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Review of Railways Rehabilitation in Central Asia

for Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan

Module B – Detailed Design and Tender Documents of the rehabilitation measures for the Beyneu – Uzbek Border railway section (Kazakhstan)

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Project Number:	**65290 – EuropeAid/116151/C/SV/Multi**		
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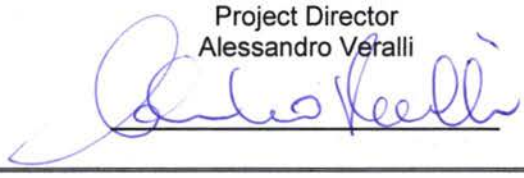
Signature:			

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ABBREVIATIONS

ABLS	Automatic Block Line System
ADB	Asian Development Bank
ALC	Automatic Level Crossing
BC	Border crossing
CAR	Central Asian Republic
COTIF	Convention concerning the International Transport of Goods by Rail
CIS	Commonwealth of Independent States
CTC	Central Traffic Control
CWR	Continuous Welded Rail
EAEC	Euro Asian Economic Community
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ECE	UN Economic Commission for Europe
ECO	Economic Cooperation Organisation
ECMT	European Council of Ministers of Transport
EDD	Unified Transit Tariff
EIRR	Economic Internal Rate of Return
ERII	Electric Relay Interlocking Installation
EU	European Union
FSU	Former Soviet Union
GDP	Gross Domestic Product
IGC	Intergovermental Commission TRACECA
IMF	International Monetary Fund
IRU	International Road Transport Union
IsDB	Islamic Development Bank
JBIC	Japanese Bank for International Cooperation
KAZ	Kazakhstan
KGZ	Kyrgyz Republic
KTZ	Kazakhstan Temir Zholy (Kazakhstan national railways)
MLA	Multilateral Agreement on International Transport for Development of TRACECA
KZT	Kazakhstan Tenge
LC	Level Crossing
MKDII	Mechanic Key dependent Interlocking Installation
MOTC	Ministry of Transport and Communications
MTT	International Railway Tariff
OECD	Organisation of Economic Co-operation and Development
OSJD	Organisation for the Cooperation in Railways (based in Varshaw)
PRC	People's Republic of China
PW	Permanent Way (rails, sleepers, fastenings, ballast)
SIS	Static Interlocking System
SMGS	Agreement on International Railway Freight Transport
SPECA	Special Programme for the Economies in Central Asia
TA	Technical Assistance
TACIS	Technical Assistance for the Commonwealth of Independent States
TAJ	Tajikistan
TAR	Trans-Asian Railway
TEU	Twenty Foot Equivalent Unit
TIR	Transport International Routier
TOR	Terms of Reference
TRACECA	Transport Corridor Europe Caucasus Asia

UIC	Union International des Chemins of Fer (based in Paris)
UN	United Nations
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
USAID	United States Agency for International Development
USD	United States Dollar
UTY	Uzbek Temir Yullari (Uzbekistan national railways)
UZB	Uzbekistan
WTO	World Trade Organisation

TABLE OF CONTENTS

Executive summary

After the development of the Feasibility Study (March 2005), project activities aimed at producing tender documents suitable for international tender for rehabilitation measures for the Beyneu – Uzbek Border railway line. The present document is to report the conclusions of such activities of Detailed Design and Tender Documents.

Historically the section under study belongs to the line Kungrad - Beyneu (407 km) as it is shown in the following Figure.

Figure - The Kungrad – Beyneu railway line

After the collapse of the former Soviet Union, the line has been split into two sections because of the introduction of the national border between Uzbekistan and Kazakhstan: the Kungrad – border (326,6 km) and the Beyneu – Border (81 km).

Conditions of the two sections are different because of the different maintenance measures adopted during the last years.

As matter of sample, the section in Uzbekistan needs intervention especially for permanent way and some structures but also for safety devices, while, for the Kazakh side, intervention in those field are very marginal and limited to punctual problems. On the contrary telecommunications is an issue in both sections.

The meeting held in Astana on January 31st, 2005 by Consultant representatives and high representatives of the Kazakhstan Temir Zholy has confirmed the above. As a consequence of the meeting Mr. Talaspekov has suggested to concentrate efforts on the telecommunication

system (letter dated 17th March 2005). The Consultant agreed on the priority of the telecom issue and has developed a detailed design and tender documents study for such aspect.

Therefore, the activities for the Detailed Design and Tender Documents preparation have been performed by the Consultant developing the proposed "Telecom Works Option" of the Feasibility Study delivered in March 2005.

The suggested Telecom Works consist in the installation of a new telecommunication system based on digital technology and on the adoption of optic fibre cable together with PCM (Pulse Code Modulation) technology transmission systems.

The adoption of the following system is proposed:

- STM1 (155 Mbps) + E1 (2 Mbps) - using a SDH (Synchronous Digital Hierarchy) based system for the primary backbone complemented by PDH (Plesyocronous Digital Hierarchy) based system for the secondary backbone.

Costs for the implementation of the new telecommunication system has been estimated to be of 2 millions of US$ and due to the entity of the investments and the good financial performance of the Kazakh railways, the Consultant has recommended to implement the project using internal funds.

As the works to be performed are of the same nature, one single lot has been considered:

  - Lot 2.1 – Telecommunications

Because of the nature of the works to be performed, the tender should be an international tender for "procurement of goods". According to this rationale the Consultant has developed the tender documents package using international standards (ADB guidelines) and including:

A - prequalification of bidders, and

B - tender for procurement of goods (single stage).

The very same approach has been used recently in the area for the Central Asia Railway Telecommunications Project (completed in July 2003).

Such approach of using international standards leaves open the possibility of adopting guidelines of procurement of bodies other than ADB. Thus the approach doesn't prevent the Beneficiary to implement the project using other guidelines (i.e. World Bank, EBRD, national, etc.) simply taking the core part of the tender document, namely the technical drawings and specifications, and embedding them into a different set of standards documents.

The Consultant has presented such documents in a separate Annex A which can be straight used for the tender just including some basic additional information from the Beneficiary (i.e. employer's name and address, representative of the employer, deadline for presentation, etc).

