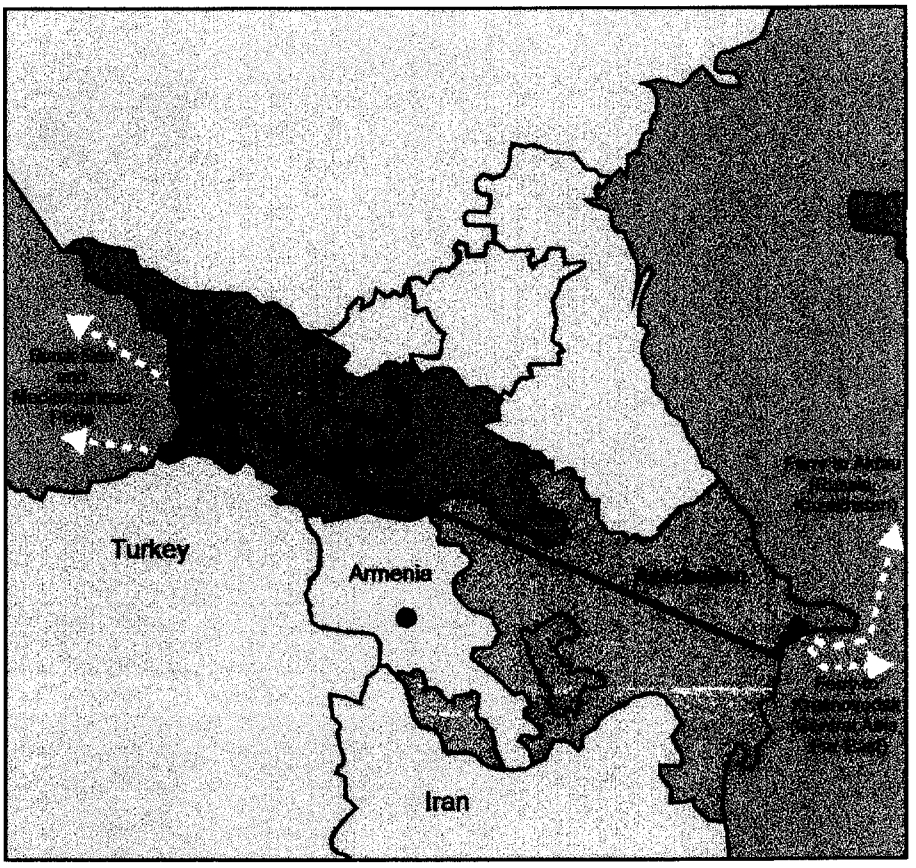
TRACECA

Infrastructure Maintenance 1
-
Railways
Pre-Investment study and Pilot train
Baku - Tbilisi - Batumi/Poti



Project Progress Report

Annex 5

September 1996

Annex 5

Annex 5.1

Technical pre-feasibility of Track and Constructional work

Baku, Tbilisi, Berlin - August 1996

Annexes

Interim Report

WP1300

Technical pre-feasibility of the track and constructional works on both the Azerbaidshan Railways and the Georgian Railways

1 Introduction

1.1 Objectives of the project

The objectives of this part of the study is the determination of the technical requirements for the rehabilitation of the main Transcaucasian rail route between Aserbaijan and Georgia. Part one (point 2 to 4) will be the investigation of the track route Baku - border point to Georgia for the work packages WP 1300 for track and constructional works. Part two (point 5 to 7) will be the investigation of the track route border Azerbaijan - Tbilisi - Senaki - Poti, port on the Black Sea. The co-operation with the railway authorities has been helpful. The participated authorities are named and listed in annex 1.

2 Existing situation

2.1 Track line Baku - Tbilisi

The investigated line leads in west - north direction from Baku to Tbilisi and is constructed as a double electrified track line. The double line is only interupted in km 73.9 to 72.9 by a single track section (see chapter 3.127.). Side track length is 503 km. The border station of the track line Baku-Georgia is Beyuk-Kesik, the border point is located 3.0 km behind this station.

The main line is equiped with 1,475 switches, the track is a Russian design.

2.2 Composition of the permanent way.

The most applied track material is supplied by Russian manufactories. On the main line (the investigated line) the rail profile is R 65 Kg/m and supported by concrete monobloc sleepers also supplied by Russia. On the investigated line the rails are posed in length of 800 m with an interruption section of three lengths from 25m and 4 expansion gaps.

The rail quality used in AZhD belongs to the self - hardening and heat treated rails and cover a strength range about 800 to 1200 N/mm $^{2.}$ Self - hardening rails dominate the market and practically all current applications can be covered with these rails. A distinction can be made between 4 groups:

- rails with 690 N/mm ^{2} minimum tensile strength corresponding to UIC requirements
- rails with 820 N/mm ^{2} minimum tensile strength corresponding to ASTM and GOST requirements
- rails with 880 N/mm ^{2} minimum tensile strength corresponding to the wear resistant qualities and
- rails with 1080 N/mm ^{2} minimum tensile strength,that have been used to a great extent when high operating loads exist.

Table below provides a survey of the chemical composition of the rail qualities used in AZD.

Mechanical Properties and chemical composition of delivered rails								
Type of rail	Delivery condition	name of steel	Chemical composition,content in percent C	Mn	Si	S	P	Tensile strength N/mm2
R75,R65	Gost 8160-63	M76	0,69-0,82	0,75-1,05	0,13-0,28	0,045	0,035	840
R65,chromi-	ChMTU							
ferous	2-64-68	M71	0,65-0,76	0,75-1,05	0,13-0,28	0,045	0,035	900
R65,volume-	ChMTU							
tempered	2-59-68	M72	0,68-0,78	0,75-1,05	0,13-0,28	0,045	0,035	1160
R50	ChMTU							
	6944-63	M75	0,67-0,80	0,75-1,05	0,13-0,28	0,045	0,035	840
R50	ChMTU							
	2-16-67	N865	0,56-0,75	0,60-1,0	0,15-0,30	0,06	0,07	800
R50,volume-	ChMTU							
tempered	2-59-68	M72	0,67-0,77	0,75-1,05	0,13-0,28	0,045	0,035	1160
R50,surface-	STU 71							
tempered	MS-66-62	N865	0,56-0,75	0,60-0,90	0,15-0,30	0,06	0,07	950
R43,R38	GOST							
	4224-54	M71	0,64-0,77	0,60-0,90	0,13-0,28	0,05	0,04	800
Legend:								
C=Carbon,Mn=Mangan,SI=Silicon,S=Sulfur,P=Phosphorous								
Rail Qualities used in AZhD and current applications.			belong to the self-hardening rails that cover practically all					

The density of the posed sleepers in straight line comes to 1840 sleepers in curves to >1840 till 2000, and correspond to an average sleeper spacing of 0,54 resp. 0,50m. In addition to the concrete sleepers, timber sleepers were also laid. The timber quality is pinewood treated by impregnation. The average lifetime is up to 15 years. The better timber quality in beech or oak is not available or to expensive.

Rail fixing to the concrete sleeper consists of base plate with rigid clip, base plate is fastened on the concrete body by an anchoring screw turned a quarter in a chamber.

This kind of rail fastening is not in line with current practise in West Europe and causes the lost of force absorbing assembly by vibration of wheel/rail contact which damage the fixing chambers of the anchorage screw.
Rail fixing to the timber sleeper consists of:
- The fastening is realised by spikes with base plate.Also this fastening system is not suitable because the rail/wheel contact vibrations loosen the fixing devices. Knowing these unsuitable rail fastening to the timber sleeper an improvement has been started by coach screws, particular in curves.

2.2.1 Switches

As mentioned above there are 1475 switches on the investigate main line.All of them are connected with the through line.Theire geometric form is R65 300 1:11 and correspond with the switches used in Europe.

2.2.2 Level crossings

30 level crossings are installed on the main line 8 of them will served automatically 11 electrically by push button, and 11 by hand.

2.2.3 Bridges and tunnels

Tunnels are not constructed on the main line Baku/Tbilisi and vice versa. On the other hand 985 bridges alltogether are installed. These constructions are divided in bridges of length till: 25 m - 680 constructions
100 m - 57 „
>100 m - 5 „ .

243 constructions are culverts, arched stone and concrete drain pipes till 2.00 m span. The year of construction of all types is given by AZhD between 1883 - 1904. The present situation of these bridges is mentioned as sufficient and need no repair. In annex 2.2.3 the bridges of great importance are enumerated. This list contents only bridges >25m length till bridges >100m length. All bridge construction

methodes are present arched stone bridges, reinforced concrete bridges and metallic decks assembled by rivets or bolts. The bridges are generally well maintained and in sufficient condition. Some bridges are in critical condition and need major repair or renewal. The arrangements for their rehabilitation are discribed in chapter 3.1.2

2.2.4 Ballast

The main line is constructed on a 30 to 35 cm ballast bed. The gauge standard is 40/70 mm. At time AZD exploits two quarries, one is located in Shamkir the other is located in Kizildja. The broken stone from the Kizildja quarry is, as we could seen, from high quality. In Shamkir only river gravel is extracted that is not qualified as ballast allthough it is used as ballast. The gravel is not broken, round and not compressable.

