Replacement system in Japan depends on calculation, but in UTY we adjust during use.	<<	Explanation about replacement of electronic components
When the defect liability period (3 years) provided by the supplier shall begin?	>>	From the moment of delivery. During 3 years all works connected with equipment failures shall be carried out by the supplier.
Adoption of automatic maintenance will result in staff redundancy problem.	<<	Under explanation connected with "pantograph".

c) Extracts from Recorded Impressions about Training Session

I am a staff of Depot Karshi and attended lectures delivered by expert from Japan. We were impressed by this lecture. We had possibility to receive valuable information about railways in Japan and to exchange

opinions with Japanese experts for railway operation. In the course of lectures we got acquainted with many different photographs and materials which could be useful for us in the future. We would like to express our desire that in the future lectures it would be preferable to use video materials vividly demonstrating execution of any types of work

d) Results Received in the Course of Training

- In the course of training session, brief explanations about electronic parts of electric locomotives were referred but it might be rather good to make more detailed explanation to depot employees. As the teaching materials were prepared targeting to the workshop staff, some of the contents are too difficult for depot staff and some others are contrary.
- After completion of electrification project all diesel locos will be taken out of operation, however depot needs to conduct inspection of diesel locomotives for only one train a week. Depot staffs are required to learn from basic issues of electric locomotives, because they have no experience for the maintenance of them.
- All the staff in the depot seemed to be tackling with preparation for electrification. Some of the construction works of electrification project have already begun.

(7) Training Session in UE "Uztemiryulmashtamir"

a) Participants

9 out of 10 participants were present on May 7 and May 14.

b) Q&A in the Session

[Table 2-48] Q&A in the Session (UE "Uztemiryulmashtamir")

Participants		Expert Funaki
We have one persons in charge for communicating necessary information.	<<	Do you have any network of maintenance management system?
Isn't it dangerous when a locomotive driver is not supported by an assistant driver in the driver's cabin?	>>	Previously there was an assistant driver in the driver's cabin, but as far as safety system is on a very high level now there is no need to have an assistant driver.
What is the life cycle of electric locomotives in Japan?	>>	About 30～40years.
Do wheel failures happen in Japan?	>>	No they do not.
How many meters are allowed for emergent stop in Japan?	>>	At a distance of 600 meters.

c) Extracts from Recorded Impressions about Training Session

Since the third training day was canceled with an urgent meeting conducted by the electrification project and participants could not submit written impression of the session. Followings are some of the opinions during the session.

I would like to express my acknowledgement and gratitude to Mr. Funaki. Information about new type electric locomotives as well as about a trend for electronic components future failures was very useful for us. Especially, we would be able to use information of new electric locomotive materials in the future.

It would be good if in the future we would be able to receive more materials about GTO of electric locomotive of “Uzbekistan” series, since their inspection and maintenance will be carried out at UE “Uztemiryulmashtamir”.

d) Results Received in the Course of Training

When the information of Japanese railways are introduced, the participants asked questions about similar and different things from UTY. But the most interested issue of UE “Uztemiryulmastamir” staff was about the electric locomotive of “Uzbekistan” series which they were going to repair in the nearest future. “Uzbekistan” series equipped with GTO and put into operation in 2003 shall pass through general overhaul in 2015 for the first time and their electrical component shall be repaired or replaced. Since until now the maintenance of electronic components has been serviced by the foreign supplier, even the staffs of Depot Uzbekistan are not familiar with implementation of such works.

As the general overhaul of “Uzbekistan” series have never been carried out until now, staffs of UE “Uztemiryulmashtamir” have neither information about GTO nor experience of inspection and repair of electric locomotive’s electronic components.

Taking into consideration the above, some materials about GTO needs to be provided to UE “Uztemiryulmashtamir”.

Modernization of equipment in UE “Uztemiryulmashtamir” is planned under electrification project.

(8) Training Session in Depot Uzbekistan

a) Participants

10 out of 10 participants were present on May 16 and May 17.

b) Q&A in the Session

[Table 2-49] Q&A in the Session (Depot Uzbekistan)

Participants		Expert Funaki
What is the maximum speed of high-speed trains in Japan?	>>	320 km / h
Yes, they do. But final approval by management is required.	<<	Do the staff of depot directly participate in preparation of work standards?
No, we do not have any network but we exchange information by letters and fax.	<<	Do you have any network for maintenance management system?
Yes it is.	<<	Is dynamic brake used in locomotives of Russian production?
Almost never.	<<	How often does AC motor go out of operation?
I would like to know how the inspection and maintenance of new locomotives are carried out.	>>	Instruction manuals shall be provided with the delivered locomotives
Is there any possibility to produce spare parts and components, whose production has been already stopped after expiry of 10 year period?	>>	Yes it is possible.
Is it possible just to replace GTO by IGBT and to go on using the same locomotives? One of the weakest points of “Uzbekistan” series is GTO.	>>	It is not possible just to replace just the parts by another because the auxiliary equipment shall be replaced as well.
In Uzbekistan the operation speed is regulated according to the size of wheel flat. Is it same in Japan?	>>	In Japan, the rolling stock with wheel flat shall not be operated.

c) Extracts from Recorded Impressions about Training Session

First of all I would like to express my gratitude to UTY and JTC experts for these fruitful and interesting two days training sessions which were very useful for us. If there is any possibility we would like to see video presentations on the following subjects: (i) Cleaning of printed-circuit card, (ii) Inspection of pantograph status, (iii) Detector of wheel surface failure, (iv) Braking system of freight cars in Japan, (v) Twin-screw compressor.

d) Results Received in the Course of Training

- In the progress of training session many questions were asked about newly introduced electric locos, but unfortunately, due to the lack of information, we could not give answer to all of them.
- One of the serious problems is that the inspection, repair and replacement of electronic components are carried out by manufacturer's specialists. Therefore local specialists have insufficient information about GTO and IGBT failures.
- Currently the maintenance work is carried out by a German company under the contract, but new electric locomotives are equipped with electronic components produced in Japan by "Toshiba" company. Work style of Toshiba will be similar to the example of railway operation in Japan. Since the locomotive itself will be manufactured by a Chinese company, the work style might be similar to "Uzbekistan" series.
- Considering the sustainability in future, inspections, repair and replacement of electronic components are better to be carried out by local specialists of UTY.

2.4.4. Recommendations for Improvement of Inspection System

Expert has visited facilities of UTY regarding inspection and repair works of locomotives and exchanged views with the staff engaged in the repair works there through the opportunity of training session. Based on these activities, we recommend the following issues for the improvement of inspection system.

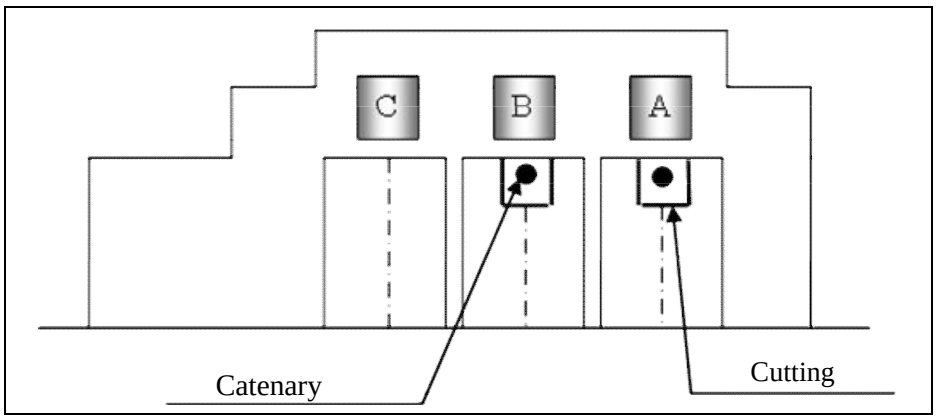
(1) Depot Termez

Even after the completion of electrification project, diesel locomotives will be used for transportation to neighboring countries. Therefore it is required to establish maintenance system for both types of locomotives.
Moreover, as the work with electric locomotives is connected with high voltage (25 kV), it is required to increase awareness through the repetitive training of personnel and preventive measures for avoiding accident by electroconvulsive shock.
After completion of electrification project, at least one train by diesel locomotive per week will be operated and maintenance work for diesel locomotive will continue at the intermediate Depot Darband. However, the electric locomotives will be also serviced there, so the depot staff shall be properly prepared to conduct inspections and maintenance for both types of locomotives.