0. Project synopsis

Project Title:	Review of Railway Rehabilitation in Central Asia
Project Number:	65290 – EuropeAid/116151/C/SV/Multi
Country:	Kazakhstan, Kyrgyz Republic, Tajikistan, Uzbekistan

Wider project objectives: The development of viable, secure, safe and competitive transport routes linking the countries of Central Asia with Europe and other neighbouring countries. Strengthened border management capacity facilitating economic development, the movement of people and goods and the prevention of organised crime.

The object of the project is to carry out:

Module A / Analysis of the relevant national railway transport plans and any regional railway transport planning provisions.

Module B / Preparation of Technical and Economic Justifications to support and to attract the investments for the rehabilitation of railway lines in the Kyrgyz Republic, Kazakhstan and Uzbekistan for the purpose of increasing transportation capacities of these areas. Preparation of Feasibility study of measures for the maintenance, rehabilitation and renewal of the freight wagon fleet of the Tajik Railways.

Specific project objectives:

The project will carry out:

Module A /

- Overview of relevant traffic flows and forecasts, with special attention on freight transport from Central Asia towards Europe especially through TRACECA corridor;
- Identification of weaknesses and bottlenecks;
- Investigation on the cross-border elements, including co-operation in exchange of data and in customs (also with Afghanistan);
- Evaluation of multi-modal dimensions and possibilities for inter-operability;
- Harmonisation of standards and of operating procedures, with particular attention to compatibility with EU standards, in particular with regard to safety and security standards for the transportation of dangerous goods and oil products.

Module B /

Technical and Economic Feasibility Studies for the rehabilitation and construction of new railways lines. Pursuant to the Technical and Economic Justification data there will be prepared the loan applications

to the lending banks for the allocation of investments to implement the projects.

Feasibility Study of measures for the maintenance, rehabilitation and renewal of the freight wagon fleet of the Tajik Railways.

Planned outputs:

Module A /

- Recommendations concerning multimodal transport
- Recommendations on harmonisation of standards and operating procedures and interoperability.
- Recommendations on improvements of border-crossing procedures.
- Traffic forecasts.
- Tentative prioritisation of recommended actions.

Module B /

- Technical and economic feasibility study of the railway line sections previously identified in Kazakhstan, Kyrgyzstan and Uzbekistan.
- Draft tender document for the same sections.
- Definition of a policy for the maintenance, rehabilitation and renewal of wagons in Tajikistan.
- Feasibility study and preparation of tender documents for rehabilitation and renewal of the existing workshops and maintenance plants in Tajikistan.

Project activities:

Module A /

A.1 – Collection and review of transport and economic studies. Data collection

A.2 – Overview of traffic flows

A.3 – Identification and review of physical, geopolitical, social and environmental issues

A.4 – Analysis of national railway transport plans and regional railway transport planning provisions.

A.5 – Traffic forecasts – Identification of capacity bottlenecks

A.6 – Investigation of border-crossing issues – Recommendations for improvement at borders

A.7 –Review of multimodal transport – Identification of development bottlenecks – Recommendations for improved services

A.8 – Harmonisation of standards and of operating procedures – Recommendations on standards adaptation and improved inter-operability

A.9 – Selection of railway section to be submitted to feasibility study under Module B

A.10 – Discussion with the Project Partners representatives

A.11 – Refining output of Module A

Module B /

Activities to be developed in Kazakhstan, Kyrgyzstan and Uzbekistan:

B.1 - Traffic Analysis

B.2 - Technical Feasibility

B.3 - Environmental Impact

B.4 - Economic Viability

B.5 - Detailed Design

B.6 - Rehabilitation/construction implementation schedule

B.7 - Draft tender documents preparation

Activities to be carried out in Tajikistan:

B.8 - Feasibility Study of measures for maintenance, rehabilitation and renewal of the freight wagon fleet of the Tajik Railways

Project starting date: 1 March 2004

Project duration: 20 months

1. Introduction

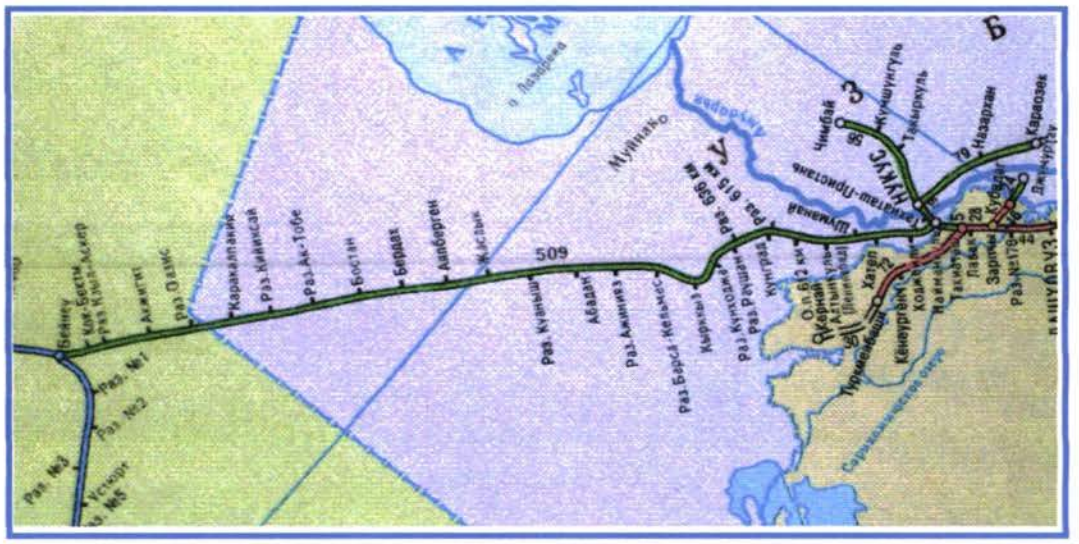
The present document is to report the conclusions of the activities of Detailed Design and Tender Documents developed following the Feasibility Study of the rehabilitation measures for the Beyneu – Uzbek border railway section in Kazakhstan delivered in March 2005.

Historically the section under study belongs to the Kungrad - Beyneu railway line (407 km) as it is shown in the following Fig. 1-1.

Fig 1-1 Kungrad – Beyneu railway line

Details of the line are shown in the next Fig. 1-2.