Laboratory test results has not been available but it is said that the tests are in hand. The ballast bed on the main line is of the most parts in a very bad condition due to the climatological erosion, sand drifts and traffic pollution (petrol and salt transports). A high percentage of fine granulation fraction containing in the ballast and the before mentioned factors lead to a rapidly pollution, so that the ballast loses its dynamic absorption, elasticity, water permeability, aeration and electrical insulation properties. The ballast can not distribute the wheel load from moving vehicles over the subballast as evenly as possible, as well as providing adequate resistance to both longitudinal displacement and lateral shift.

2.2.5 Subsoil

The subsoil will have required support capability for accepting the static and dynamic forces arrising from train traffic only if its elastic modulus is $E>800kp/cm^2$. This value could not be proved and in most parts of the track line that we saw by our visits, a lot of muddy patch in the ballast have been stated. Fact is that the subsoil has not the required support capability. Subsoil investigation by digging below the surface ore drilling tests and their laboratory analysis are necessairy, so that

an improvement of the subsoil can be planned and made when a track renewal is in hand.

2.2.6 Technical layout data and spezification of track geometrie

The evaluation of the longitudinal profil, only main line Baku - Tbilisi and vice versa, resulted in following data:

minimum radius 350m
maximum super elevation 150 mm,with parabolic transition curves
maximal vertical gradient 12‰
vertical or levelling curves 300 - 3000 m
distance between centers of lines 4100 mm
distance between centers of lines in stations 5,30 m
average sleeper spacing 1840 in curves up to 2000
permissible speed 100 km/h for passenger trains
permissible speed 80 km/h for freight traffic
gauge 1520 mm, minimum 1516 mm,maximum 1540 mm.

The longitudinal profil is drawn in a scale 1:10000, for length and 1:1000 resp 1: 500 Not only the level of the upper surface of the rail a. s. l., the level over ground is also indicated. The maximum high over ground is up to 12 m.

Also indicated are:

The track line with all stations entry distance, exit distance, switches leading in and out of the passing tracks, signal position, level crossings, constructions and special installations like marshalling yard, loading ramps, work shops and others.

The areas on both sides of the track line and its utilisation as agriculture or forestry operation.

2.2.7 Arrears of maintenance and damaging/destruction of assets

The investigated track from Baku - Tbilisi is as we found out in a desousterous situation. A track inspection from Baku - Pirsogat we stated that the actual situation would be more than hopeless for a seriously traffic handling. The ballast bed is compact as a concrete slab. The hammer effect wheel/rail contact is reflected instead absorbed, no more elasticity, water permeability and aeration with the unavoidable consequencies of destruction of the track assets, damaging concrete sleepers and lost of rail fastenings. In additional to these facts, the load limit of 500 million tons have gone beyond what is permissible.

One of the consequences of the compact ballast bed is the high number of broken rails in 1995/1996 recorded with 165 broken rails, all on the Baku - Tbilisi line. The distribution on participated districts, is as follows:

district	broken rails
Baladjari	23
Baku	52
Kürdamir	42
Gyandja	12
Akstafa	6
Ewlach	30
Total	165

The arreas of track maintenance that can be put down to the fact, that AZD is totally dependend on imports for all track materials, exept ballast, from the former Soviet Union.

Due to the lack of financial sorces, AZD is presently unable to order the import of the required track material. Since 1989 the annual track renewal programm of 150 - 200 km had been decreased. The renewal performance in the last three years was in 1994 - 40 km

1995 - 44 km

1996 - 10 km track renewal are planned.

Summarizing the arrears in track renewals are meanwhile nearly 900 km. The table below shows the arrears related to entire network.

Survey of main track lengths of the districts and urgent track renewals

No.	Designation of district	responsible for main track lengths	track passed the load limit of 500 miot per Km	renewals of track in bad condition Km	remarks
1	Hatschmas	239,60	83,00	29,00	**the tracks in**
2*	Baladjari	127,00	39,00	0,00	**bad condition**
3*	Baki	212,70	72,00	38,00	**means :**
4	Apscheron	226,20	64,00	9,50	**load limits**
5*	Kürdamir	277,10	100,00	37,00	**>5oo miot/km**
6*	Gjandja	223,30	25,00	0,00	**rail vertical**
7*	Akstafa	238,20	5,00	0,00	**wear >12mm**
8	Saatli	251,30	44,00	4,00	**damaged**
9	Mindschiwan	163,10	33,00	0,00	**sleepers/km**
10	Ordubad	103,90	23,00	0,00	**>6 - 800/km**
11	Nachtschivan	140,50	86,00	0,00	
12	Saljan	219,50	98,00	1,30	
13*	Evlach	255,70	32,00	18,00	
14	Schirvan	117,80	23,00	4,00	
15	Schaki	162,30	122,00	140,80	
16	Summary	**2958,20**	**849,00**	**281,60**	
	Percentage of endangered main track	**100%**	**28,7%**	**9,5%**	
	The districts numbers signed by a star are districts located on the investigated line. Baku-Tbilisi.				

2.3 Analyse track and constructional work maintenance organisation and facilities.

- methodologie and organisation of maintenance

In annex 2.3 an organisation system of the track economics division (general management) is shown and managed by a Chief Engineer. The Chief Engineer organises the administrative work for track maintenance and related services of civil engineering in AZD`s administration building in Baku, including the districts and other work-units that are located on the main line. The organisation structure shows only the work-units partizipating on the investigated line. Alltogether there are normally 3,726 employees now reduced at 2,861 employees.

The tasks of methodical maintenance are to be carried out by 15 districts for the whole network. Six of them are located on the line Baku - Tbilisi. Responsible on the main line are the districts as follows:

Name of the district	Responsible for km main line	located at km
Baladjari	127	2647
Baku	212	
Kürdamir	277	342
Gjandja	223	183
Akstafa	238	88
Ewlach	255	250

The main tasks of a district are:

-visual control by walking on the side path and routine examination of the main system groups of the track, as rails, fastenings, sleepers and the ballast bed

-irrigularities in the track geometrie as alignment, superelevation, square position of the sleepers

-special investigation by order of the chief engineer

-emergency repairs, broken rails for exemple.

In 1995/1996 there were recorded 165 broken rails 52 of them at Baku district. Corresponding to the instructions the broken rails have to be repaired by changing a standard rail barre of 25 m. All broken rails have to be journalized by given details about, district, line or station, track number even or uneven, km point, panel number, left or right rail and rail type. The rail damages have to be discribed and must to be written visually in or outside of the damaged rail. An engineering manual gives instructions about all types of rail damages, each type description posesses a code number.

-manually ultrasonic testing carried out by a specialised team in each district performance 5 km/hour, the results are reported.

Additional to the above mentioned track and rail tests, the rails of the entire network are examined ultrasonic and magnetic by 3 inspection coaches owned and operated by the central management at Baku (defectoskop coaches 312, 411 and 365). A track measuring coach located at district Baku records the geometrical parameters of the entire track - network twice a month. The results from the geometrical measuring is assessed by a digital quality coefficient concerning all defficiencies of the geometrical parameters.

The classification of the calculated coefficient is, as follows:

-0	-	40	very good, practically after a general track renewal
-40	-	100	good, serveral points in the line are to check
-100	-	500	tendency from moderate to bad, consequently observation till partly renewal, ballast cleaning, sleeper changing and rail fastenings
-		>500	bad, the track needs renewal.

Due to the lack of regular maintenance in the last 7 years, it occurs often that the coefficient appears to four digit.

The facillities as district office building, workshop, social rooms are very poor and need a consequent planned and executed modernisation. The mobilitie is broken down by missing all kinds of transport possibilities.

Annex 2.3 a shows the organistion of the district Baku, as alternativ for the other 14th. The other ones are structured in the same way. Annex 2.3 b indicates the basic equipment with small track - maintenance machines and tools to cope with the tasks.

2.3.1 Permanent - way workshop

For major repairs and complete track renewals (general repairs) AZD use three well equiped and staffed permanent - way work shops. They are located at Kyourok, Sangatschali and Tscharkhi. A chief engineer leads the work shop and he gets his work instruction from the general management at Baku. The work instructions depend on the annual work - programm and in this dimension the track material is stored in the work shops. The available track engines are of Russian construction and except of the UK units, which are working very efficient, although a rehabilitation will be necessary, the tamping, -lining and ballast cleaner machine have to be

replaced. The UK - system is working with 25 m track panels, which are pre - assembled and loaded on special wagons. The panels are transported to the side. The crane, well known as `platow crane` takes the preassembled panels and puts them on the prepared track formation. The special wagons as a couple of two can be loaded with 5 panels, so that a unit of 12 wagons is needed for the transport of 750 m track. The same is needed for the transport of the removed panels. The performance in a possession of 6 hours is said would be 1200 m including ballast cleaning, tamping, lining and ballasting. When finished the work , the first 3 train will go with 15 km/h, the next three with 25 km/h and then the permissible speed with 80/100 km/h is permitted.