1-1) Maintenance Shed at TO-2 Level

a) Overhead Catenary System

For inspection of the newly introduced electric locomotives, the overhead catenaries shall be constructed over the A and B tracks for inspection and maintenance.



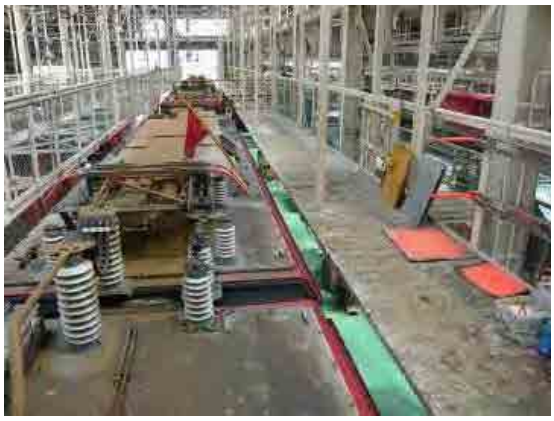
[Fig. 2-28] Maintenance Shed of TO-2 Level

b) Inspection Scaffold

Since the inspection of roof equipment is currently carried out for diesel locomotives' maintenance, it is required to modify for inspection and maintenance of roof equipment for electric locomotives.

At the same time after construction of catenary system, it will be necessary to take all possible safety measures in order to work at the roof of electric locomotives. Particularly, entrance shall be lockable to avoid skin burns and inflammation of people executing technical maintenance work.

Overhead catenaries will not be installed over the inspection track C, because this track is to be exclusively used for diesel locomotives.



[Fig. 2-29] Scaffold for Inspection and Maintenance of Roof Equipment

[Fig. 2-30] Photo of the Lock (Right)

1-2) Maintenance Shed at TO-3 and TR-1 Levels

a) Extension of Inspection and Maintenance Depot

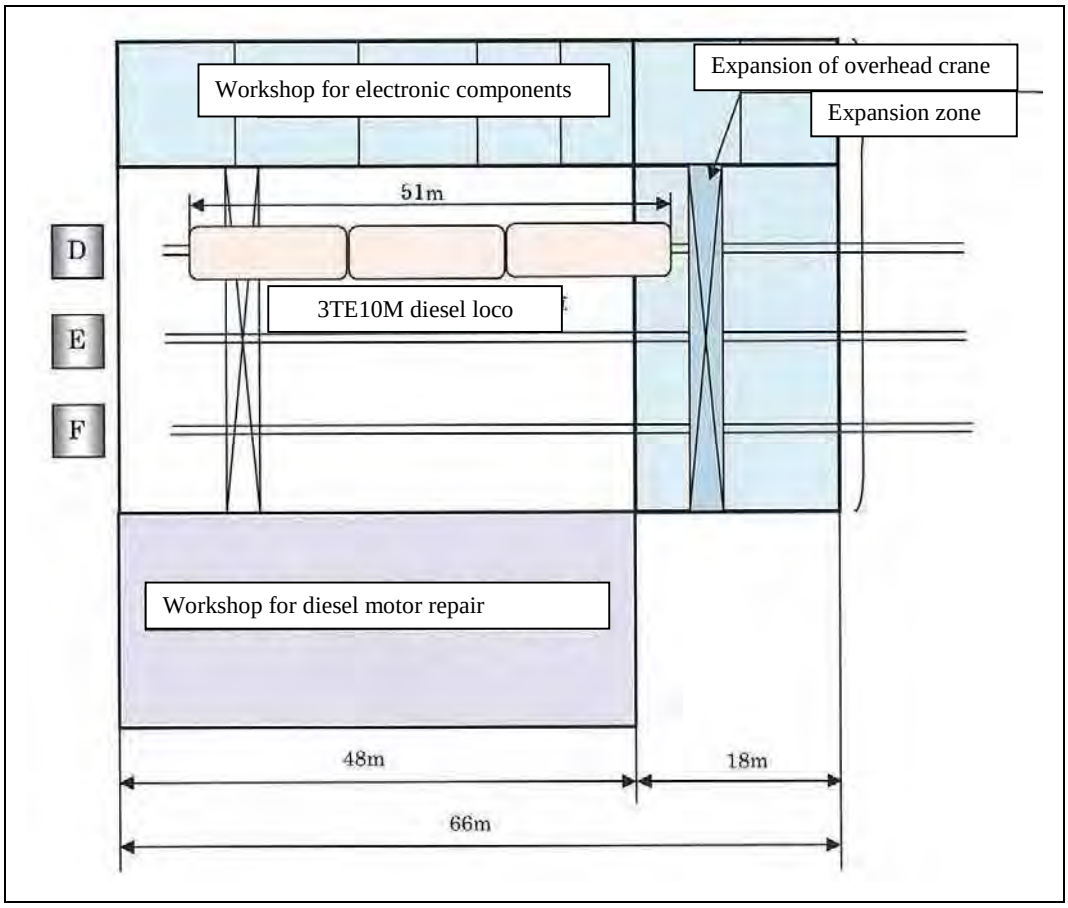
The length of TO-3 and TR-1 workshop is 48 meters, however the length of diesel locomotive 3TE10M series is 51 meter. Therefore it is necessary to extend the workshop by 18 meters.

b) Allocation of Workshop for Inspection and Repair of Electronic Components

In order to repair different electric components of newly introduced electric locomotives, it is necessary to secure a space for such purpose. Therefore a workshop for electronic parts shall be placed beside the inspection lines.

c) Expansion of the Overhead Cranes

Due to the fact that the workshop will conduct maintenance work at TO-3 and TR-1 levels for both of diesel and electric locos and the weight of the components to be replaced is very heavy, it is a necessary to expand the number of the overhead cranes (10 t.)



[Fig. 2-31] Maintenance Shed of “TO-3”,” TR-1” Level

d) Modernization of Diesel Motor Repair Workshop

Inspection track D, E, F are located alongside of diesel motor repair workshop. After completion of electrification project and reduction in the number of diesel locos, the area for repair of diesel motor components may be decreased. The acquired space will be used at a later stage for the purpose of storage of parts.

e) Replacement of Wheel Re-profiling Machines

The wheel re-profiling machine which is currently located beside the maintenance shed for TO-3 and TR-1 levels will be replaced by a new one. The power supply for the machine needs to be considered even without the power from overhead catenary.

[Fig. 2-32] Wheel Re-profiling Machine

[Fig. 2-33] Power-supply Unit

1-3) Replacement of Machinery Used for Inspection and Maintenance work

In accordance with the procurement plan of the Electrification Project:"Karshi – Termez Railway Electrification Project (UZB-P10: L/A signed on February 2012), the obsolete machinery shall be replaced with new similar equipment required for inspections and maintenance as well as introducing new one for electric locomotives.

(2) Depot Karshi

Modernization of Depot Karshi is implemented under the electrification project financed by ADB and consultant services undertaken by Systra co., therefore detailed information were not available. However, even after completion of electrification project, diesel locomotives will be serviced at the depot and it is required to establish system of maintenance for both electric and diesel locomotives.

Moreover, since after electrification the work will be conducted at high voltage (25kV), it is required to prevent accidents through awareness campaign, repetitive training of personnel and preventive measures for burns from electricity.

(3) Unitary Enterprise "Uztemiryulmashtamir"

3-1) The Role of UE "Uztemiryulmashtamir"

UE "Uztemiryulmashtamir" is of paramount importance because maintenance at TR-3, KR-1 and KR-2 levels is conducted there for all rolling stock belonging to UTY, and it plays the key role in the sector of inspections and maintenance. The maintenance and repair of high speed train "Talgo" of Spanish production has been conducted there and its technical level is high. Moreover, the inspection and repair of newly introduced electric locomotives is planned to be conducted there.

3-2) Maintenance Shed in UE "Uztemiryulmashtamir"

According to the latest data, the works carried out in UE "Uztemiryulmashtamir" is shown in [Table 2-50].