Fig 1-2 Details of Kungrad – Beyneu railway line



After the collapse of the former Soviet Union, the line has been split into two sections because of the introduction of the national borders between Uzbekistan and Kazakhstan: the Kungrad – border (326,6 km) and the Beyneu – Border (81 km).

The administrative change could not modify so much the situation since the two sections are still working in conjunction. This is why the report is often making reference to the whole line.

Besides this fact, improvements along the main line have to be financed and managed by two different Railway Administrations. Consequently the study has to consider two addressees for the two different Feasibility Studies for rehabilitation measures concerning sections of the same line.

In this respect, it is worth mentioning that conditions of the two sections are different because of the different maintenance measures adopted during the last years.

As matter of sample, the section in Uzbekistan needs intervention especially for permanent way and some structures but also for safety devices, while, for the Kazakh side, intervention in those field are very marginal and limited to punctual problems. On the contrary telecommunications is an issue in both sections.

The meeting held in Astana on January 31st, 2005 by Consultant representatives and high representatives of the Kazakhstan Temir Zholy has confirmed the above. As a consequence of the meeting Mr. Talaspekov has suggested to concentrate efforts on the telecommunication system (letter dated 17th March 2005). The Consultant agreed on the priority of the telecom issue and had developed a detailed design and tender documents study for such aspect.

According to the above the feasibility study delivered in March 2005 has purely listed other minor infrastructure works mainly to bring the whole line from Kungrad to Beyneu to the same standard and condition. According to the Beneficiary opinion, such interventions will be gradually carried out during the routine maintenance activities and have not been included in the cost-benefit analysis as well as in the detailed design and tender documents.

Therefore, the activities for the Detailed Design and Tender Documents preparation have been performed by the Consultant developing the proposed "Telecom Works Option" of the Feasibility Study delivered in March 2005.

Due to the entity of the investments for the telecommunications and the good financial performance of the Kazakh railways, the Consultant has recommended to implement the project using internal funds.

As the works to be performed are of the same nature, one single lot has been considered:

- Lot 2.1 – Telecommunications

Because of the nature of the works to be performed, the tender should be an international tender for "procurement of goods". According to this rationale the Consultant has developed the tender documents package using international standards (ADB guidelines) and including:

A - prequalification of bidders, and

B - tender for procurement of goods (single stage).

The very same approach has been used recently in the area for the Central Asia Railway Telecommunications Project (completed in July 2003).

Such approach of using international standards, leaves open the possibility of adopting guidelines of procurement of bodies other than ADB. Thus the approach doesn't prevent the Beneficiary to

implement the project using other guidelines (i.e. World Bank, EBRD, national, etc.) simply taking the core part of the tender document, namely the technical drawings and specifications, and embedding them into a different set of standards documents.

The Consultant has presented such documents in a separate Annex A which can be straight used for the tender just including some basic additional information from the Beneficiary (i.e. employer's name and address, representative of the employer, deadline for presentation, etc).

2. Detailed Design of the telecommunications system (Lot 2.1)

As already mentioned some defects have been detected by the Consultant's experts during their site visits. Such defects were for the following aspects:

- Infrastructure (including PW, earthworks and structures, stations and LC),
- Safety devices,
- Telecommunications,
- Power supply.

During meetings and contacts, the Beneficiary remarked his intention to overtake minor problems for permanent way, structures, stations, level crossing, safety devices, power supply during routine maintenance as they already did in several parts of the section. Consequently it has been agreed the Consultant to develop project concerning telecommunications aspects.

2.1 Description of the present situation for railway telecommunications

In the following a synthetic description of the telecommunications equipment of the Beyneu - Uzbek border railway section is provided. A graphic description of the present telecommunication situation of the line is presented in Figure 2.1-1.

The analogue transmission system along the railway line use aerial links.

The steel/bimetal aerial link is of the following technical type: V-12-3 and V-3-3.

All the stations are equipped with manual commutation of stations and line sections telephone service, for operation and maintenance activities. The following types of commutators are installed: KASS – 6 and KASS – DU.

Telecom switch (analogue PABX) is installed only in the station of Beyneu and it has the following technical characteristic:

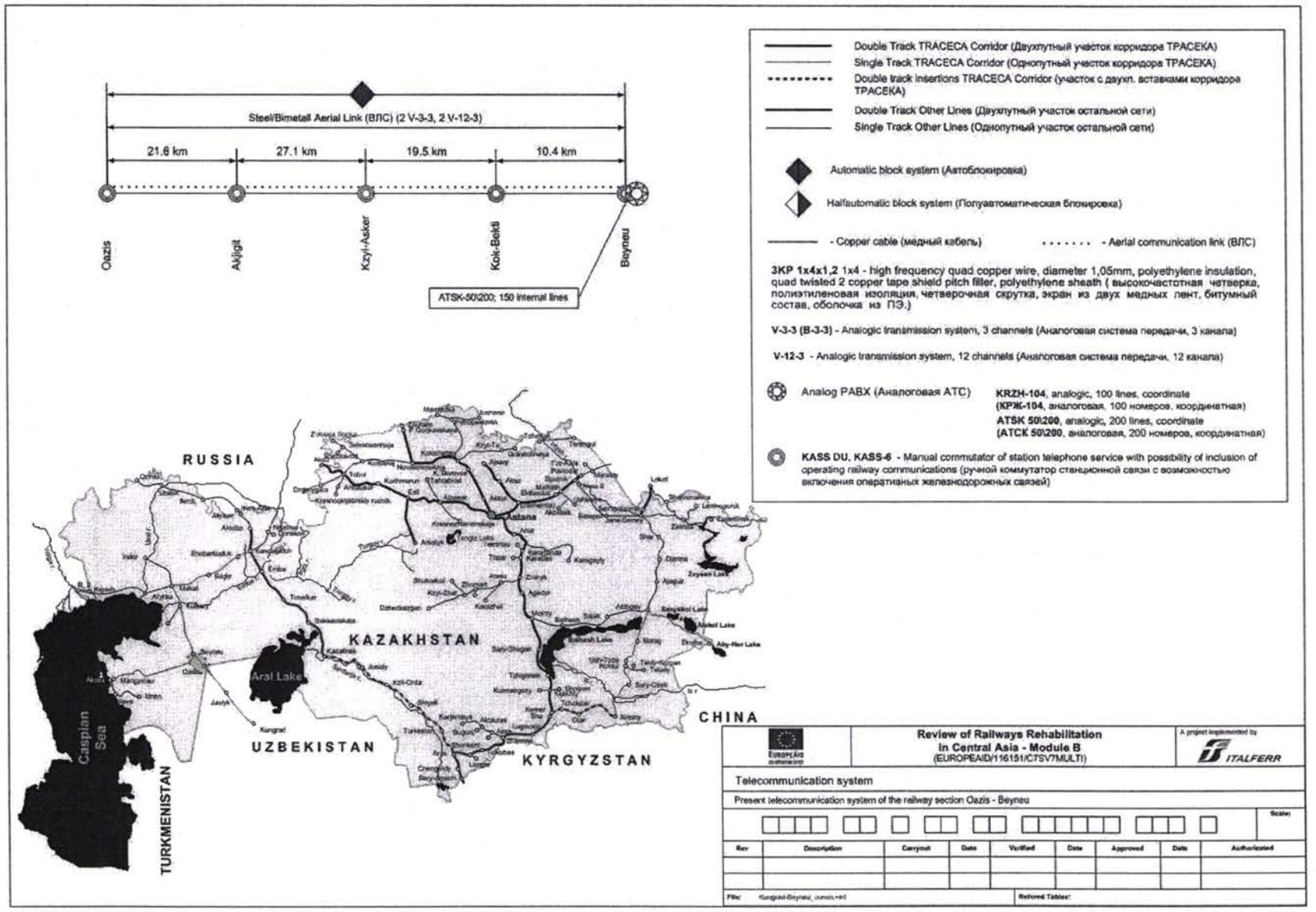
– ATSK-5000; 150 internal lines.