The staff normaly amounts to 116 peopel now reduced to 79. Annex 2.3.1 shows the organisation structure of the Permanent - way work shop Sangatschali.

2.3.2 Welding plant at Saliani

The welding plant at Saliani is very important for track renewal of the whole network. It is said, that at Saliani the standard rail bars of 25 m are welded to 800 m long rails. The transport of them is realised by special wagons without any problems. It has not been the occasion for visiting the plant, so that all information we have got, were coming from the general management division at Kabu.

2.3.3 Depot and workshop for track engines repairing at Baladjari

The Baladjari track engines repairing plant has been built in 1903. The constructions as halls and shops are related to its age in a sufficient condition. The equipment of tools and machine tools are working but a modernisation will be necessary. At time 30 workman and 10 administrativ employees work in this plant. The work orders are coming from the general management and could be done when spare parts would be available. The instruction requirements of the different inspections cannot be followed by missing all kind of spare parts. The main activities are focussed in repairing diesel motors by dismanteling others to get spare parts.

A generally modernisation on the existing buildings, new machine tools, tools and new work place organisation will be necessary. Cost estimation 200,000 $.

2.3.4 General management division at Kabu

The general division at Kabu leads and has the control of all facilities which are settled on the line and on the administration at Baku. All events that occured on the line and on constructions are collected and journalized. The causes are disocvered and measures are taken to prevent such events like derailments, or other interruptions to train movements. The documents show frank and open the reality of the unsufficient situation of the damages on the track lines which are originate to the lack of maintenance or necessary renewals.

The lack of prevention is caused by no means over a lot of years.

The most important document is the so called `track pàssport or track C. V. in which all events on the track are shown since the last renewal. The main facts are: date of last renewal, load comulated in million tons, rail stresses, number of damages on the rails, damaged sleeper per km, ballast pollution and interventions by maintenance measures or small repairs. Each km of the superstructure disclosed by this document can be examined at any time.

The general management division for the superstructure and all related services that is capable to find out and to journalize all important mistakes on track elements with such an exactness, will be also capable to renew and to maintain their track line themselves knowledge and scilled staff is available. Its only missing financial means and nearly all kind of equipment.

3 Analysis of weaknesses and limitations

3.1 General

As mentioned above in chapter 2.1 the existing situation of the main track line Baku - Tbilisi and their related component parts has been explained. Chapter 3 will show the damages and bottelnecks of the track line and it is pointed out „what is to do", to eliminate all damages which are in the opposite to a steady flow of traffic.

3.1.1 Switches.

On the main line are installed 1475 switches, which are all connected from and to the main line. All these connections have to be well maintained and in a good condition. It will be very important that the pilot train or all through trains are passed the stations without speed restriction. This condition is only to realise when the switches has been renewed as the actual situation it demands.

Quantity of switches which are to renew = 200 R 65 300 1: 11

Quantity of crossing timber set complete = 140 sets

3.1.2 Bridges and tunnels

The most of the bridges on the main line (annex 2.2.3) are generally in good condition realised by methodic maintenance measures. Although there are some bridges which have to be rehabilitated by major repair or renewal. The chapters 3.1.2.1 - 3.1.2.7 below in order of urgency show the bridges which are in need of heavy repair or renewal.

3.1.2.1 Bridge number 56 in km 541+500

The Bridge entrance and exit of Baku main station is so destructed that the track panel over this bridge (right or even track) had been dismantled in July 1996, to avoid any traffic. The bridge constructed as prestressed concrete slab is in danger of collapsing because the road traffic destroyed the prestressing of the concrete slab.

The concrete slab is no more able to be applicated of a dynamic load (moving train) to a bridge. The even track is locked for an indefinite period. All trains going to and coming from Baku are passing now the temporary singel - line working over the still well operating separate bridge of the uneven track. The detention of trains (passenger and goods) in junction stations have to be planned and careful traffic control have to be arranged. The project to renew this bridge part is in hand . A cost estimation has not been available.

3.1.2.2 Bridge construction in km 157+700

The Bridge of the bridge list number 19 and 20 is jeopardized by wash aways of the foundations of the abutments and piers. River training and security measures have to be undertaken. Project documents are already prepared. The cost estimation is figured with 866,000 $.

3.1.2.3 The bridge in km 111+200

The bridge construction number 10 and 11 of the bridge list is partial in need of replacement. The works of renovation are in hand. Project documents exist, the cost estimation is figured with 954,000 $.

3.1.2.4 The bridge in km 234+600

The bridge number 31 of the bridge list have to be complete renewed. The bridge openings of 4 times 3,60 m are to small for the mass of water coming from the catchment area. The bridge is endangered by wash away. Project documents do not exist. Estimation 100,000 $.

3.1.2.5 The bridge in km 252+800

The bridge construction number 33 and 34 of the bridge list needs a complete renovation. This bridge has been constructed in 1927 as a riveted steel construction. The physical deterioration and heavy corrosion demand the bridge renewal. Project documents are already prepaired. The cost estimation is figured with 2,950,000. $

3.1.2.6 The bridge in km 360+200

The bridge number 41 and 42 of the bridge list demands continuation of safety and protection measures. The construction is in good condition but endangered by undermining the foundations of abutments and piers by mass of water. The project documents shows an amount of 200,000 $.

3.1.2.7 The bridge in km 72+300

The bridge number 5 of the bridge list renewed in 1996 and located in a singel track-line section. This singel track could be in the future a bottelneck when the line is carrying dense traffic. In case of such improved traffic a second track in this section could be needed, then a second bridge have to be constructed for having a free flow traffic system. The project documents are prepared, the cost estimation is figured with 4,545,000 $.

3.2 Track line rehabilitation

The permanent lack of financial means since 1989 led to the arrears in track renewals and in scheduled full track maintenance. The need to catch up amounts nearly to 900 km. To catch up this backlog an extensive and in short-term realized track renewal programme has to be started. Annex 3.2a contents the worsest track sections on the main line about 200 km. These sections have to be renewed before the pilot train starts. AZD has no production of any track material except ballast so that all track elements as sleepers, rails and fastenings have to be imported. The quality of AZD`s own ballast production is not sufficient because the quarry -

equipment like crusher, riddel system and wash equipment must be renewed so that the daily output could be raised from to day 300 m^3 to more than 10 - 20,000 m^3/day. Within the improvements it would be possible to get the ballast without filler, fine granulation fraction and dust.

AZD is able to do the track maintenance and track renewal themselves, man power and skilled personal are available. However the best personal cannot be efficient when the equipment and track engines are not working and available. Here we have also a lack due to the lack of the financial situation of the last years. Annex 3.2 shows the shortage on small track maintenance machines and tools for one district only. A cost estimation is made to replenish the shortage (see table below).

Nr.	Designation	shortage	price per unit $	total $
1	Tamping units, type GB 4 with Briggs and Stratton engine	34	16 717	568 378.
2	Rail saws, type SRN-E with electrical engine 220/380 V DC, 50 Hz	5	3,443	17,215.
	supplement for hydraulical device		983	983.
3	Rail drilling machines, type PR 8-E-2V	2	3,933	7,866.
4	Rail grinding machines, type MP 12-E	15	4,033	60,495.
5	Coachscrewing machines, type T52-E	31	6,097	189,007.
6	Coachscrewing machines, type TS2 with gasoline engine Bernard 617	34	6,490	220,660.
	supplement for torque limiter		295	295.
7	Track lifting and slewing machines type RV 100 for track 1520 mm	2	39,333	78,666.
8	Hydraulic jacks, type CH 65	35	930	32,550.
9	Wooden sleeper carring tongues	34	88	2,992.
	Concrete sleeper carring tongues	34	106	3,604.
10	Hand operated rail pullers with chaine	10	1,733	17,330.
11	Generators, type CR 2500 with Briggs and Stratton gasoline engine	8	847	6,776.
	carried forward			**1,2o7,817.**

Nr.	Designation	shortage	price per unit $	total $
	carried forward			1,206,817
12	Generators, type RG 4500 T with			
	Briggs &Stratton gasoline engine			
	mounted on a hand pushed one wheel			
	trolley, power 4 kw /220/380 V/50 Hz	2	1,733	3,466.
13	Signalling lamps, 3 colour lights	129	243	31,347.
14	Brigade carriers	12	40,000	480,000.
15	Four wheel drive cars	2	30,000	60,000.
	direct costs			1,781,630
	value added tax 15 % 1781630			267,245
	dispatch and insurance 20 % 1781630			356,326
	unforseen			94,799
	Total			**2,500,000.**

The efficiency of a district is dependent from its equipment and completed only the shortage of annex 3.2 an amount of 2,5 million $ is necessary. This sum is to multiply 6 times, that is the number of the districts located on the main line. Therefore a total of 6 x2,5 = 15,0 Mio $ will be necessary. In due course an actual shortage lists have to be drawn up. With the completed equipment and the possibility of mobilisation by own brigade carriers the scheduled full maintenance on the line is ensured.