[Table 2-50] Maintenance Works carried out in UE “Uztemiryulmashtamir”

(Unit: per year)

Loco Type		TR-3	KR-1	KR-2
EL	VL60K		5	
	3VL60K			3
DL	TEP70BC	2		
	2TE10M	6	8	10
	3TE10M	4	9	3
	4TE10M		1	
	TEM2		5	6

(Source: UTY)

After checking these records, the volume of works per day is calculated, comparing with the work space available in the workshop and for the repair works in future is examined. Plan of inspections /day is shown in [Table 2-51].

[Table 2-51] Plan of Inspections / Day for "KR-1", "KR-2”

Inspection Classification		Loco Type	Inspection Cycle	Inspection Time	Inspection Results	Inspection Plan/Day
KR-1	EL	VL60K	600T.KM	14Day	5	0.28
	DL	2TE10M	800T.KM	18Day	8	0.54
		3TE10M	800T.KM	22Day	9	0.75
		4TE10M	800T.KM	26Day	1	0.10
		TEM2	7.5 Year	12Day	5	0.23
KR-2	EL	3VL60K	800T.KM	24Day	3	0.27
	DL	2TE10M	1600T.KM	20Day	10	0.76
		3TE10M	1600T.KM	24Day	3	0.27
		TEM2	15 Year	16Day	6	0.36

(Source: UTY)

As current maintenance shed can locate six bodies of locomotives, it is confirmed to be possible to carry out the work even in future.

3-3) Replacement of Equipment Intended for Inspections

In accordance with the procurement plan of the Electrification Project, the obsolete machinery shall be replaced with new similar equipment required for inspections and maintenance.

3-4) Other Improvement

After introduction of new series of electric locomotives the number of locomotives together with "Uzbekistan" series will be increased, therefore development of maintenance system for electronic equipment especially IGBT is required. UE has started construction of the workshop designed for general inspections of new electric locomotives, however the equipment and facility is still under the process of procurement. The general overhaul of "Uzbekistan" series at KR-1 level shall be conducted in 2015, therefore the appropriate preparation work shall be done as soon as possible. Particularly, cleaning room for electronic components and air braking parts shall be constructed, as well as repair of drying system for car body painting are required as soon as possible.

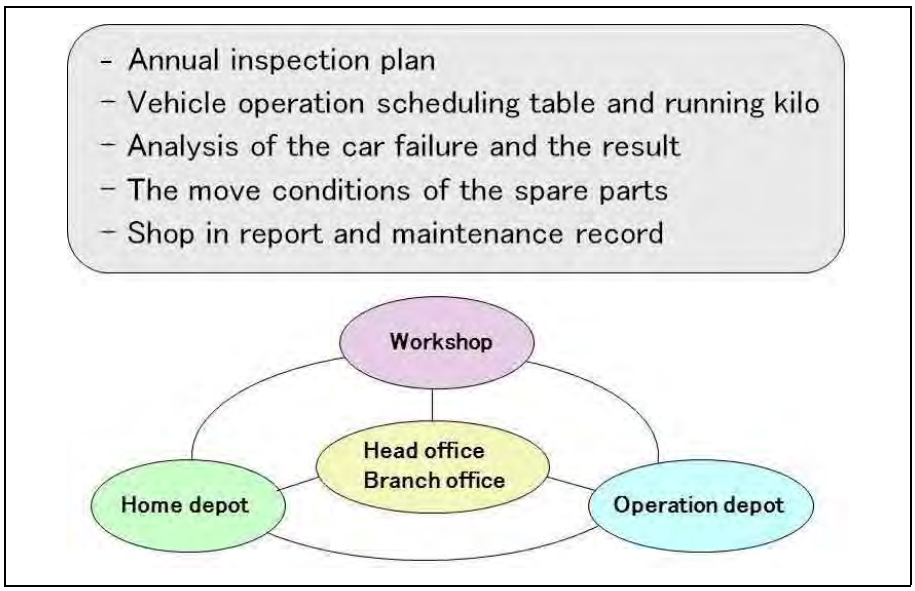
(4) Depot Uzbekistan

Currently Depot Uzbekistan conducts inspection of electric locomotives and electric multiple units and it is the best-equipped depot in Uzbekistan. Therefore actual knowledge of staff is higher than the other depots, and their desire to receive information about newly introduced electric locos is also high. The most important recommendation is about the maintenance of electronic components. Detailed explanation of this issue is given under item 5-2) below.

(5) Common Issues and Recommendations

5-1) Development of Inspection and Repair Management System

According to the findings during the training sessions, Depots and UE exchange information on executed works by means of official letters, fax or by phone. Even in Japan such system existed in the past, however as latest and timely information becomes inevitable, an Inspection and Repair Management System was established and utilized (refer to [Fig. 2-34]). This system helped not only to considerably accelerate the inspection and repair operations but also to improve quality of vehicle maintenance. Therefore it is recommendable to introduce similar system in Uzbekistan.



[Fig. 2-34] Inspection and Repair Management System

5-2) Electronic Spare Parts Management

Currently the electric locomotive of “Uzbekistan” series manufactured in China is used on the sections of Tashkent-Marakand and Tashkent-Angren.

The body of this series is manufactured in China, but main electronic components are in Germany, and braking systems are in Russia. Even after expiration of a warranty period of the electronic components, the maintenance services are provided by German company on a contract basis, and UTY staffs are not engaged in the work.

New locomotives to be operated in mountain section are manufactured in China, but their electronic components will be manufactured in Japan. In the normal practice in Japan, on expiration of a warranty period, for example 3 years, further inspection and repair works are carried out by the railway staff themselves.

Besides, inspection and repair works shall be conducted by the railway staff in the case of failure or breakdown of machinery even during the warranty period, therefore it would be necessary to provide staff of UTY with all necessary knowledge and skills in order to conduct such inspections and repair works by them.

It is also recommended to transfer the experience and methodologies in the field of inspections and repair works including Japanese policy of “preventive maintenance” system will be effective and useful for UTY.

2.5. Assistance to the Procedure for Equipment Provision

In parallel with this Project, necessary equipment to support project activities such as equipment for track maintenance was planned to be procured by JICA and provided to UTY. JTC conducted assistant work for the procurement procedure.

In January 2012, Track Maintenance Department of UTY sent a letter to PIU Director (Mr. Kadirov at that time), regarding the list of necessary equipment, consisting as follows:

a) Portable generator
b) Rail cutting machine and cutting disc
c) Rail boring machine
d) Electric Hand Tie Tamper
e) Hydraulic type of rail joint adjustment
f) Hydraulic type of rail lifting jack
g) Rail welding machine

JICA Uzbekistan Office was preparing procurement of aforementioned equipment. However, after Japanese experts had commenced their work in June 2012, Mr. Djalalov requested the experts to advice him the modern and most effective equipment used in Japan. On 25 June 2012, PIU-E officially withdrew the aforementioned request of equipment list by sending a letter to the Expert team. Afterwards, PIU-E jointly with UTY management in the face of Mr. Hasilov H. N. had examined and approved the procurement probability of "Track Master", which are applied for track maintenance in Japan, and finally, the procurement of "Track Master" and ultrasonic rail flaw detector were agreed between JICA and UTY.

Detailed specification was examined with a supposed schedule to finish the procurement in fiscal year 2012 (by March 2013), and candidate of equipment which meets the predetermined specification was suggested. As a result, the tender of 4 sets of "Track Master" was held in JICA headquarters in early January 2013, where Marubeni Corporation has received the procurement order. The products manufactured by Kaneko Corporation were transported to Tashkent by air in late March 2013. JTC performed supporting services in preparation of tender document, preparation of answers from questions raised after tender announcement, supervision of delivery inspection, etc.

JTC also performed supporting services in procurement of 1 Ultrasonic Rail Flaw Detector which carried out in late January 2013 by JICA Uzbekistan Office. As a result, Geismar Corporation from France has received the order, and then transported the equipment to Tashkent by air in late March 2013.

As described above, Ultrasonic Rail Flaw Detector and 4 Track Masters as provided equipment have arrived in the customs warehouse of Tashkent in March 2013. On 27 May, the equipment were moved our from customs warehouse and delivered to UTY premises in early June.

After the aforementioned customs clearance was finished, training on the operation guidance of the equipment is to be conducted. For the Track Master, an Engineer from Kaneko Corporation was dispatched from Japan to provide training for track maintenance personnel of UTY in Tashkent from 17 to 19 June 2013. On the other hand, for 2 (two) unit of Ultrasonic Rail Flaw Detector were originally scheduled to be procured in 2012 fiscal

year. However, according to the policy of JICA, the first unit was procured in 2012 fiscal year, and the second unit is scheduled in 2013 fiscal year. Currently, supporting services on procurement of the second Ultrasonic Rail Flaw Detector is still in progress. Therefore, training on the operation guidance of Ultrasonic Rail Flaw Detector are scheduled after the procurement of the second unit.