The following equipment for loud speaking communication is present: TU – 50, TU – 100, TU – 600, RUS.

The equipment for train to station radio communication presently installed is IZ RTS, 71 RTS.

Most of the equipment is very old, aged about 30 years, since it dates from the first years of 70s when the line was built.

Figure 2.1-1 - Present telecommunication system of the Beyneu – Uzbek Border railway section



2.2 Description of the new telecommunications system

The Consultant has recently developed for the European Commission the TACIS/TRACECA project Central Asia Railways Telecommunications (2002-2003). Outputs of that project were the Central Asia Railways Telecommunications and Signalling Master Plan and 8 Feasibility Studies for the modernisation of railways telecommunication systems. The present telecommunication project is consequently in accordance with the indications and recommendations of the mentioned Master Plan and the adopted methodology and the proposed technical solutions are derived by the Central Asia Railways Telecommunications Project.

Particularly, two Feasibility Studies were developed for Kazakhstan in the Central Asia Railways Telecommunications Project and one of them is for the railway line Kandagach – Makat – Beyneu – Aktau. The present Oazis – Beyneu section has been therefore studied as a branch of the mentioned main line and a compatible technology has been proposed.

Services to be guarantee

The telecommunication services to be guaranteed in the strictly railway context can be grouped into the following categories:

- *Signalling telecommunications* (train spacing and protection). The role of this type of telecommunications is to transmit information regarding the status of the signalling field elements such as: signal condition, track circuit clear, points setting, etc. This information serves to space and protect trains in circulation; therefore they must be securely transmitted. In and around stations, the flow of information from track to signal boxes and vice versa utilises a local cable network. For full line section information can travel from track to station as well as from station to station.

- *Operating telecommunications* (traffic and energy command and control). The term "Railway operating telecommunications" covers all telecommunications directly connected with train circulation other than signalling information, like for example: railway operations and electric line control; control over various line elements (for example, level crossings); dedicated station to station lines; lines dedicated to maintenance; shunting radio; ground to train radio; etc.

- *Applications telecommunications* (management information system, invoicing, ticketing, etc.). In terms of global development of computer applications, the railway sector has also experienced a significant increase of requirements for high-speed data transmission systems, and an equally significant increase in the demand for high quality and secure connections. The network to design must therefore respond to these needs by guaranteeing adequate transmission capacity.

The role of these services affects the choice of the type of telecommunications system to adopt, with particular reference to the type of cabling.

Naturally, other functions have to be considered as well, such as: short and long distance automatic telephone services; data transmission; radio communications; public services.

Definition of needs of the telecommunication system

The increase in the demand for ever higher volumes of information and transmission speed has been such an incentive for technological development as to lead, especially in the case of telecommunications, to the replacement of perfectly functioning systems with others of the latest generation with lower investment and maintenance costs. This type of replacement intervention

had never been before part of the railway logic. Now it has, however, become a standard of new trends in the sector. Multi-service networks, for services companies, are coming to the fore as a strategic medium: all the various types of communication (data, voice and video) being channelled along the same transmission medium.

The multi-service networks that have to meet these requirements have, also, to respond to the following major criteria:

- use of a multi-hierarchical level architecture, based on the most recent technology adopted in Western Europe;
- secure transmission;
- open and flexible structure to facilitate extension and upgrading;
- management systems compatible with local and long distance operability;
- the capacity to interface with all types of terminals;
- an adequate number of spare channels to implement advanced level services, considering also the future expansion of the demand in communications;
- and the possibility of marketing residual capacity.

To meet these basic requisites it is essential to consider the adoption of digital technology as an inevitable fact, because it permits cost reductions for both constructors and users, as well as increased performance.

Among the many existing transmission technologies, the most respondent ones to the explained needs could be based on the utilisation of copper cable or optic fibre cable.

For the same transmission capacity the sheer dimensions of copper cables compared to optic fibre is a point in favour of fibre optics cable, because it allows smaller ducting as well as junctions and terminals. Also, the adoption of optic fibre cable, together with PCM (Pulse Code Modulation) technology transmission systems, allows a great number of channels with high quality transmission characteristics, because the system, using optic fibre transported light impulses, is practically immune to the electromagnetic interference normally induced in copper cables and even more so in aerial lines. Moreover, optic fibre is a dielectric component and therefore not subject to breakdown due to lightning strikes or other sources of overload by contact with overhead traction power lines (if present). There are no drawbacks in using fibre optics for railway operating and telecommunications applications. Local copper cable networks are only necessary for certain signalling telecommunication services and for short distance and limited bandwidth communications.