The track renewal is planned and executed by staff and equipment of the permanent-way work shop (see chapter 2.3.1...). The available track-engines and equipment are causing to its age prone to break down. The break down stoppages during the track renewals are in full progress, force the responsables to improvisations. All improvisations influence the quality of the work and are the first reasons of increased maintenance measures. Annex 3.2 shows the inventory of track engines and their actual usability. These track engines are origine from the former Sowjet Union. They are very heavy, old and are no more up to date for modern track renewals and maintenance measures. Instead of expensive repairs of the available engines as VPO 3000 tamping and levelling, R 2000 track liner we

recomment to buy new ones. The ballast cleaner Shom has to be replaced by a new modern and productive working ballast cleaner, which is able to clean the ballast to a depth of 1.00 m below top of rail and the guided excavation chain produces an exactly straight subgrade. The new track engines are to understand as a unit consists of: ballast cleaning, tamping and ballast regulating machine. This unit will be needed twice, one in short term, the other medium term. The table below shows the kind of machines and guiding price for required machines.

Item	short description	guiding price per Unit in $
1	RM 80 UHR	
	Ballast cleaning machine for switches,	
	crossings and plain track universal application.	
	length over buffers = 31.80 m	
	excavating width standard = 4.00 m	
	max excavating depth below top rail = 1.00 m	4.38 million
2	Unimat 08-475 4S	
	perfect maintenance of switches and crossings.	
	technical data	
	length over buffers = 33.99 m	
	width = 3.00 m	
	total weigth of machine = 100 t	
	four tamping units	2.86 million
	carry over	7.24 million
3	High performance ballast regulating machines	
	Technical data:	
	length over buffers = 17.45 m	
	width = 3,000 mm	
	weigth = 36 t	1.24 million
	Total	**8.48 million $**

The above listed machines are succesful working in GUS. In order to utilise high performance machine systems properly, it is essential to have a perfect user technology tailored to the specific operating conditions. This user technology has been developed in close cooperation with the railway authorities on the basis of experience in many countries under the most varied climatic, geographic and permanent way conditions. Training programmes, tailored to the operating condition of AZD are available.

Another important weaknesses are the quarries, vandalized and destroyed of the most important equipments , the quarries are unable to produce the different fractions of grain, specially ballast, or others for prefabricated concrete parts. Full working quarries will be the guarantor of high quality of ballast for the permanent way and all required grain size for the production of prefabricated concrete parts, even prestressed concrete sleepers. An estimation given by the AZD authorities amounts to 0.60 million $. It includes: new crusher and riddel systems pipes and conveyor belts, wash equipment to clean the broken stones from dust and filler bulldozers, excavators and trucks, other materials for the renovation of offices and social rooms.

The dependence to import all track materials signifies uneaseness. With modern equipped quarries AZD would be able to develop an own prestressed concrete sleeper production, with new, according the European standard sleeper design and fastenings. First investigations show that a full mechanised concrete sleeper plant will cost 12 million $, a partial mechanised 8.7 million $. This prices do not include ground, land development, works hall, necessary infrastructure like roads, works siding, power sources and water.

3.3 Definition of training needs.

Professional skill is the most important requirement in order to achieve quality and high performance in mechanised track works, track renewal and track maintenance. The skill is required in 3 fields.

- railway track

Operation staff of the general management till permanent way inspector. The training contents organisation of track renewal and track maintenance, work programme, time schedule of completion, updating of engineering manuals and instructions, competitive procurement procedure, computerizing of track inventory and constructions.

-Operation of new track engines and

-maintenance of machines.

The training of operating and servicing staff is thus gaining greater importance for succesful and economical operation of the machines. The training programme will help the machine crews to operate the engines in high performance. Objective of the training programme will be to inform and to teach the leaders of machine crews to operate the engines for the best results in performance and long service life. The training should be realised by seminars of 4 weeks. The programme contents theoretical and practical parts and visits on sides. Required skill for machine operation, machine crew and members, for machine maintenance service specialist, mechanics and electricians.

3.4 Financial pre - feasebility

The financial pre - feasebility contents all weaknesses and limitations described in chapter 3 and shows the amounts that are unavoidable necessary to rehabilitate the track line Baku - Tbilisi. The cost estimations obtain a general view of direct repair costs and the possibilities to achieve the full scheduled maintenance system by new generation of track engines and equipments. The recommended engines and equipments represent the basic equipment. Within AZD is far - reaching

independent for an extensive track maintenance and track renewal and conserve the track for long service life. The table below shows the summary of the financial means distributed of the next ten or fifteen years. Annexes 3.4 - 3.4.3 show the more detailed cost estimations.

Summary of financial means to rehabilitate the track line Baku - Tbilisi

Designation	2000	2005	2010	2015
Permanent way 200 km in future 40 km /year annex 3.4	**68.700 mio.$**	**68.700 mio $**	**68.700 mio $**	**68.700 mio $**
Equipments of districts and track engines annex 3.4.1	**27.380 mio.$**	**10.245 mio.$**	**0.905 mio.$**	
Bridges, annex 3.4.2	**3.140 mio.$**	**2.950 mio.$**	**4.545 mio.$**	
Construction costs annex 3.4.3	**10.200 mio.$**			
Total	**109.420 mio.$**	**81.895 mio.$**	**74.150 mio.$**	**68.700 mio $**

4 Conclusions for the pilot train

4.1 The pilot train in view of the permanent way.

The pilot train will use the Transcaucasian line between Baku -Tbilisi -Senaki - Poti and vice versa as intermarshalling yard train. The preconditions for the realisation will be as follows:

-safety of traffic and

-running in permissible speed.

At time both preconditions are not complied with. The track line suffers on relevant irrigularities in geometric position as well as in physical conditions. The backlog of missing scheduled full track maintenance over a long period and the necessary track renewals when wear and tear of track elements and even the instructions its insists on, led to noumerous speed restrictions. The average speed from Baku to Poti amounts at time max 40 or less km/h. That means a lost of 50 % of the permissible speed of 80 km/ h.

Fullfilled preconditions signify:

- scheduled full maintenance in both track and constructions
- track renewal programme in short term for 460 km (GZD+AZD)
- track renewal programme 40 - 50 km /year only on the line Baku - Poti medium and long term
- switches renewal programme short term 600 switches, in long term 40 switches per year
- bridges construction programme as described in the reports.
- in connection to the above mentioned procurements of track engines, small track engines, tools, equipments for districts, permanent - way workshop, depot of track engines repairing, prestressed concrete sleeper plant, quarry equipment and impregnation plant.