	
Ultrasonic Rail Flaw Detector (FILUS X27, GEISMAR Corporation)	Track Master (KS5736, KANEKO Corporation)

[Fig. 2-35] Appearance of Equipment to be Provided to UTY

2.6. Issues on Project Management

2.6.1. Activities Modified from the Original Plan

Activities in each field were planned to be implemented according to the Inception Report. However, after Experts commenced their work and found current situation of Uzbekistan, it was necessary to modify the action plan which was initially assumed. The main points of them are as follows:

(1) Operation Planning

a) It was planned to carry out the practical training by using Russian made software (Ter Vsm) for assessment of operation time, but it was found that the software was not used in UTY, therefore we used a Japan-made simple software instead.

b) During the practice of rolling stock planning, the use of performance data of electric locomotive that will be used in the target section in the future was desirable, but the details were not known at the time. Therefore, C/Ps have calculated the performance data utilizing performance curve of a locomotive of Japan with similar power output.

c) It was desirable to use data representing accurate current track condition of the target section, however the survey work delayed and its deliverable was not available in time for the practical training of operation planning. We used track data from existing Track Profile obtained from UTY.

d) Technical knowledge level of C/P are high and basic issues in the seminar curriculum were omitted

e) In the initial plan, after drawing up locomotive operation diagram, practice of reviewing train operation facilities such as depot, station, signaling system etc., were to be followed. However, these tasks will be examined in the electrification project under Yen Loan and it may cause some confusion, therefore the practice of evaluating line capacity through the target section has replaced with it.

f) Apart from the modification of activities of this Project, it was found that current practice of Operation Planning in UTY does not have urgent problem for dealing with current traffic volume, and also the operation schedule of freight trains are fixed in accordance with demand, which is different from Japanese way.

(2) Track Rectification Planning (Alignment Plan)

a) Existing Track Profile did not reflect actual condition of the track in the target section (curve and gradient). As the activities of Alignment Planning shall be based on the current track condition, we had to wait the deliverables of survey under this Project become available and postponed the commencement of Expert's work for one and half month.

b) As observation of the track condition from head/tail window of the train could not be arranged, it was difficult to overview the current situation through the line. We examined photos taken by Expert in charge of survey, who walked through the target section before the commencement of the survey work.

Also, after selecting locations where track realignment is necessary, Expert and C/Ps visited 9 critical points to confirm current condition.

c) Technical knowledge level of C/P in this field are also high and that the design methods of track plan, vertical alignment plan and cross section plan are similar in Uzbekistan and in Japan. Therefore the schedule of training program was changed.

d) At some section with high embankment there are steep gradients with concave shape which are supposed to be resulting from the road bed settlement. Realignment of such sections shall be carried out under the title of “road bed repair” but not under the title of “track profile alignment”, therefore further rectification planning was carried out only for horizontal alignment.

(3) Track Maintenance Planning

a) Same as the Alignment Plan, observation of the track condition from head/tail window of the train could not be arranged, and it was difficult to overview the current situation through the line. In addition to the photos taken by Expert in charge of survey, data chart by the Track Inspection Car of UTY was examined.

b) Data of the Inspection Car was saved inside the vehicle and it took time to obtain the data chart while the Inspection Car was in operation outside of Tashkent. Also some discrepancies were found between the chainage indicated on the chart and the chainage of actual track position (at a station).

c) At the section where the curve radius was measured manually by Experts, there were discrepancies between the figure written on the curve post, figure in the existing Track Profile and the actual measured radius.

d) If the Track Master donated by JICA were delivered during the period of Expert's activity, it could have been utilized for effective advice, but it was not done. When the equipment were delivered to the venue of UTY, the Expert's assignment was already over.

e) It was confirmed that track maintenance works to remove sharp curve on the target section have been executed by UTY.

(4) Electric Locomotive Maintenance Planning

a) Duration of the assignment of the Expert was 45 days (in 2013) and almost half of that of other fields. As wide variety of contents were included in the teaching materials and it needed time to prepare it, as well as seminar itself were conducted at the Depots in Karshi and Termez which made Expert to spend traveling time to and from there, period for Expert’s activity was a little bit short.

b) As for the seminar in UE ”Uztemiryulmashtamir”, additional class was scheduled depending on the request from the participants there, but due to another sudden arrangement happened on the same day in UE ”Uztemiryulmashtamir” twice, and our class was finally cancelled.

c) In many of the workshop site, visual aids showing work processes were presented on the wall, which proved efforts of staff on keeping high quality of works, and existing equipment and facilities were well utilized.

d) A specialist of locomotives: Mr. Ziyamuhamedov Akil, who is an engineer of Karshi – Termez Electrification Project, is one of the members of the development team of new electric locomotive to be

operated in the Mountainous section and had information of the new locomotive. He could join this seminar and introduced outline of the new locomotive which enriched the program.

There are several reasons which caused rescheduling or modification of original plan, and they can be summarized as follows:

- In order to obtain necessary information such as statistics or technical data regarding current condition of railway operation, project team had to issue official letter to UTY and it needed time to be provided.
- During the execution of survey, local engineers insisted on conventional but inefficient methods, which resulted considerable delay of the work.
- Technical knowledge levels of UTY C/Ps are higher than supposed.
- Distance between Tashkent and the target section was geographically long.

These items above had better be taken into consideration for planning stage of future technical cooperation project in Uzbekistan and the schedule of activity needs to be decided with some margin to accommodate unexpected occasion happens.

2.6.2. Input and Output of the Project

The framework of this Project was stipulated in the Memorandum of Understanding (MOU) signed on March 20, 2012, and Input and Output is mentioned in the PDM as follows:

< Input from Japanese Side >

(1) Dispatch of Japanese Experts
- Chief Expert/Train Operation: 1 person
- Track maintenance (alignment): 1 person
- Track maintenance (track): 1 person
- Locomotive: 1 person
- Survey: several persons

(2) Counterpart training in Japan
- Approximately 10 persons

(3) Equipment
- Necessary equipments

(4) Expense
- Cost for employment of local consultants
- Other expenses related to traveling and training
- Interpreters/local assistants

< Input from Uzbek Side >

(1) Assignment of Counterpart Personnel for Preparation Unit

- Train Operation: several persons
- Track alignment: several persons
- Track maintenance: several persons
- Locomotive: several persons
- Survey: several persons

(2) Provision of facilities for the Project Implementation
- Provision of office space with necessary furniture

(3) Expense
- Local cost for Experts
- Cost for office rent and equipments
- Other expenses related to the project

These items are regularly applied to the Technical Cooperation Project by JICA in general. In this Project, JICA directly procures equipment to be donated to UTY, and the assistant work for the procedures of procurement by JICA was included as one of the task of consultant's TOR. If some equipment were included in the contract between JICA and consultant, which is categorized as equipment accompanied with Experts, it might have been equipment within the contract, however in the case of this Project there is no such equipment at the time of contract.
Regarding the number and field of Experts, JICA approved the proposal submitted from consultant which had some difference from PDM/TOR.

Among the Input from Uzbek side, the assignment of C/P needed time for UTY to understand its importance, because UTY did not have many experiences to implement project for capacity development by JICA. As the assignments of Japanese Experts were composed of short period, fixed C/P was not specified for each Expert during 2012.
Activity of this Project in 2013 was planned to begin training type and the assignment of C/Ps were essential matter for it. Expert team asked PIU-E to specify C/P for Track Rectification Planning (Alignment Plan) by a letter dated on November 30, 2012 (PCD-029). In response to this request, 2 persons from UTY and 1 person each from the Design Institute ("Toshtemiryolloyiha" and "Boshtransloyiha") were appointed. The implementing agency of this Project is UTY and C/P shall be appointed from UTY primarily. However, in Uzbekistan, design works of railway construction have been entrusted to either of the Design Institutes, and for the construction of the target section of this Project, the section Tashgzar – Akrabat was designed by "Toshtemiryolloyiha" and Akrabat – Kumkurgan was designed by "Boshtransloyiha".
Participation of Design Institute employees directly involved in track alignment planning to this capacity development seminar and joint work helped greatly learning the railway alignment technology and method of Track Rectification Planning in Uzbekistan.