The technical/economic comparison between aerial and buried cable leads to the conclusion that the recommended solution for railway applications should be that of a cable buried in a High Density Polyethylene (HDPE) conduit for the high degree of protection this offers, coupled with advantages in terms of functional reliability, operational costs, ease of maintenance and cable life span.

Network availability and flexibility

Availability is one of the indicators that measures quality of service and refers to the probability that a certain system, operating in a given environment, is available at a certain time.

Redundancy is used to increase network availability. Fundamentally, redundancy for SDH networks can be obtained with a ring-shaped structure achieved by connecting the extremities of

the transmission system together, which permits access to the apparatus from two different directions.

The flexibility of the network refers to its attitude toward low cost modification to respond to the requirements of changing demand.

For this purpose, modular structure is required, especially for transmission equipment, and, if necessary, for increased transmission capacity simply by adding other modules.

Importance of standard protocol

It has to be stressed the importance of using systems based on standard protocols. Although a solution based on proprietary protocol can be valid from the technical point of view and can be competitive from the financial side, it will have strong implications for the future steps too.

Telecommunications works as a system; which means that to talk about railways telecommunications generally doesn't mean to talk about a single railway line you are considering, but of the telecommunications system needed for the operation of that line. Consequently during the technical evaluation of the possible solution also the following aspects have to be considered in discarding "proprietary protocols based-solutions":

- there will be no fair competition in the tenders once a proprietary protocol will be starting colonising the area;
- additional costs will be born for allowing different part of the network (with different protocols) to talk each other, providing that this is possible;
- maintenance and future provisions of spare parts can't take the advantage of economy scale (with different systems in place) but mainly will be in the hands of the protocol owner with uncontrollable consequences on the costs.

2.2.1 General description

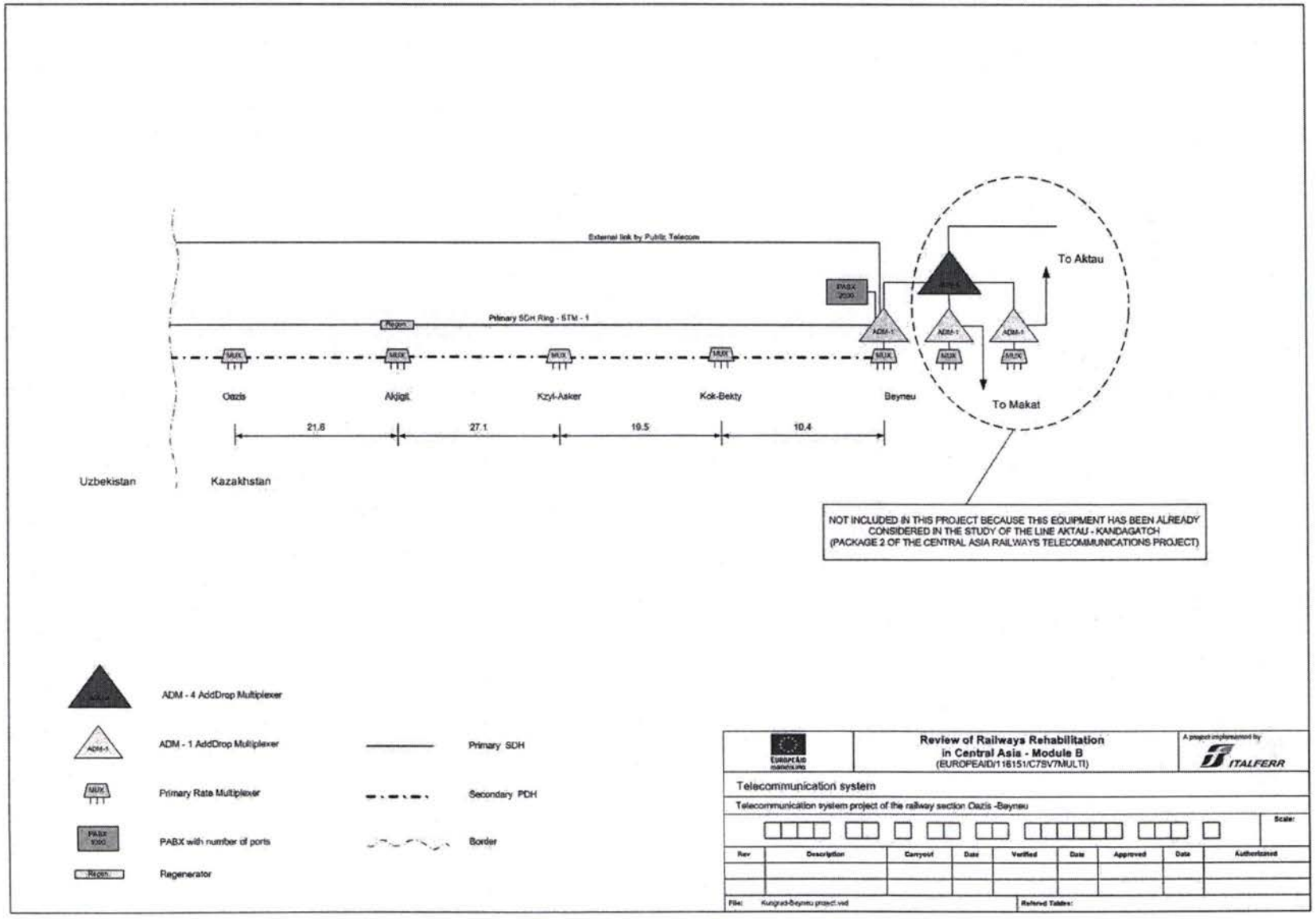
Telecom Works consists in the installation of a new telecommunication system based on digital technology and on the adoption of optic fibre cable together with PCM (Pulse Code Modulation) technology transmission systems.

The adoption of the following system is proposed:

- STM1 (155 Mbps) + E1 (2 Mbps) - using a SDH (Synchronous Digital Hierarchy) based system for the primary backbone complemented by PDH (Plesyocronous Digital Hierarchy) based system for the secondary backbone.

A scheme of the works to be performed along the line is attached in Figure 2.2.1-1.