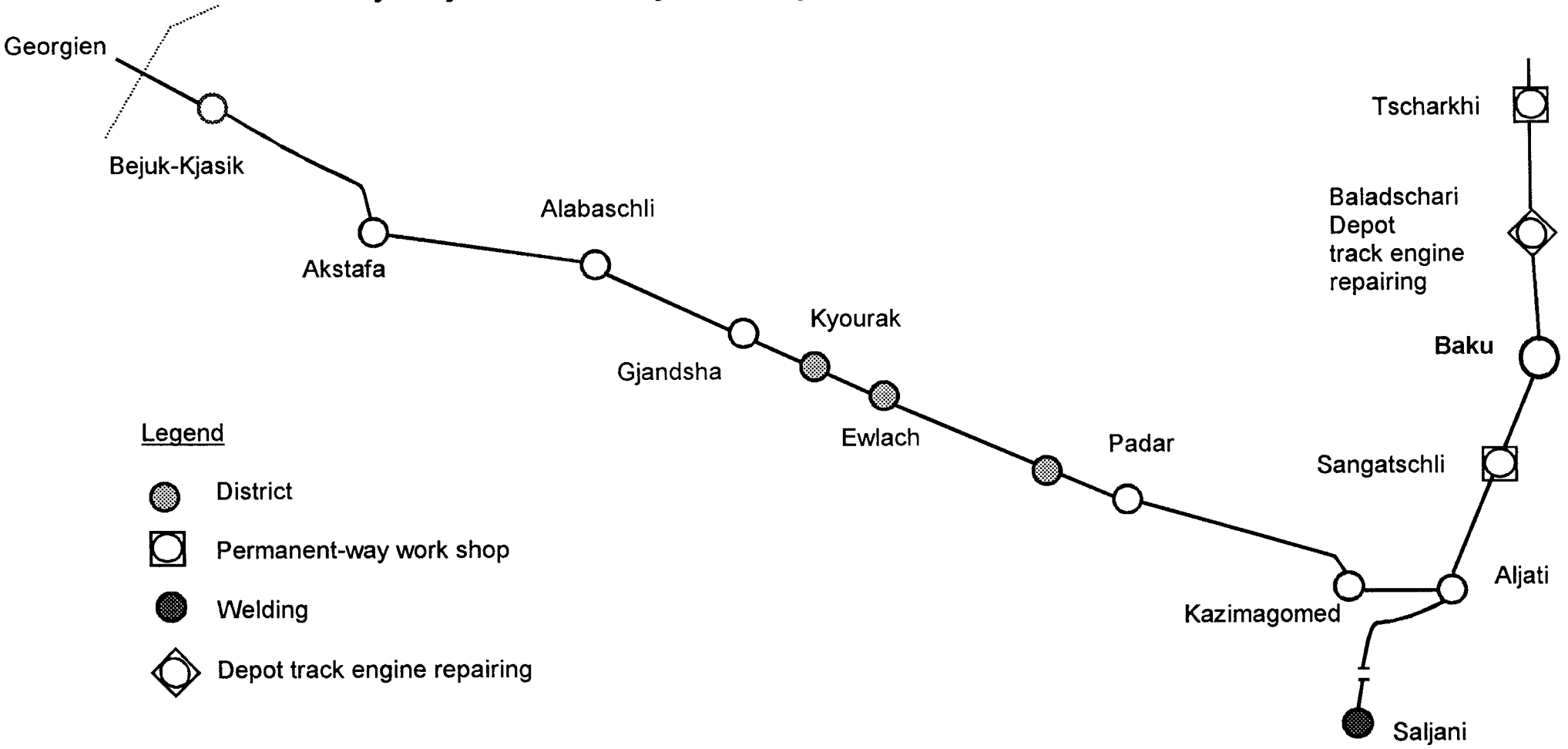
With the procurement of above listed engines and equipment GZD and AZD will be enable to manage the renovation and rehabilitation themselves.

Annexes

annex	2.1	Survey of the track line Baku - Tbilisi
annex	2.2.3	Bridgelist
annex	2.3	Organisation structure of permanent-way general management
annex	2.3a	Organisation structure of district Baku
annex	2.3b	Equipment with small track maintenance machines and tools
annex	2.3.1	Organisation structure of permanent-way workshop Sangatschali
annex	3.2	Inventory of track engines
annex	3.4	Costs for permanent way
annex	3.4.1	Costs for equipment of districts
annex	3.4.2	Costs for bridge renewals
annex	3.4.3	Costs for quarries and future concrete sleeper plant

Track line Baku - Bejuk-Kjasik of Azerbaijan Railways (AZhD)

annex 2.1



item	Definition and short description	Quantity	2000	2005	2010	2015
1	Equipments of districts see cost estimations					
	table page 16 and 17, 11 districts		5,000	5,000		
2	Track engines for permanent - way work shop					
	2 RM 80, ballst cleaning machine, universal application, 1 till 2000,second till 2005 4,380					
	2 Unimat 08-475-4S 2,860					
	completed by spare parts 10% 0,700		7,940	7,940		
	1 high performance ballast regulating machine 1,240 completed by spare parts 0,160=1,400 million$ page 20 +21		1,400	1,400		
3	Draisine for bridge inspection VMT 846 COA		1,170	1,170		
	Rail road loader excavator KGT with accessories	6 units	0670	0,670	0,670	
	Work draisine VMT GR 850	5 units	1,140	1,140	0,570	
	Sleeper positioner PRT-6	2 units	0,910	0,910		
	Hydraulic rail threater	2 units	0,110			
	Total in million $		13,340	10,230	1,240	

item	Definition and short description	Quantity	2000	2005	2010	2015
	Bridges chapter 3.12 - 3.127					
1	Bridge nr. 56 in km 541+500, Baku entrance and exit of main station	1	1,000			
2	Bridge nr. 19+20 in km 157+700	2	0,886			
3	Bridge nr. 10+11 in km 111+200	2	0,954			
4	Bridge nr. 31 in km 234+600	1	0,100			
5	Bridge nr. 33+34 in km 252+800	2		2,950		
6	Bridge nr. 41+42 in km 360+200	2	0,200			
7	Bridge nr. 5 in km 72+300	1			4,545	
	Total in million $		3,140	2,950	4,545	

item	Definition and short description	Quantity	2000	2005	2010	2015
	Costs of constructions and items of equipments					
	to get independence of track material imports.					
1	Quarry equipments as crusher, riddelsystems,					
	pipes, conveyor belts, wash equipment, bulldozers, excavators and trucks and others					
	lump sum		1,000			
2	prestressed concrete sleeper plant in work employments effectuation. Only the important					
	parts for high quality production will be full mechanised. in million $		8.700			
3	Technical equipment for offices and constructions,lump sum		0,500			
	Total in million §		10,200			

item	Definition and short description	Quantity	2000	2005	2010	2015
1	Maintenance permanent way					
	Track line Tbilisi - Baku					
	annex 3.2 ranking list 1 -12 = 116 km					
	price / km = 0,300 million $	116	34,800	30,000	30,000	30,000
2	Track line Baku - Tbilisi					
	annex 3.2 ranking list 1 - 7 = 84 km					
	price / km = 0,300 million $	84	25,200	30,000	30,000	30,000
3	Switches on the main line					
	both directions Baku - Tbilisi and vice-versa					
	price / unit = 0,040 million $	200	8,000	8,000	8.000	8,000
4	Crossing timber sets					
	price / unit 0,010 million $	140	0,700	0,700	0,700	0.700
	Total maintenance permanent way million $		68,700	68,700	68,700	68,700
	Total maintenance permanent way million $		68,700	68,700	68,700	68,700

Annexes

Annex 5.1	Survey Tbilisi - Poti
Annex 5.3	Organisation chart General Management
Annex 5.3a	Organisation chart district Tbilisi
Annex 5.3b	Basic equipment district Tbilisi
Annex 5.3.1	Organisation permanent way work shop Tbilisi
Annex 6.1.2	Bridge list
Annex 6.2	Inventory of track engines
Annex 6.4	Costs for permanent way
Annex 6.4.2	Costs for bridge renewals
Annex 6.4.3	Quarries and futur concrete sleeper requirements

5 Existing situation

5.1 Track line border point AZD - Tbilisi - Senaki - Poti

The investigated line leads in west direction from Tbilisi to Poti and is constructed as a double electrified track line. The double line is several times interupted by single line:

Senaki - Samtredia	14 km
Senaki - Poti	41 km
Brozeula - Rioni	4 km
Sestafoni - Chashuri	18 km

Side track length is 317 km added by 41 km Senaki - Poti, the total length of the investigated line is 358 km.The border station of the track line for GZD is Gardabani. The main line is equiped with 1397 switches, the track is Russian design. Annex 5.1 shows a survey of the main line Tbilisi - Poti and the located permanent - way services.

5.2 Composition of the permanent way.

The most applied track material is supplied by Russian manufactories.

On the main line (the investigated line) the rail profile is R 65 +R 50Kg/m and supported by concrete monobloc sleepers also supplied by Russia.

On the investigated line the rails are posed in length of 250 m welded in a welding plant located at Tbilisi. The 250 m lengths are welded on side to 750 m long welded rails with an interuption section of three lengths from 14 m and four expansion gaps.

The rail quality used in GZD belongs to the self - hardening and heat treated rails and cover a strength range about 800 to 1200 N/mm ^{2}. Self - hardening rails dominate the market and practically all current applications can be covered with these rails.

A distinction can be made between 4 groups:

- rails with 690 N/mm^2 minimum tensile strength corresponding to UIC requirements
- rails with 820 N/mm^2 minimum tensile strength corresponding to ASTM and GOST requirements
- rails with 880 N/mm^2 minimum tensile strength corresponding to the wear resistant qualities and
- rails with 1080 N/mm^2 minimum tensile strength,that have been used to a great extent when high operating loads exist.

Table below provides a survey of the chemical composition of the rail qualities used in GZD.