Regarding Operation Planning, the team asked PIU-E to specify C/Ps by a letter dated oh January 9, 2013 (PCD-033), and in response to this request, a meeting was arranged between Expert and UTY on January 22

in order to confirm the plan of training seminars and required target group of C/Ps. Attendants for the meeting from UTY side were one representative each from Operation Control Center and Locomotive Operation Department, and Deputy head of PIU-E who was in charge of this Project. Expert had explained the outline of training seminar to be conducted from February. At this time, the number of C/P was supposed to be not more than 10 from Tashkent. However Mr. Djalalov, Head of PIU-E has decided later that the participants would be not only the person who works at the Headquarters in Tashkent but also including young engineers from Karshi RBB and Termez RBB. Then, 10 persons from each location, 30 in total were nominated. At the same time, it was agreed that the candidates of training program in Japan should be selected from the participants of training seminars conducted in Uzbekistan.
C/Ps have their own duty in UTY, therefore in order to participate in the activity of this Project, it is necessary for them to leave from their business. As the training seminar of Operation Planning was scheduled with the frequency of 3 days every week, 2:00 to 6:00 pm, it was concerned at first how much attendance rate could be secured. But due to the lead of Mr. Djalalov, as well as the incentive for participants to be nominated as candidates of the Training in Japan, a high attendance rate was materialized particularly in UTY headquarters.

For Track Maintenance Planning, sections in UTY which actually manage track maintenance work are located along the target section (organization called as "Track Distance" which corresponds to the Track Maintenance Office in Japan) and far away from Tashkent, therefore it was not easy to contact appropriate persons in charge, arrange hearing about current situation and problem on track maintenance work, then preparing seminar's contents corresponding to participants. As a result, some of the participants of the seminars were not necessarily appropriate C/P for the objectives.

For Electric Locomotive Maintenance Planning, seminars were arranged at four locations: 3 Depots (Termez, Karshi, Tashkent (Uzbekisutan)) and Tashkent workshop (UE ”Uztemiryulmashtamir”), 2 days each. From each place 10 participants were selected.

These participants of the training seminars had to leave their own duty in UTY in order to participate in the seminars. Therefore they are defined as C/P of this Project and counted as “Input” from Uzbek side. Details are described later.

Next, the “Output” of this Project is written in the PDM as follows:

1) Proposal to raise the effectiveness of the train operation plan is prepared
2) Proposal to raise the effectiveness of the track rectification plan is prepared
3) Proposal to raise the effectiveness of the locomotive maintenance plan is prepared

As for the "Output" in the PDM for projects aiming at capacity development, such expression as "Somebody (as target group of the project) will become able to do XXX" is commonly used. In the case of this Project, if the final target is "Department of UTY in each field will become able to develop more effective plan", the proposal preparation for it may be considered as a step in the process. As the period of this project has been

planned for 15 months, which is shorter than usual Technical Cooperation Projects by JICA, it may be interpreted that it was aiming at guidance for future directions, rather than develop capacity of UTY staff reaching the ability of planning by themselves.

As to the output of this Project, "proposal" to raise the effectiveness of planning of each field has not been prepared, instead, tangible products are teaching materials of each training seminars and the track realignment plan with drawings in the field of Track Rectification Planning (Realignment Plan). As it was described in this report 2.6.1, the activities of this Project were implemented with some modifications due to the circumstances after its commencement. There is a fact that C/P have obtained knowledge and experienced works through the seminar and practical training conducted in this Project, and it could be counted as one of the "Output" of this Project. In addition, all Experts have prepared recommendations, depending on the information they obtained through the field study and dialogue with C/Ps. It could be also defined as the "Output" for the future development of the management of UTY.

According to the process of Project Cycle Management (PCM) method, level of achievement shall be evaluated at the end of the project by using “Objectively Verifiable Indicators” which were defined in advance. In the case of the PDM of this Project, “Objectively Verifiable Indicators” are defined as whether each activity is implemented or not. Accordingly, the level of achievement how C/P obtained relevant knowledge and developed capacity could not be measured.

In finalizing this Project, the idea of “Input” and “Output” are described as above, and the summary of detailed “Input” in each field is shown in [Table 2-52] and [Table 2-53]. They are a part of presentation which was explained in the Project Completion Meeting held on August 5, 2013 at UTY Headquarters.

[Table 2-52] Input from Japanese Side

Field	Expert	Training in UZ	Training in JP	Sub contract
Operation	Mr. Miura 7.73 MM	Offered **146** hours Tashkent, Karshi, Termez	6 days	
Track Alignment	Mr. Odan & Mr. Yamashina 5.54 MM	Offered **58.5** hours Tashkent		
Track Maintenance	Mr. Takino 4.87 MM	Offered **39** hours Tashkent, Karshi, Termez	6 days	
	Supporting work for provision of Equipment			
Locomotive	Mr. Funaki 2.07 MM	Offered **36** hours Tashkent, Karshi, Termez		
Survey	Mr. Horiuchi 4.10 MM			Boshtransloyiha
TL, CDN	Mr.Okamoto (Team Leader) 4.56MM, Mr.Tobita/Ishiuchi(Coordinator) 6.16MM			
common	Cost for the activities of Experts			

[Table 2-53] Input from Uzbek Side

Field	C/P	Participation for Training in UZ	Participation for Training in JP
Operation	21 persons	1,226 pers*hours (average **58.3** hours/person)	7 persons 42 pers*days
Track Alignment	4 persons	147 pers*hours (average **36.3** hours/person)	
Track Maintenance	39 persons	161 pers*hours (average **4.1** hours/person)	3 persons 18 pers*days
	Supporting work for provision of Equipment		
Locomotive	35 persons	288 pers*hours (average **8.2** hours/person)	
common	Cost for the activities of C/Ps in Uzbekistan		
common	Provide office & training venue, coordination, permission etc.		

In [Table 2-53], column "C/P" shows the number of C/P who participated at least one day of the training, and "Participation for Training in UZ" shows accumulated hours of C/Ps' attendance for all subjects.
For Operation Planning, the accumulated hours of C/Ps' attendance reached 1,226 hours, and average attendance for each C/P was 58.3 hours. In the field of Track Rectification Planning (Alignment Plan), number of C/P was four but the average attendance for each C/P was 36.8 hours.
On the other hand, average attendance for Track Maintenance Planning and Electric Locomotive Maintenance Planning were 4.1 hours and 8.2 hours respectively.

As for the "Output" of each field, there is no tangible product except Track Rectification Planning (Alignment Plan). In the field, improvement plan of alignment for 83 sharp curves in the section between Dehkanabad and Boysun where track survey was implemented by this Project was prepared. This plan is to shift horizontal alignment of the track into curve radius more than 300m, including some locations with only R=250m due to unavoidable condition of structures on-site.
As for other output of this Project, it can be pointed out that C/P obtained knowledge regarding efficient management method through the training seminars in Uzbekistan by introduction of Japanese practices, as well as they understood the similarity and difference of system and policy between Japan and Uzbekistan.
In addition, the participants of the Training in Japan could practically experience the knowledge obtained during the training in Uzbekistan through observation visit in the program, and also learn techniques more in detail by the lecture presented by Japanese engineers who were directly engaged in the task in Japan.

Expert team of this Project proposed recommendations in each field depending on the current situation of the management of UTY which were interpreted through the activities. In order to assess how much the objectives as capacity development of C/P is achieved, we have to watch how UTY will adopt and exploit the recommendations adjusting to its own circumstances.

2.7. Recommendations for the Future

Since the activity of this Project commenced, information on current situation of the management of UTY are obtained and Experts understood the difference and similarity of management system compared to Japan. In the inauguration era in 19th century, Japanese railway adopted western technology and operation method. Afterwards, the current effective transportation institution has been established by continuous innovation reflecting topographical, cultural and social circumstances of Japan. On the other hand, other countries have each different historical background and there may be cases where Japanese principle cannot be adopted as it is. Thus, sufficient analysis is necessary for considering how to improve operation effectiveness, not only by simple adoption of Japanese method.