Figure 2.2.1-1 – Future telecommunication system of the Beyneu – Uzbek Border railway section



2.2.2 Detailed description

The Consultant has developed a parallel Feasibility Study for the railway section Kungrad – Kazakh border in Uzbekistan for the rehabilitation of the entire line Kungrad – Beyneu. The technical solution studied for the Beyneu – Uzbek border section is therefore the very same solution designed for the section in Uzbekistan and they can be seen as two parts of the same project.

The following telecommunication system, suitable for low traffic lines, is proposed and has been evaluated for the Beyneu - Uzbek border section:

- STM1 (155 Mbps) + E1 (2 Mbps) - using a SDH (Synchronous Digital Hierarchy) based system for the primary backbone complemented by PDH (Plesyocronous Digital Hierarchy) based system for the secondary backbone.

The system is based on two level network solution, with a first level of backbone assured by SDH 155.52 Mbps technology and a secondary provided by PDH technology with multiplexer of 2 Mbps capacity.

The highest backbone of the system is a ring structure using STM1 (155 Mbps) for the transport between the Add/Drop Multiplexers (ADM1) at the higher order station (Beyneu) which is equipped also with PABX.

The secondary backbone uses PDH technology, adopts E1 (2Mbps) for transport and uses PRMs (Primary Rate Multiplexer) for the transmission and for interfacing with higher level.

A scheme of the system proposed for the Beyneu - Uzbek border section is represented in Figure 2.2.1-1.

The system uses:

- 2 fibres of the optic cable for the functionality of the primary connection
- 2 fibres of the optic cable for the functionality of the secondary connection
- 2 fibres of the optic cable for redundancy reason (closure of the line).

Fibres for the primary and secondary connections are normally in the same cable while fibres for redundancy should be physically located in another cable and in another place.

Since the second cable is needed to ensure the redundancy of the system in case of problems with the first one (a cut of the cable, a card out of order or not functioning properly and consequent need of substitution), this measure allows for safety conditions of trains running along the line. In order to do that, it is "necessary" to maintain the two cables physically separated so to prevent the simultaneous cut of both.

Every cable is supposed to be of the current international standard: at least 32 fibres. Thus the cable's capacity is redundant in respect to the real use for the railways purpose (4 fibres in one cable and 2 fibres in the other one). Because of that and to reduce costs, the two-cable solutions are adopted only when there are no other possibilities, so to reduce costs.

Therefore for the Beyneu - Uzbek border section, as far as the redundancy is concerned, the following two possibilities have been considered:

- implement a second cable for the redundancy, or
- renting of channels or a fibre pair from third party.

A preliminary screening of the just mentioned possibilities has excluded the first-one, namely the adoption of a second cable, for costs reasons: major cost vis-à-vis an oversized system composed by two optical fibres cables (the "two-cable solution" is - in so far the total cost of the solution - at least 40 percent to 60 percent more expensive than the alternatives with the "one-cable solution").

Therefore, as a transitory measure, the closure of the ring will be by external link and the suggestion is to use the existing facilities of public Telecom along the railway line. For the closure of the ring 5 links at 2 Mbps are needed.

It has to be remarked that the use of a link external to the railway network could be seen as a transitory measure in the time being up to when long distance transmission will be in operating on the primary railway network (in this case, involving also the Uzbek network, Kandagach – Makat – Beyneu – Miskent – Samarkand – Tashkent – Arys – Kandagach) and consequently the closure of the ring can be actuated directly by the railways.

Taking into consideration optical signals attenuation and distances between higher order stations, additional regenerators of optical signals have been introduced in correspondence of stations every time distances appears to be critical for the efficiency of the transmission.

The suggested solution covers also copper cable transmission for service telephones (those in open line in correspondence to the signals for neighbouring track circuits, additional future needs like remote signals control, interlocking station systems, central control of power supply for the line contact, remote level crossing control).

The adopted standards will simplify the technical arrangement necessary to operate trans-border train services in the border stations of Karakalpakia and Oazis with Uzbek Railways.

As already explained, the whole architecture would require 6 fibres. The cable to be implemented (a 32 optic fibre cable) will be supplying 4 fibres while the other links will be taken externally as explained previously.

Both the primary backbone and the secondary backbone are protected by a ring configuration, thus the system is able to guarantee the proper functioning in consequence of a single failure and allows point-to-point link.

Point-to-multipoint links, the use bandwidth on demand and the automatic re-routing are not allowed by this system, but some of these just mentioned weak points can be later exceeded because the system has the capability of growing with a minimum of changes (adding other devices, such as IP Router in the main station).

The old telecom exchange in Beyneu will be replaced with latest generation automatic electronic exchanges (PABX) of adequate potential, that will include the interfaces with the digital junction lines (conforming to ITU-T standard G.703) in output and a fully automatic system for calls, with the adoption of a new national numbering plan that makes calls between different exchanges possible by forming certain telephone number prefixes.

For each connected number it will be possible to allow or deny national and international calls and automatic connection to the public network. It will also be possible to provide each customer, with adequate apparatus, DTMF or digital telephones and all the services of a modern public telephone system (call notice during a conversation, call back in case of number engaged, call transfer, etc.).

The new exchange will also allow for easy expansion of capacity, foreseeing spaces in the cabinets for inserting user cards without having to add or replace control and switching gear, which must already be adequate at maximum capacity of the exchange model and redundant for greater reliability.

This transmission system is highly suited to replace the service currently provided by telex, now rarely used and with high maintenance costs, especially for the dedicated telegraph exchanges and telex machines themselves.

All stations are also equipped with UPS and PABX is provided with special electric power supply station, sized on the effective needs of the system, and able to be further expanded by incorporating modules. A storage battery will assure the proper functionality of the PABX for at least 8 hours – in case of blackout of power supply. The battery will also assure the functionality of accessory devices (i.e. service terminals) in the case the system is not equipped with devices for memorising failure signals during blackout.

A system for management, supervision, and maintenance of all PCM equipment of the country has to be implemented. Generally, for a country network railways configuration, such a system is organised on two levels: the first level is formed by Element Manager (EM) spread along the lines supervised by the system, while the second one by a Network Manager (NM), consisting of one only equipment. By this system, the possible alarm will be recorded by both the competent EM and the NM. The costs for the PCM management system have not been included in this study, since they were already considered in the Feasibility Study of the railway line Kandagach – Makat – Beyneu – Aktau (Package 2 of the Central Asia Railways Telecommunications Project) and the Oazis – Beyneu section can be considered as a branch of that main line.