Mechanical Properties and chemical composition of delivered rails

Type of rail	Delivery condition	name of steel	Chemical composition,content in percent C	Mn	Si	S	P	Tensile strength N/mm2
R75,R65	Gost 8160-63	M76	0,69-0,82	0,75-1,05	0,13-0,28	0,045	0,035	840
R65,chromi-	ChMTU							
ferous	2-64-68	M71	0,65-0,76	0,75-1,05	0,13-0,28	0,045	0,035	900
R65,volume-	ChMTU							
tempered	2-59-68	M72	0,68-0,78	0,75-1,05	0,13-0,28	0,045	0,035	1160
R50	ChMTU							
	6944-63	M75	0,67-0,80	0,75-1,05	0,13-0,28	0,045	0,035	840
R50	ChMTU							
	2-16-67	N865	0,56-0,75	0,60-1,0	0,15-0,30	0,06	0,07	800
R50,volume-	ChMTU							
tempered	2-59-68	M72	0,67-0,77	0,75-1,05	0,13-0,28	0,045	0,035	1160
R50,surface-	STU 71							
tempered	MS-66-62	N865	0,56-0,75	0,60-0,90	0,15-0,30	0,06	0,07	950
R43,R38	GOST							
	4224-54	M71	0,64-0,77	0,60-0,90	0,13-0,28	0,05	0,04	800
Legend:								
C=Carbon,Mn=Mangan,SI=Silicon,S=Sulfur,P=Phosphorous								
Rail Qualities used in AZhD and current applications.			belong to the self-hardening rails that cover practically all					

The density of the posed sleepers in straight line comes to 1,840 sleepers in curves to >1,840 till 2,000, and corresponds to an average sleeper spacing of 0.54 resp. 0.50m. In addition to the concrete sleepers, timber sleepers were also laid. The timber quality is pinewood treated by impregnation. The average lifetime is up to 15 years. The better timber quality in beech or oak is not available or to expensive.

Rail fixing to the concrete sleeper consists of:

-base plate with rigid clip,

-base plate is fastened on the concrete body by an anchoring screw turned a quarter in a chamber.

This kind of rail fastening is not in line with current practise in West Europe and causes the lost of force absorbing assembly by vibration of wheel/rail contact which damage the fixing chambers of the anchorage screw.

Rail fixing to the timber sleeper consists of:

The fastening is realised by spikes with base plate. Also this fastening system is not suitable because the rail/wheel contact vibrations loosen the fixing devices. Knowing these unsuitable rail fastening to the timber sleeper an improvement has been started by additional coach screws, particular in curves.

5.2.1 Switches

As mentioned above there are 1,397 switches on the investigate main line.All of them are connected with the through line.Their geometric form is R65 300 1:11 and correspond with the switches used in Europe.

5.2.2 Level crossings

see Signalling and Telecommuication report.

5.2.3 Bridges and tunnels

GZD's track network is equiped with all kinds of artificial constructions also tunnels. There are 5 tunnels located on the main line, their lengths differ from 50 m to 4,000 m. The tunnels need an increased maintenance and special investigation to check the water outlets in some parts of the tunnels.

The most important bridges are listed in annex 5.2.3 with remarks of minor or major repair or renewal. The present situation of the most bridges is sufficient, however backlog of maintenance is stated. Some bridges are in critical conditions and need major repairs or renewals. The arrangement for their rehabilitation see chapter 6.1.2.

5.2.4 Ballast

The main line is constructed on a 30 to 35 cm ballast bed. The gauge standard is 35/65 mm. At time GZD exploits two quarries, both located near Tbilisi. The broken stone from the Marabda quarry is, as we were able to see, from high quality, the other one extracts only river gravel that is not qualified as ballast although it is used as ballast. The gravel is not broken and, round and not compressable.

Laboratory test results has not been available but it is said that the tests are in hand. The ballast bed on the main line is of the most parts in a very bad condition due to the climatological erosion, sand drifts and traffic pollution (petrol and salt transports). A high percentage of fine granulation fraction containing in the ballast and the before mentioned factors lead to a rapidly pollution, so that the ballast loses its dynamic absorption, elasticity, water permeability, aeration and electrical insulation properties. The ballast can not distribute the wheel load from moving vehicles over the subballast as evenly as possible, as well as providing adequate resistance to both longitudinal displacement and lateral shift.

5.2.5 Subsoil

The subsoil will have required support capability for accepting the static and dynamic forces arrising from train traffic only if its elastic modulus is $E>800kp/cm^2$. This value could not be proved and in most parts of the track line that we saw by our visits, a lot of muddy patch in the ballast have been stated. Fact is that the subsoil has not the required support capability. Subsoil investigation by digging below the surface ore drilling tests and their laboratory analysis are necessairy, so that an improvement of the subsoil can be planned and made when a track renewal is in hand.

5.2.6 Technical layout data and spezification of track geometrie

The evaluation of the longitudinal profil, only main line Tbilisi - Senaki and vice versa resulted in following data:

minimum radius 150 m

maximum super elevation 150 mm,with parabolic transition curves

maximal vertical gradient 29‰

vertical or levelling curves 300 - 3,000 m

distance between centers of lines 4,100 mm

distance between centers of lines in stations 5.30 m

average sleeper spacing 1,840 in curves up to 2,000

permissible speed 100 km/h for passenger trains

permissible speed 80 km/h for freight traffic

gauge 1,520 mm, minimum 1,516 mm,maximum 1,540 mm

The longitudinal profil is drawn in a scale 1:10,000, for length and 1:1,000 resp. 1: 500. Not only the level of the top of the rail a.s.l., the level over ground is also indicated. The maximum high over ground is up to 15 m.

Also indicated are:
The track line with all stations entry distance, exit distance, switches leading in and out of the passing tracks, signal position, level crossings, constructions and special installations like marshalling yard, loading ramps, work shops and others.
The areas on both sides of the track line and its utilisation as agriculture or forestry operation.

5.2.7 Arrears of maintenance and damaging/destruction of assets.

The investigated track from Tbilisi - Senaki is as we found out in lot of parts in desousterous situation. A track inspection from Chashuri -Sestafoni and Tbilisi - Beyuk - Kesik we stated that the actual situation would more than hopeless for a seriously traffic handling. The ballast bed is compact as a concrete slab. The hammer effect wheel/rail contact is reflected instead absorbed, no more elasticity, water permeability and aeration with the unavoidable consequences of destruction of the track assets, damaging concrete sleepers and the lost of rail fastenings. In additional to these facts the load limit of 500 million tons have gone byond what is permissible: The arrears of track maintenance that can be put down to the fact, that GZD is totally dependend on imports for all track materials, exept ballast, from the former Soviet Union. Due to the lack of financial difficulties, GZD is presently unable to order the import of the required track material. Since 1989 the annual track renewal programm of 100 - 150 km had been decreased. The renewal performance in 1996 is planned with 25 km, provided that the financial means for the material are available.
Summarizing the arrears in track renewals are meanwhile nearly 770 km. The table below shows the arrears related to the entire network.

Survey of main track lengths of the districts and urgent track renewals .					
No.	Designation of district	responsible for main track lengths	track passed the load limit of 500 miot per Km	renewals of track in bad condition Km	remarks
1	Suchumi	121.80	0	0	**the tracks in**
2	Otschamtschiri	167.50	0	0	**bad condition**
3*	Samtredia	202.80 (138.00)	58.00 (47.00)	67.50 (65.00)	**means : load limits**
4	Batumi	119.80	50.00	50.50	**>5oo miot/km**
5*	Sestafoni	165.00 (64.00)	51.00 (46.00)	63.50 (21.00)	**rail vertical wear >12mm**
6*	Chashuri	146.70 (140.00)	41.00 (41.00)	43.40 (43.40)	**damaged sleepers/km**
7	Bortschomi	82.30	28.00	36.7	**>600-800/km**
8*	Tbilisi 1	252.90 (212.00)	118.00 (116.00)	122.00 (107.00)	
9*	Tbilisi 2	234.20 (94.00)	89.00 (53.00)	83.90 (24.70)	
10	Gurdshari	186.70	0	145.00	
11	Zalka	160.00	0	149.60	
	main track length	**1,839.70**	**435.00**	**762.10**	
	parts on Tb-Poti line,figures( )	**648.00**	**303.00**	**261.10**	

The table above makes clear that the arrears of renewal backlog is enormous.The investigated line Tbilisi - Poti participates with 648 km on the total of maine lines at GZD. 261 km of 648 km have to be renewed (40,3%) and 303 km have passed the load limit of 500 millio tons/km and have to be also renewed according the valid instructions.

5.3 Analyse track and constructional work maintenance organisation and facilities.

- methodologie and organisation of maintenance

In annex 5.3 an organisation system of the track economics division (general management) is shown and managed by a Chief Engineer. The Chief Engineer organises the administrative work for track maintenance and related services of civil engineering in GZD`s administration building in Tbilisi including the districts and other work-units that are located on the main line.

The tasks of methodical maintenance are to be carried out by 11 districts for the whole network. Fife of them are located on the line Tbilisi-Potii. Responsible on the main line are the districts as follows:

Name of the district	Responsible for km main line	located at km
Samtredia	203	2260
Sestafoni	165	2321
Chashuri	147	2382
Tbilisi 1	253	2507
Tbilisi 2	234	2507

The main tasks of a district are:

-visual control by walking on the side path and routine examination of the main system groups of the track, as rails, fastenings, sleepers and the ballast bed

-irregularities in the track geometrie as alignment, superelevation, square position of the sleepers

-special investigation by order of the chief engineer

-emergency repairs, broken rails.