In this Project, Experts have provided technical guidance by mainly referring Japanese way of management system, and prepared recommendations for the future improvement of management system of UTY in each field. In the occasion of Project Completion Meeting held on August 5, 2013, the recommendations were presented to the representatives of various departments of UTY. The summary of them is described as follows:

2.7.1. Operation Planning

(1) Currently rail freight traffic volume through the project target section is assumed to be 8 to 9 million tons per year, and as there is some room for the line capacity, there is no urgent problem even with the operation planning method currently applied. However, when the traffic volume in freight and passenger is increased in the future, it will be necessary to introduce more efficient method of operation planning like Japan, in order to make the most of the line capacity. At the time, UTY staff shall carry out the operation planning works by themselves. The period of this Project was short and C/P have only experienced practical training of each stage of operation planning method which is adopted in Japan, but capacity development for C/P to master skills enough to carry out by them were not implemented. In order to attain the objectives, another project for capacity development shall be designed and implemented. In case of such progress, a decision by UTY shall be made to adopt new system of operation planning in Uzbekistan.

(2) In the mobilization plan for locomotive crew and rolling stock currently applied in Uzbekistan, the combination of crew and locomotives is fixed in principle and crew and locomotive are replaced in the same section. Such a scheme was also used once in the days of steam locomotive in Japan, however when the electrification projects are completed, it will not be able to take advantage of the line capacity and locomotive performance. For example, electric locomotives are capable for continuous long run and high speed operation. In order to make use of it, efficient mobilization plan and locomotive maintenance plan currently used in Japan is necessary to be introduced.

During the Training in Japan, a lecture regarding basics of mobilization plan in Japan was scheduled by an engineer from JR Freight co. and reference materials in Russian were distributed to the participants. The

summary of the basics is as follows:

a) The plan for rolling stock or crew to go and back in which section with which train is called as “Trip”. When the Trip for rolling stock is prepared, transport condition, locomotive performance, facilities for station and depot, inspection of rolling stock, and work system inside the station yard shall be duly considered.
b) As the first step of mobilization plan of rolling stock, the type of rolling stock is fixed.
c) As the second step, train operation diagram is fixed depending on the Minimum Running Time which are figured out from the performance of the rolling stock and condition of the track. Considering the location of station and depot, Trip of the rolling stock is prepared.
d) As the third step, a series of Trip for the rolling stock are prepared. The inspection cycle of the rolling stock shall be taken into consideration at this time.
e) Total number of rolling stock for the operation of all the trains in the section can be confirmed by the series of Trip. Total number of rolling stock shall be minimized even considering spare locomotive for periodical inspection.
f) Prepare Trip of Crew. Working condition shall be duly considered such as upper limit of continuous operation time and distance, upper limit of one cours including intervals at the station of turn, and minimum interval period until the next Trip, etc.

(3) In order to secure safety train operation after electrification, training of drivers to improve driving skill or maintenance of track condition in certain criteria in order to prevent accidents due to pantograph separation from catenary, etc. are required.

Drivers who operates heavy freight train in mountainous section are required special skills for acceleration and breaking the train. In Uzbekistan, most of the electrified railway sections locate plain land and it is not available to provide training to drivers with live locomotives on the line. In Japan, a driving simulator are installed in the Training Center of JR Freight co. and during the Training in Japan in June, participants could have opportunity to visit there and tried to use the simulator. This simulator use Computer Graphic technology for the view from the driver’s cabin, and it needs made-to-order manufacturing. However in order to train drivers in mountainous section, it is advisable for UTY to introduce this simulator.

2.7.2. Track Rectification Planning (Alignment Plan)

(1) UTY has been executing track realignment works to eliminate sharp curves and compound curves of the target section. Further works are recommended to be planned and implemented referring to the proposed track realignment plan by this Project.
(2) The rectification work above requires necessary budget and time, therefore even before elimination of compound curves, intermediate transition curve can be inserted as an optional countermeasure.

2.7.3. Improvement of Track Maintenance Work

Recommendations for Track Maintenance Work are described in this report 2.3.8. in detail. They are

summarized as follows:

a) Utilization of Track Master will not only ensuring efficient track maintenance planning, but also enabling quick evaluation of track maintenance work by measuring the same place before and after the maintenance work. Four sets of this equipment have been donated by JICA and they are already distributed to the target section. We hope its effective utilization.
b) Introduction of a device for detection of track inspection car's location will enable the data chart of track inspection car to be more accurately point out the exact place where maintenance work is required.
c) Introduction of fixing device of rail on PC sleepers, which allows changing slack value, will enable to set appropriate slack in the curve section.
d) Introduction of concrete blocks for level-crossings with less technical maintenance work
e) Installation of signposts at the beginning and the end of gradients for effective track maintenance work and train operation.
f) It is desirable to install L-shape guard on such specific sections as sharp curves with a radius less than 250m, overlapping of sharp curve and steep gradients, as well as high embankments etc., where this countermeasure is necessary for preventing derailment accident.

2.7.4. Electric Locomotive Maintenance Planning

(1) In the scope of on-going electrification project, replacement of old existing equipment and introduction of new equipment are planned for Tashkent Workshop, Termez Depot and Karshi Depot. These equipment are machining equipment such as screw-cutting lathe and testing equipment such as stand for testing compressor for electric locomotives. In addition to these modernization plans of relevant equipment, Expert has proposed several renovation and additional facilities at each depot and workshop, preparing for maintenance work after electrification. (Detailed recommendations are described in this report 2.4.4.)

(2) In Japan "Inspection and Repair Management System" are developed and introduced to share information of inspection record, spare parts replaced record, operated km and future inspection plan for respective rolling stock, among depot, workshop and headquarters. In order to make the locomotive maintenance work more efficient and higher quality, it is recommended for UTY to introduce such system as well.

(3) Currently repair works of the electric locomotive of "Uzbekistan" series are executed by engineers of German company and staff of UTY does not know the cause of trouble and how to repair. It is recommended that the inspection and repair works of electronic parts of new electric locomotive had better be executed by UTY staff directly.

2.7.5. Summary of Recommendations

With the electrification between Karshi and Termez including the target section of this Project, transportation capacity will be definitely increased. However, In order to secure safety operation under the expected increase

of tractive load of a train and speed up, necessary countermeasures shall be continuously executed. In order for the better maintenance works of Track and Locomotive, as well as for improvement of the driver's operation skill, this Project has proposed several recommendations.

The method of train operation planning and mobilization planning of crew and rolling stock, which are introduced by this Project, may not be urgently required, considering the current traffic volume on the section. However, in order to tackle with the future increase of traffic demand, appropriate planning of train operation as well as mobilization of locomotive crew and rolling stock are desirable to be introduced

The Project Completion Meeting was held on August 5, 2013, and Mr. Djalalov, Project Director and Head of PIU-E summarized his remarks as follows:

We are grateful to JICA for implementing this Project to develop capacity of UTY. Some of the recommendations presented by expert team today were already carried out by us, however, all the recommendations were duly examined through reading final report and the management of UTY will decide its introduction. We would like to adopt the recommendations as much as possible.

Even after this Project is over, we hope to continue and develop the relationship with JICA.

The electrification project is scheduled to be completed in 2017, and we need to begin training drivers who operate newly introduced electric locomotive. We would like to ask JICA to consider assistance to introduce operation simulator which are utilized in Japan.

Chapter 3

Details of Actual Activities

3.1. Schedule of Activities

In the original work schedule of this Project, period of Phase 1 was until the end of April 2013, activities in Uzbekistan would complete in the early July, and contract period between JICA and JTC was until August 15, 2013. It was changed in December 2012. The main reason is the progress of topographical survey work, which carried out by a Design Institute and commenced in August 2012, was delayed. Originally, the deliverables shall be submitted in November 2012. In December it was anticipated that the submission of deliverables would be delayed about 2.5 months. As the deliverables by the survey was a prerequisite condition to carry out on-site works for Track Rectification Planning (Alignment Plan) and Track maintenance Planning, commencement of the mentioned works were postponed about 1.5 month. In addition, as the Wrap-up seminar of Electric Locomotive Maintenance Planning had been planned with that of track rectification planning, the schedule of electric locomotive Expert was also adjusted

As the deliverable of survey was not necessarily required for the activity of Train Operation Planning, the schedule of Expert was not changed. However, the implementation period of Training in Japan for Operation Planning was postponed about 1 month, therefore the works in Japan and on-site works in Phase 2 were also postponed.