The PABX Management System consists in a Domain Management System that allows centralized management of all the PABX of the line by high-level user interfaces. All the functions are realised on the same HW and SW platforms and use the same database to achieve a global management system with a single access point. The system is implemented on PC and will interface with global network management systems (telecom and data), in accordance with the standard SMNP (Simple Network Management Protocol). Again the costs for the PABX Management System have not been included in this study, since they were already estimated and charged in the Feasibility Study of the railway line Kandagach – Makat – Beyneu – Aktau. In accordance with that study, the PABX Management System is based in Makat and from there also the Oazis – Beyneu section can be managed.

The Synchronisation System allows every apparatus to receive the synchronisation signal from both sides. At the ends of every section and every 30-35 apparatus, a SASE (Stand Alone Synchronisation Equipment) has to be installed. The SASE produces a high-quality clock that is used for synchronisation of all the apparatus. With this system, every apparatus will use the Ck coming from one side as prime priority signal and the Ck from the other side as signal with second level of priority. SASE installed in Beyneu, and already planned in the Feasibility Study of the railway line Kandagach – Makat – Beyneu – Aktau will also managed the Oazis – Beyneu section.

Technical specifications are provided separately in Annex A.

The Consultant strongly recommends to continue the technical co-operation with Uzbek Railway because of the possible future synergies able to reduce costs form both sides.

Co-operation with public telecom has also to be carried out. The limited resources to be devoted to the renewing of the existing telecom infrastructure suggest a close collaboration between different possible actors in the sector aiming at optimising the resources utilisation.

Finally it has to be remarked that the proposed system uses standard protocols, as recommended in the basic criteria previously described.

The following table details the number of every specific equipment to be implemented and the quantity of civil works to be performed for allowing the implementation of the system.

Table 2.2.2-1 Telecommunication work items

Bill of Quantities			
Item	**Q-ty**	**Unit**	**Note**
ADM 4 with installation	0	unit	
ADM 1 with installation	1	unit	
MUX D/I with installation	5	unit	
Regenerators	1	unit	
UPS with installation	5	unit	
PABX 500 with installation	0	unit	
PABX 800 with installation	0	unit	
PABX 1000 with installation	0	unit	
PABX 1500 with installation	0	unit	
PABX 2000 with installation	1	unit	
PABX 2500 with installation	0	unit	
Various item for equipment (frames, cards, etc.)	10%	percentage	percentage of the equipment costs
Stock	10%	percentage	percentage of the equipment costs
Fiber Optical Cable	86,46	km	
Other costs for OF cable (junctions, cable ends, tubes, shafts, etc.)	15%	percentage	percentage of the OF Cable costs
Laying of the OF cable	78,6	km	
Copper Cable	86,46	km	
Other costs for Copper cable (junctions, cable ends, tubes, shafts, etc.)	15%	percentage	percentage of Copper Cable costs
Laying of the Copper cable	78,6	km	
Preparation of rooms, big stations	1	unit	
Preparation of rooms, medium stations	0	unit	
Preparation of rooms, small stations	4	unit	

2.2.3 Performances improvements

The adoption of a new functional telecommunication system, will assure:

1. direct benefits deriving from performance improvements in the following domains:
   - telecommunication maintenance and operation cost,
   - traffic management and train delays,
   - revenues from leasing excess capacity to third parties,
   - train operational improvement,

- energy costs,
- enterprise management,
- installation of powerful communications links between railways in the region.

2. indirect benefits are difficult to be quantified and have not been considered in the analytic calculation; anyway they are important and contribute to the evaluation of an economic investment:
   - installation of further set of equipment using standard technologies,
   - creation of the infrastructure required for the installation of more advanced traffic control, operation, maintenance systems,
   - creation of the infrastructure necessary to fit real-time freight tracking systems requested by customers.

3. Costs estimates

The capital cost has been estimated starting from the bill of quantities of the proposed telecommunication system which details the number of every specific equipment to be implemented and the quantity of civil works to be performed for allowing the implementation of the system (*see Table 2.2.2-1*).

In the subsequent stage, these quantities have been associated to the correspondent unit rate in order to produce the final estimation of the global capital costs. The unit rates reflect market prices and conditions prevailing at the end of 2004 and also include costs for installation/set up of the equipment, hypothesis for the discount rates used during tender stage and taxation effects.

As far as costs for installation/set up of equipment are concerned, they have been estimated as percentage of the purchase costs. The percentage to be used has been carefully assessed taking into account the large experience of the Consultant in installing railways telecom equipment in Europe and abroad together with factors like difficulty and possibility to use local expert under supervision of expatriate experts. The percentage ranges from 2% to 10%.

As for the discount rates during tender stage, the Consultant has deducted the reduction usually applied by suppliers. The reduction has been evaluated from the Consultant experience in evaluating tenders for the Italian State Railways but with a very cautious approach in order not to underestimate capital costs. Consequently, although deduction is sometime higher, the applied discount rates are ranging form 10% to 20%.

Finally, as the equipment is normally exempt form taxes and duties on imported goods especially vis-à-vis funds from IFIs, all taxes have been omitted in the study.

A provision for contingency has been introduced on the basis of the aggregate investment, as commonly happens for preliminary studies. The suggested percentage is 10%, in accordance with the Consultant experience.

Following the above mentioned assumption, estimates for the capital costs related to the renewing of the telecommunication system are summarised in the following table:

Table 3-1 Capital costs for telecommunication system

Rehabilitation works for Kungrad - Beyneu Line (Uzbek Border-Beyneu section) *Option Telecom Works "Telecom system"*	
Description	**Amount (US$)**
Equipment	314.000
Fibre optical and copper cables (with junctions, cable ends and conduits)	1.123.000
Laying of fibre optical and copper cables	377.000
Civil works	3.000
Contingencies (10 %)	182.000
Total	**1.999.000**

As already explained in the technical analysis, the proposed technical solution needs the closure of the ring for redundancy reason. This necessity would be turning into running costs for renting channels or fibres from third parties.

It is suggested for the first period to rent channels from public Telecom for assuring redundancy (5 links at 2 Mbps are needed for the closure of the ring). In this way the cost of renting can not be suffered because of the mutual advantage of the parts. In a second period, as it was explained, redundancy can be assured by rings internal to the railways.