Corresponding to the instructions the broken rails have to be repaired by changing a standard rail bar of 25/14m. All broken rails have be journalized by given details

about, district, line or station, track number even or uneven, km point, panel number, left or right rail and rail type.The rail damages have to be discribed and must to be written visually in or outside of the damaged rail. An engineering manual gives instructions about all types of rail damages, each type description posesses a code number.

-manually ultrasonic testing carried out by a specialised team in each district performance 5 km/hour, the results are reported.

Additional to the above mentioned track and rail tests, the rails of the entire network are examined ultrasonic and magnetic by inspection coaches owned and operated by the central management at Tbilisi (defectoscop dep). A track measuring coach located at Tbilisi records the geometrical parameters of the entire track - network in regular intervals. The results from the geometrical measuring is assessed by a digital quality coefficient concerning all deficiencies of the geometrical parameters. The classification of the calculated coefficient is, as follows:

-0	-	50	very good, practically after a general track renewal
-51	-	100	good, serveral points in the line are to check
-101	-	500	tendency from moderate to bad, consequently observation till partly renewal, ballast cleaning, sleeper changing and rail fastenings
-		>500	bad, the track needs renewal.

Due to the lack of regular maintenance in the last 7 years, it occurs often that the coefficient appears to four- digit.

The facilities as district office building, workshop, social rooms are very poor and need a consequent planned and executed modernisation. The mobility is broken down by missing all kinds of transport possibilities.

Annex 5.3a shows the organistion of the district Tbilisi, as alternativ for the other 10. The other ones are structured in the same way. Annex 5.3b indicates the basic equipment with small track - maintenance machines and tools to cope with the tasks.

5.3.1 Permanent - way workshop

For major repairs and complete track renewals (general repairs) GZD use two well equiped and staffed permanent - way work shops. They are located at Tbilisi and Samtredia. A chief engineer leads the work shop and he gets his work instruction from the general management at Tbilisi. The work instructions depend on the annual work - programme and in this dimension the track material is stored in the work shops. The available track engines are of russian construction and except of the UK units, which are working very efficient, although a rehabilitation will be necessary, the tamping, -lining and ballast cleaner machine have to be replaced. The UK - system is working with 25 m track panels, which are pre - assembled and loaded on special wagons. The panels are transported to the side. The crane, well known as `platow crane` takes the pre - assembled panels and puts them on the prepared track formation. The special wagons as a couple of two can be loaded with 5 panels, so that a unit of 12 wagons is needed for the transport of 750 m track. The same is needed for the transport of the removed panels. The performance in a possession of 8 hours is said would be 800 m including ballast cleaning, tamping, lining and ballasting.When finished the work , the first 3 train will go with 15 km/h, the next three with 25 km/h and then the permissible speed with 80/100 km/h is permitted. The above mentioned performance had been long time ago, to day with the lack of maintenance caused by missing spare parts and in time changed wear and tear parts, the efficiency is calculated with 50 %.

The staff normaly amounts to 150 people. Annex 5.3.1 shows the organisation structure of the permanent - way work shop Tbilisi.

5.3.2 Welding plant at Tbilisi

The welding plant at Tbilisi is very important for track renewal for the whole network. The welding plant produces standard rail bars of 25 m to 250 m long rails. The transport of them is realised by special wagons without any problems. We could see the loading procedure at our visit of the plant. Only new rails are welded, the reuse of removed rails, sorted and classified for reutilisation to 250 m long welded

reclaimed rails is not practised. The removed rails are reposed without any control in sidings and main lines, when the vertical wear of the rail head is < 12 mm.
The criteria are for the reclamation of removed rails vertical wear from 6 - 8 mm in main lines, >8mm in secondary lines. A second production line could be installed a welding apparatus is available and it is said working too. The welding plant is equiped with two welding train. These are used for welding the long rails of 250 m to 800 m and more by butt - welding system. At time experiments on long welded rails >1000 m are in hand. The welding plant constructed on 6 ha ground has enough space and buildings to extend the effectiveness. At time there are recruited 145 peopel, 25 for stationary welding, 20 workshop production for related services and 100 occupite on the welding trains,

5.3.3 Depot and workshop for track engines repairing.

GZD do not dispose of a depot and workshop for track engines repairing. In the former times the track engines had been repaired in a central depot of former Soviet Union. This possibility cannot more used. Considerations of commoun tasks in view of the Transcaucasian railways between GZD and AZD could find out a common solution with the rehabilitation of the track engines repairing depot in Baku.

5.3.4 Impregnation plant at Gori

The impregnation plant in Gori supplies the whole region with impregnated sleepers and is very important for the GZD and also AZD. The former simple one tank equipment has been extended 1989 by two additional tanks including the construction that has been not yet ready. Each of the tanks takes 250 sleepers per feeding. The daily production amounts to 2000 sleepers. The production can be forced by 2 or three shift / day. The creosote and 70 % of the sleepers are imported from Russia, only 30 % local production. The vacuum system is used and one sleeper takes 8-9 kg creosote. The capacity and productivity will not utilized. The nomal number of staff is 130 at time 30 are employed. The sleeper stock is figured with 30,000.

5.3.5 General management division at Tbilisi.

The general division at Tbilisi leads and has the control of all facilities which are settled on the line and on the administration at Tbilisi. All events that occured on the line and on constructions are collected and journalized. The causes are to discover the actual situation of the track is presented with the consequence that measures are taken to prevent such events as derailments, or other interruptions to train movements. The documents show frank and open the reality of the unsufficient situation of the damages on the track lines which are originate to the lack of maintenance or necessary renewals. The lack of prevention is caused by no means over a lot of years. The most important document is the so called `track pàssport or track C. V. in which all events on the track are shown since the last renewal.

The main facts are: date of last renewal, load comulated in million tons, rail stresses, number of damages on the rails, damaged sleeper per km, ballast pollution and interventions by maintenance measures or small repairs. Each km of the superstructure disclosed by this document can be examined at any time.

The general management division for the superstructure and all related services that is capable to find out and to journalize all important mistakes on track elements with such an exactness, will be also capable to renew and to maintain their track line themselves. Knowledge and scilled staff is available. Its only missing financial means and nearly all kind of equipment.

6 Analysis of weaknesses and limitations

6.1 General

As mentioned above in chapter 5.1 the existing situation of the main track line Tbilisi - Poti and their related component parts has been explained. Chapter 6 will show the damages and bottelnecks of the track line and it is pointed out „what is to do", to eliminate all damages which are in the opposite to a steady flow of traffic.

6.1.1 Switches.

On the main line are installed 1,397 switches,which are all connected from and to the main line. All these connections have to be well maintained and in a good condition. It will be very important that the pilot train or all through trains are passed the stations without speed restriction. This condition is only to realise when the switches has been renewed as the actual situation it demands.

Quantity of switches which are to renew = 400 R 65 300 1: 11

Quantity of crossing timber sets complete = 150 sets

6.1.2 Bridges and tunnels

The most of the bridges on the main line (annex 6.12 ..) are generally in good condition realised by methodic maintenance measures. Allthough there are some bridges which have to be rehabilitated by major repair or renewal. The chapters 6.1.2.1 - 6.1.2.6 below in order of urgency show the bridges which are in need of heavy repair or renewal.

6.1.2.1 The bridge in km 2,289+216

Bridge number 18 of the bridge list, maine line at Lioni. This bridge is costructed in 1896 and needs total renewal. Cost estimation 5.00 million $.

6.1.2.2 The bridge in km 2,324+239

The bridge construction number 27 of the bridge list jeopardized by material fatigue, construction year 1907. The cost estimation is figured with 2.00 million $.

6.1.2.3 The bridge in km 2,404+790

The bridge construction number 56 of the bridge list crossing the Mtkwari on the Chashuri - Tbilisi line needs renewal. Construction year 1896. Cost estimation 2.0 million $.

6.1.2.4 The bridge in km 2,472+759

The bridge number 65 of the bridge list crossing the Mtkwarion the Chashuri - Tbilisi line needs renewal. Construction year 1896. The cost estimation is figured with 2.0 million $.

6.1.2.5 The bridge in km 10+144

The bridge construction number 79 of the bridge list crossing the Lotschino needs a complete renovation. This bridge has been constructed in 1896. The physical deterioration demands the bridge renewal. The cost estimation is figured . Project documents are already prepaired. The cost estimation is figured with 1.0 million $.

6.1.2.6 The bridge in km 31+849

The bridge number 1-4 and 10, 11 and 13 of the bridge list, crossing the Rioni, km 29+700 crossing thee Korathi, km 21+791 crossing the Korathi, km 18+657 crossing the Kurathi, km 2,241+529 crossing the Abasche, km 2,248+179 crossing the Nochela and km 2,255+143 crossing the Zchenisskaro demands renewal of bridge sleepers. The bridge in km 2,248+179 needs also far reaching corrosion protection.