As a result, the end of Phase 1 was revised to the end of May 2013, and the contract expiration date was also amended to the end of September.

The work schedule from Task No.100 of IC/R to No.301, and No.441 is shown in [Table 3-1], and schedule from Task No.400 to 700 is shown in [Table 3-2] respectively.

[Table 3-1] Work Schedule (1)

	活動	2012									2013		
		4	5	6	7	8	9	10	11	12	1	2	3
		Phase 1											
100	**First Works in Japan (Phasse 1)**	←	→										
110	**Preparation of Inception Report**												
200	**First on-site Works in Uzbekistan (Phase 1)**			←						→			
201	Explanation and Discussion of Inception Report												
202	Discussion and Confirmation of Project Operation Structure												
210	**Confirmation of Current Condition of Target Railway Section**												
211	Confirmation of Current Condition of Train Operation and its Plan												
212	Review of alignment survey results conducted by UTY												
213	Confirmation of Existing Track Profile and Curve Ledger												
214	Confirmation of Current Condition of Track Maintenance and Realignment Plan												
220	**Preparation and Establishment of Track Rectification Plan (Alignment Planning) ①**												
221	Examination of Necessity of Alignment Improvement												
222	Preparation of Alignment Improvement Plan (First Draft)												
230	**Survey for Obtaining Accurate Alignment**												
231	Confirmation of Method and Contents of Survey and Necessary Procedure for Procurement of Sub-consultants			PK1		PK1	PK2		PK2				
232	Implementation of Alignment Survey (PK1)												
232	Implementation of Alignment Survey (PK2)												
240	**Examination of Improvement of Track Maintenance Work, Supporting in Procedure of Equipment Provision**												
241	Preparation of Improvement Plan of Track Maintenance Work (First Draft)												
242	Selection of Necessary Equipment to be Provided along with this Project												
243	Assistance in Equipment Procurement Procedure by JICA (PK1) Track Master (procured in Japan)												
243	Assistance in Equipment Procurement Procedure by JICA (PK2) Rail Flaw Detecto (procured in Uzbekistan)												
250	**Wrap-up of First on-site Works in Uzbekistan (Phase 1), Discuss on re-scheduling**												
300	**Second Works in Japan (Phase 1)**												
301	**Preparation of Progress Report 1**												
440	**Planning of Introducing Electric Locomotive for New Railway Line**												
441	Examination of Necessary Capability and Technical Specification of Electric Locomotive based on Train Operation Plan												

[Table 3-2] Work Schedule (2)

	活動	2013								
		1	2	3	4	5	6	7	8	9
		Phase 1					Phase 2			
400	**Second on-site Works in Uzbekistan (Phase 1)**	←				→				
401	Explanation and Discussion of Progress Report 1									
410	**Preparation and Establishment of Track Rectification Plan (Alignment Planning) ②**									
411	Examination of Necessity of Alignment Improvement									
412	Preparation of Alignment Improvement Plan (Second Draft)									
420	**Examination of Improvement of Track Maintenance Work, Dissemination and Enlightenment to Related Staff**									
421	Preparation of Track Realignment Plan, and Analysis & Cant Resetting of Compound Curves and S-Curves									
422	Review of Track Maintenance Regulation and Recommendation									
423	Seminar related to Track Maintenance									
430	**Establishment of Operation Planning through Examination of Running Time utilizing Software Application for Run Curve**									
431	Planning of Electrification Transportation Plan									
432	Planning of Rolling Stock Plan									
433	Planning of Train Plan and Operation Facilities Plan									
434	Simulation Training of Operation Planning									
440	**Planning of Introducing Electric Locomotive for New Railway Line**									
441	Examination of Necessary Capability and Technical Specification of Electric Locomotive based on Train Operation Plan									
442	Preliminary Recommendation concerning Inspection and Maintenance Work of Procured Electric Locomotive for Mountain Section									
450	**Assistance in Equipment Procurement Procedure by JICA Office**									
460	**Preparation of Progress Report 2**									
470	**Wrap-Up Seminar regarding Planning on Track Rectification and Electric Locomotive**									
500	**Third Works in Japan (Phase 2)**						↔			
510	**Implementation of Training in Japan (Operation Planning, TrackMaintenance Planning)**									
511	Outline of Training Course									
512	Works regarding Training Program									
600	**Third on-site Works in Uzbekistan (Phase 2)**							↔		
610	**Follow-up of Training in Japan and Assistance for Sustainable Management**									
620	**Project Completion Meeting (in Uzbekistan)**									
700	**Preparation of Project Completion Report (Final Report)**									

3.2. Input by JICA

(1) Dispatch of Japanese Experts (7 field, 9 person)

- Chief Expert: (1 person) 4.56 MM
- Operation Planning: (1 person) 7.73MM
- Track Rectification Planning (Alignment): (2 person) 5.54MM in total
- Track Rectification Planning (Track): (1 person) 4.87MM
- Electric Locomotive: (1 person) 2.07 MM
- Survey: (1 person) 4.10 MM
- Coordinator: (2 person) 6.16MM in total

(Note: MM includes days born by the consultant)

(2) Counterpart training in Japan (2 fields, 10 participants in total)

- Operation Planning in Mountainous Railway: 7 participants. June 12 to 21, 2013
- Track Maintenance and Rectification Planning in Mountainous Railway: 3 participants. June 17 to 26, 2013

(3) Expense for sub-contract

Contract with "Boshtransloyiha" for the survey works on traverse, track center, horizontal and vertical alignment, cross-sections and revised track profile

(4) Equipment Provision (JICA procures and provides to UTY outside of contract with JTC)

a) Track Master PC + Model KS5736 4sets manufactured by Kaneko Corporation

b) Ultrasonic Rail Fraw Detector Model Filus X27 2sets manufactured by Geismar

For the Track Master, an Engineer from Kaneko Corporation was dispatched from Japan to provide training for track maintenance staff of UTY in Tashkent from June 17 to 19, 2013. The ceremony of handing over from JICA to UTY was held on June 20, 2013.

3.3. Details of Experts

Personnel formation of Experts is shown in [Table 3-3].

[Table 3-3] Personnel Formation of Experts

Assignment	Name	Company	Remarks
Team Leader	Shigeru Okamoto	JTC	
Co-Team Leader / Operation Planning	Yoshinobu Miura	JTC	
Track Rectification Plan (Alignment)	Takashi Odan	Individual Consultant	Until July 2012
	Seiji Yamashina	JTC	From November 2012
Track Rectification Plan (Track)	Yukio Takino	Individual Consultant	
Electric Locomotive	Katsuo Funaki	JTC	
Survey	Chifuyu Horiuchi	Individual Consultant	
Coordinator	Hirotaka Tobita	JTC	In 2012
	Kazuya Ishiuchi	JTC	In 2013

3.4. Meetings and Seminars

3.4.1. Explanation of Inception Report

(1) The Inception Report was explained to the JICA Uzbekistan Office at the beginning of the on-site work.

(2) A kick-off meeting was held inviting relevant parties from UTY on June 5, 2012. The UTY side was headed by Mr. Djalalov F.S. and included representatives from the Investment Department, Train Operation Department, Track Department, Locomotive Department, and Power Supply Center.

In this meeting, the three approaches of this Project as well as the basic policy, schedule, experts assigned and expected outputs were all presented and explained.

After the plenary session, the attendants were divided into 2 groups, train operation and track, which then continued to share information. Mr. Miura attended the former group while Mr. Takino, Mr. Odan and Mr. Horiuchi attended the latter.

(3) The Draft Inception Report (Russian version) was handed to the PIU and shared the overall picture of the Project and confirmed the necessary measures to be taken by each side. Considering the comments made by the UTY side, the Report was modified through consultation with the JICA Uzbekistan Office and then finalized. Major comments from UTY and the results of the consideration are shown in [Table 3-4].