4. Implementation schedule

The following Table 4-1 shows the implementation plan for the "Telecom Works".

The Option Telecom Works considers that all the activities will be up to Contractors. One Contract is envisaged for providing and installing both optic fibre cable and accessories.

The scheduled activities will be completed in 12 months.

Table 4-1 Implementation programme for Telecom Works

BEYNEU - UZBEK BORDER
WORK PROGRAM

OPTION TELECOM WORKS

	ACTIVITY/months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	CABLES AND ACCESSORIES (KAZAKH RAILWAYS)																								
1	*Approval and financing work*	✳																							
	CABLE AND ACCESSORIES																								
2	*Final tender document preparation*	▬																							
3	*Tendering and signing contract*		▬	▬																					
4	*Ordering materials*				▬																				
5	*Production and handing over material*					▬	▬	▬	▬																
6	*Installation of cable and accessories*								▬	▬	▬	▬	▬												
7	*Commissioning*													▬											

5. Tender Documents

5.1 Introduction

Purpose of this activity is "to prepare contract packages for international competitive bidding, international shopping and direct purchase in accordance with standards development bank procedures".

The scope of each package depends on the recommended solutions in the Feasibility Studies (FS). The following detailed design of the recommended improvement has given the input to the tender documents preparation.

Besides the technical recommended solutions, the procurement activities are deeply affected by standard development bank procedures. Despite a common philosophy, each bank normally has its own Guidelines for Procurement or a standard document to be adapted time by time.

On the other hands, the Consultant can't produce tender documents taking into consideration all factors deriving form all the possible combination among: several feasible packages and four (maybe more) standard documents (EBRD, ADB, IDB, World Bank, national).

All the above results in the following:

- each package has been prepared in accordance with requirements of the Guidelines of possible financing banks, which assure International Competitive Bidding;
- the Consultant can produce only a "draft tender document" since several details (for instance (i) tender Identification Number, (ii) Deadline for submission of the Tender, (iii) time, date and place of tender opening, (iv) date and location of pre-tender or site meeting, (v) Employer's address, etc.) are not known at the moment and will be known in the time being up to end of the project;
- several details are susceptible to be changed before the date of the tender publication.

5.2 The philosophy for procurement to be adopted

The Consultant has developed the philosophy for a successful procurement of the Package taking into consideration the following basic criteria.

The Standard Bidding Documents of Asian Development Bank (ADB) have been adopted.

It is noted that the Standard Bidding Documents adopted from various banks such as WB, EBRD, IDB, ADB, etc. slightly differs one each other.

In fact the above said banks have adopted since many years a policy of homogenization of the Tender Documents.

Such approach of using international standards leaves open the possibility of adopting guidelines of procurement of Institutions other than ADB.

Basically the legal relationships between the Borrower and the Bank are governed by the Loan Agreement. However, in the present circumstance, the procurement procedures are undertaken before signing the related Bank loan.

The rights and obligations of the Borrower and the providers of goods and works for the project are governed by the bidding documents, and by the contracts signed by the Borrower with the providers of goods and works.

In the case of the Beyneu – Uzbek border section, however, the Kazakh Railways could implement the project using internal funds and without asking for any loan. Anyway the Consultant strongly recommend the adoption of international standards documents.

In fact, for major contracts involving the procurement of advanced technological equipment it is common practice to develop the procurement procedures through an International Competitive Bidding (ICB).

The objective of ICB is to provide all eligible prospective bidders with timely and adequate notification of a Borrower's requirements and an equal opportunity to bid for the required goods and works.

The bidding documents shall clearly state the type of contract to be entered into and contain the proposed contract provisions appropriate therefor. The most common types of contracts provide for payments on the basis of unit prices or a lump sum.

For the Beyneu – Uzbek border (Kazakhstan): Lot 2.1 Telecommunication, the ADB Standard Tender Documents (STD) for Procurement of Goods have been taken as reference.

In fact, the ADB's STD for Procurement of Goods are used for contract where the supply of goods and material prevails on the installation works and other related services.

The Single-Stage: One-Envelope bidding procedure is the main bidding procedure used for most of the procurement financed by the ADB. In the Single-Stage: One-Envelope bidding procedure, Bidders submit Bids in one envelope containing both the Price Proposal and the Technical Proposal. The envelopes are opened in public at the date and time advised in the Bidding Document. The Bids are evaluated and the Contract is awarded to the Bidder whose Bid has been determined to be the lowest evaluated substantially responsive Bid.

In accordance with ADB established procedures, prequalification of bidders is required for procurement contract related to expensive and technically complex items to ensure that only experienced and financially capable firms will submit bids.

Therefore a combination of:

- ADB's SPD for Prequalification, and
- ADB SBD for Procurement of Goods with Single Stage – One Envelope procedure

has been adopted for the procurement of the telecommunications system of the Beyneu – Uzbek Border section.

The main data provided by the Consultant are on the results of the Feasibility Studies, and are namely:

- For the SPD for Prequalification:

- Short description of the project
- Major contract components
- Estimated quantities of major components
- Contract implementation period

- For the SBD for Procurement of Goods with Single Stage – One Envelope procedure:
  - List of goods and related services
  - Technical specifications of goods and related services
  - Drawings.

6. Conclusions

Following the positive results of the Feasibility Study, the Consultant has prepared the detailed design necessary for the development of the related tender documents.

The comparison of the magnitude of the investment with the financial performance of the Kazakh Railways brings to the conclusion that such investment is affordable and that no specific financing mechanism has to be studied. Consequently tenders documents should be used for launching a tender for procurement of goods related to the installation of a new telecommunication system based on digital technology and on the adoption of optic fibre cable together with PCM (Pulse Code Modulation) technology transmission systems.

The adoption of the following system is proposed: STM1 (155 Mbps) + E1 (2 Mbps) - using a SDH (Synchronous Digital Hierarchy) based system for the primary backbone complemented by PDH (Plesyocronous Digital Hierarchy) based system for the secondary backbone.

One single lot has been considered:

- Lot 2.1 – Telecommunications

Tender documents here attached have been prepared using international standards (ADB Guidelines) and can be straight used by the Kazakh Railways for launching the related tender.

The Consultant strongly recommends the adoption of international standards documents to assure an International Competitive Bidding.

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