[Table 3-4] Comments from UTY on Draft IC/R and Results

Comments from UTY	Results
The Japanese Embassy should not be included even as an observer on the Joint Coordination Committee (JCC). The Embassy is a political entity and thus not suitable to be involved at the implementation stage of a project such as this. If the Embassy is listed, the Ministry of Foreign Affairs in Uzbekistan also needs to be listed, and it is not UTY's intention for the Committee to have such a nature.	The JICA Uzbekistan Office originally issued a letter to establish the JCC and included the Japanese Embassy as an observer. However, UTY expressed their intention in their reply letter to which JICA then agreed.
The entity due to undertake the survey work under the contract with JTC was referred to as a "local consultant", but UTY asked to have them referred to as the "Design Institute" instead. Boshtransloyiha etc. are not part of UTY but UTY still capitalizes them and this is the expression usually used.	Agreed.
What is "Track Master"?	An outline of the equipment was explained using a catalog.
In the Track Rectification Plan section, the term "Bank Collapse" is mentioned. UTY understands this Project will deal with roadbed and track, and that bank maintenance is therefore not covered. In case any trouble is anticipated, necessary countermeasures will be taken.	Agreed. In case any risks are confirmed, these will be discussed at the time.
It is written that the equipment procurement procedures will be handled only by JICA and JTC. However, UTY's support will be inevitable.	Agreed.
The locomotive Run Curve in task No. 412 refers only to electric locomotives although diesel locomotives are to be operated until the completion of electrification work.	Agreed. Diesel has been added.

3.4.2. First JCC

As this Project involves more than one department in UTY, namely the train operation, track and locomotive departments, JTC proposed to set up a Joint Coordination Committee (JCC) composed of representatives from the relevant UTY departments in order to ensure the smooth implementation of the Project. Discussions were also held regarding the implementation framework of the Project and the appointment of a Project Director was also confirmed.

As the Project Director, Mr. Djalalov F.S., Head of PIU-E, was assigned responsible for overall communication and coordination on the UTY side. It was first proposed that representatives from each department were to be nominated as members of the committee, but it was later decided that the committee was to be composed of representatives from the JICA office, UTY's investment department, and experts. Representatives of other departments would then be asked to participate as required depending on the agenda of the meeting. It was also decided that the Chairman would decide to call and hold the committee as needed. The members of the JCC are shown in [Table 3-5].

[Table 3-5] JCC members

Role	Organi-zation	Title	Name
Chairman	UTY	Chief Manager – Chief Engineer	Mr. Khusnutdin N. Khasilov
Member	UTY	Head of PIU for Electrification Project (Project Director)	Mr. Djalalov F.S.
Member	JICA	JICA Uzbekistan Office	Mr. Yukihiko Ejiri
Member	UTY	Investment Department	Ms. Nazarova T. D.
Member	JTC	Team Leader of Experts	Mr. Shigeru Okamoto
Supportive Member	UTY	Deputy Head of PIU for Electrification Project	Mr. Narimov Rustam
Supportive Member		Appointed as required	

The first JCC was held on June 26, 2012. From the UTY side, the Head and Deputy Head of PIU-E, the Deputy Director of the Investment Department, as well as representatives of the train operation and track departments participated in the meeting. Four members from JICA headed by the Chief Representative also attended. The Chairman, Mr. Khasilov, was absent and Mr. Djalalov therefore chaired the committee on behalf of him.

At the meeting, Mr. Narimov Rustam explained the background and outline of the Project, and the Team Leader of Experts explained about the Progress of the first on-site work and the Work Plan after the committee.

At the end of the explanation of the Work Plan by the Team Leader, the importance of the appointment of UTY Counterpart staff (C/P) was emphasized in order for the experts to be able to start collaborating with

them. The schedule of equipment procurement to be provided to UTY should be confirmed in order for the experts to be able to provide advice regarding the use of equipment after its delivery.


[Fig. 3-1] The First JCC

3.4.3. Second JCC and Wrap-up Seminar

The Second JCC was conducted on May 24, 2013 to confirm the following matters: First was to confirm the result of activities in Phase 1 which concluded in the end of May, consisting of Track Rectification Planning (Alignment Plan), Track Maintenance Planning and Electrical Locomotive Maintenance Planning. Second was to confirm the plan of the activities in Phase 2.

In addition, taking this opportunity the activities of Experts of the abovementioned 3 fields were presented to UTY staff in order to widely share their knowledge. This Wrap-up Seminar was conducted after JCC.

The second JCC was held at Main Conference Room of UTY Head Office from 11 am.

The Chairman of JCC is Mr. Khusnutdin N. Khasilov - Chief Manager, Chief Engineer. Meanwhile, committee members are consisting of Mr. M. Shikano– Chief Representaive of JICA Uzbekistan Office; Mr. Djalalov F.S. - Head of PIU for Electrification Project; Mr. Nazarova T.D. – Deputy Director of Investment Department; and Mr. S. Okamoto - Team Leader of Experts. Ms. Nazarova was absent, thus Mr. Suraev attended the meeting on behalf of Ms. Nazarova.

After greeting from Mr. Khasilov and introduction of project summary by Mr. Djalalov, Mr. Okamoto as team leader explained the performance and achievement of Phase 1, and followed by presentation of the plan of Phase 2. Afterwards, Mr. Khasilov and Mr. Djalalov provided some comments and then followed by impression from UTY staffs in the conference room, who received technical guidance (training in Uzbekistan) from the Experts. Finally, the meeting ended by closing declaration from the chairman.

Subsequently, Wrap-up seminar was conducted. Each Expert explained the activity results of technical training, in the order of Track Rectification Planning (Alignment Plan), Track Maintenance Planning and Electrical Locomotive Maintenance Planning.

Mr. Yamashina, as Expert of Track Rectification Planning (Alignment Plan), explained the result of joint works with the Expert and C/P staff. Depending on the revised Track Profile prepared by this Project, they have figured out track realignment plan for 86 locations with radius less than 300m, which should be

improved. Then, Mr. Bankov as one of C/P explained what he learned about transition curve with his personal computer by using AutoCAD software.

After that, Mr. Takino, as Expert of Track Rectification Plan (Track), and Mr. Funaki, as Expert of Electric Locomotive, explained the contents of training seminars for UTY staffs which were conducted in Tashkent, Karshi and Termez.

JCC and Wrap-up Seminar was attended by JCC members, JICA Uzbekistan Office, Experts, supporting staff and 63 staffs of UTY from various departments. The presentation of Train Operation Planning by Mr. Miura, as operation planning Expert, was not conducted because he did not attend the meeting due to his work period ended before this meeting, and his on-site activity would be continued in Phase 2. However, UTY staff from relevant sections, who received on-site training from Mr. Miura, had attended this seminar.

Greeting by Mr.Khasilov as the Chairman of JCC

Presentation of JCC Project

Main table of Wrap-up Seminar Venue

Presentation by Mr. Bankov

[Fig. 3-2] The Second JCC and Wrap-up Seminar

3.4.4. Wrap-up Seminar for Operation Planning and Project Completion Meeting

In the Wrap-up seminar held on May 24, presentation was done in three fields: Track Rectification Planning (Alignment Plan), Track Maintenance Planning and Electrical Locomotive Maintenance Planning. Wrap-up seminar to review whole activities in Operation Planning was held on August 5, 2013, at Main Conference Room of UTY Head Office from 14:30 p.m.

From UTY side, headed by Mr. Djalalov, Head of PIU-E, 24 staff had attended in total from not only train operation related section but from Track Facility Department, Locomotive Operation Department and

Tashkent Workshop. From JICA Uzbekistan Office, 3 person headed by Mr. M. Shikano - Chief Representative attended. Outline of this seminar is described in this report 2.1.6." Follow-up of Training Program in Japan and Wrap-up of Project Activities".

After this seminar on the day, Project Completion Meeting was conducted, for the purpose of summarize the activities of whole project period and exchange views on the recommendations proposed from the expert team. In the meeting, Expert Team Leader, Mr. Okamoto explained overall schedule of the Project, followed by presenting "Input" and "Output", then finalized by explaining recommendations for the future in each field. The contents of presentation are described in this report 2.6.2. "Input and Output of the project" and 2.7. "Recommendations for the future".

In response to the presentation, representatives from Operation Control Center, Track Facilities Department and Locomotive Operation Department raised comments such as some of the items of recommendations have been already introducing or they would like to consider introduction.

Mr. Djalalov, Project Director and Head of PIU-E summarized his remarks as follows:

We are grateful to JICA for implementing this Project to develop capacity of UTY. Some of the recommendations presented by expert team today were already carried out by us, however, all the recommendations were duly examined through reading final report and the management of UTY will decide its introduction. We would like to adopt the recommendations as much as possible.

[Fig. 3-3] Project Completion Meeting