Cost estimation for renewal of bridge sleepers is given with 40,000 $

Cost estimation for corrosion protection 100,000 $.

6.2 Track line rehabilitation

The permanent lack of financial means since 1989 led to the arrears in track renewals and and in scheduled full track maintenance. Annex 6.2 shows the permanent and the temporary speed restriction on the main line. The need to catch up amounts nearly to **700 km**.

To catch up this backlog an extensive and in short-term realized track renewal programme has to be started. Table on page 8 contents the worsest track sections on the main line Tbilisi - Senaki about **261 km**. These sections have to be renewed before the pilot train starts. GZD has no production of any track material except ballast so that all track elements as sleepers, rails and fastenings have to be imported. The quality of GZD`s own ballast production is not sufficient because the quarry - equipment like crusher, riddelsystem and washequipment must be renewed so that the quality will be unobjectionable and the daily output could be raised from to day 300 m^3 to more than 10 000 m^3/day. Within the improvements it would be possible to get the ballast without filler, fine granulation fraction and dust.

GZD is able to do the track maintenance and track renewal themselves, man power and skilled personal are available. However the best personal cannot be efficient when the equipment and track engines are not working and available. Here we have also a lack due to the lack of the financial situationof the last years. Annex 5.3b shows the shortage on small track maintenance machines and tools for all brigades of the districts only. A cost estimation is made to replenish the shortage (see table below).

Nr.	Designation	shortage	price per unit $	total $
1	Tamping units, type GB 4 with Briggs and Stratton engine	75	16,717	.1,253,775
2	Rail saws, type SRN-E with (SRN-E) electrical engine 220/380 V DC, 50 Hz supplement for hydraulical device	50	3,443	172,150 9,830
3	Rail drilling machines, type PR 8-E-2V	50	3,933	196,650
4	Rail grinding machines, type MP 12-E	70	4,033	. 282,310
5	Coachscrewing machines, type T52-E	60	6,097	. 365,820
6	Coachscrewing machines, type TS2 with gasoline engine Bernard 617 supplement for torque limiter	50	6,490 434	324,500 434
7	Track lifting and slewing machines type RV 100 for track 1520 mm	11	39,333	432,663
8	Hydraulic jacks, type CH 65	600	930	558,000
9	Wooden sleeper carring tongues Concrete sleeper carring tongues	400 400	88 106	. 35,200 . 42,400
10	Hand operated rail pullers with chaine	100	1,733	. 173,300
11	Generators, type CR 2500 with Briggs and Stratton gasoline engine	145	847	122,815
12	Generators, type RG 4500 T with			
	Briggs &Stratton gasoline engine			
	mounted on a hand pushed one wheel			
	trolley, power 4 kw /220/380 V/50 Hz	150	1,733	.259,950
13	Signalling lamps, 3 colour lights	860	243	208,980
14	Brigade carriers	45	40,000	.1,800,000
15	Four wheel drive cars	22	30,000	660,000
16	Hammer sleeper spikes	300	32	9,600
17	Slewing bars different kinds	500	30	15,000
18	adjustable wrenches	300	45	13,500
19	wrench sets for track works	560	40	22,400
20	abrasive discs	8,000	12	96,000
21	rail thermometer	50	60	3,000
22	rail pulling rollers	100	180	18,000
23	tamping pick	1,200	35	42,000
24	wooden sleeper drilling machine	60	4,750	285,000
25	ballast forks	1,200	35	42,000
		11	35,800	393,800
	direct costs			7,839,077
	taxes, dispatch, insurance unforseen			2,160,923
	Total in million $			10,000,000

The efficiency of a district is dependent from its equipment. Completed only the shortage of annex 5.3b an amount of 10.000 million $ will be necessary. This sum includes the necessities of all districts.

At first the shortages of the districts on the main line have to be eliminate. Therefore a total of = 5.000 Mio $ will be necessary in short term. In due course an actual shortage list have to be drawn up. With the completed equipment and the possibility of mobilisation by own brigade carriers the scheduled full maintenance on the line is ensured.

The track renewal is planned and executed by staff and equipment of the permanent-way work shop (see chapter 5.3.1). The available track-engines and equipment are causing to their age prone to break down. The break down stoppages during the track renewals are in full progress, force the responsables to improvisations. All improvisations influence the quality of the work and are the first reasons of increased maintenance measures. Annex 6.2.1 shows the inventory of track engines and their actual usability. These track engines are origine from the former Sowjet Union. They are very heavy, old and are no more up to date for modern track renewals and maintenance measures. Instead of expensive repairs of the available engines as VPO 3000 tamping and levelling, R 2000 track liner we recomment to buy new ones. The ballast cleaner Shom has to be replaced by a new modern and productive working ballast cleaner, which is able to clean the ballast to a depth of 1.00 m below top of rail and the guided excavation chain produces an exactly straight subgrade. The new track engines are to understand as a unit consists of: ballast cleaning, tamping and ballast regulating machine. This unit will be needed twice, one in short term, the other medium term. The table below shows the kind of machines and guiding price for required machines. The costs of track renewal in GZD is calculated with 400,000 $.

Item	short description	guiding price per Unit in $
1	RM 80 UHR	
	Ballast cleaning machine for switches,	
	crossings and plain track universal application.	
	length over buffers = 31.80 m	
	excavating width standard = 4.00 m	
	max excavating depth below top rail = 1.00 m	4.38 million
2	Unimat 08-475 4S	
	perfect maintenance of switches and crossings.	
	technical data	
	length over buffers = 33.99 m	
	width = 3.00 m	
	total weigth of machine = 100 t	
	four tamping units	2.86 million
3	High performance ballast regulating machines	
	Technical data:SSP-110 SW	
	length over buffers = 17.45 m	
	width = 3,000 mm	
	weigth = 36 t	1.24 million
	Total	**8.48 million $**

The above listed machines are succesful working in GUS. In order to utilise high performance machine systems properly, it is essential to have a perfect user technology tailored to the specific operating conditions. This user technology has been developed in close cooperation with the railway authorities on the basis of experience in many countries under the most varied climatic, geographic and permanent way conditions. Training programmes, tailored to the operating condition of GZD are available.

6.2.1 Lining of the track between Chashuri and Sestafoni

The critical section of the main line is located between Chashuri and Sestafoni where gradients of 29‰, curves with radii of 150 m -200 m, tunnels and bridges on doubel and singel line appear. GZD planned to improve and to rehabilitate the lining of the singel track sections. An official approval of the planned project had been done and the variant 1 obtained the approuval. Section 1 Sestafoni - Kharagauli km

2,338-2,343 = 5,000 m, section 2 from station Marelisi km 2,347 - 2,352.6 = 5,600 m. The gradients on the planned sections are max 18,5‰, the least radius in section 1 = 600m, in section 2 = 400 m. If the traffic on the Transcaucasian Line increases, the section between Chashuri and Sestafoni will become major importance.
The cost estimation for section 1 amounts = 30.000 million $, for section 2 = 47.000 million $. Project documents are available.

Another important weaknesses are the quarries, vandalized and destroyed of the most important equipments, the quarries are unable to produce the different fractions of grain, specially ballast, or others for prefabricated concrete parts. Full working quarries will be the guarantor of high quality of ballast for the permanent way and all required grain size for the production of prefabricated concrete parts, even prestressed concrete sleepers. An estimation given by the GZD authorities amounts to 1.0 million $.
It includes: new crusher and riddel systems
pipes and conveyor belts, wash equipment to clean the broken stones from dust and filler, bulldozers, excavators and trucks, other materials for the renovation of offices and social rooms, water tank 100m^3 and power station.

The dependence to import all track materials signifies uneasiness. With modern equipped quarries GZD would be able to develop an own prestressed concrete sleeper production, with new, according the European standard sleeper design and fastenings. First investigations show that a full mechanised concrete sleeper plant will cost 12 million $, a partial mechanised 8.7 million $. This prices do not include ground, land development, works hall, necessary infrastructure like roads, works siding, power station and watersupply.

6.2.2 Sleeper Impregnation plant

Although the impregnation plant is well working,threr are some rehabilitation to do. The impregnation hall is to complete and environment protection measures have to be exicuted. Costs are named with 200,000 $.

6.3 Definition of training needs.

Professional skill is the most important requirement in order to achieve quality and high performance in mechanised track works, track renewal and track maintenance. The skill is required in 3 fields.

- railway track

Operation staff of the general management till permanent way inspector. The training contents organisation of track renewal and track maintenance, work programmesfor emergency, short term, medium and long term, time schedule of completion, updating of engineering manuals and instructions, competitive procurement procedure, computerizing of track inventory and constructions.

-Operation of new track engines and

-maintenance of machines.

The training of operating and servicing staff is thus gaining greater importance for succesful and economical operation of the machines. The training programme will help the machine crews to operate the engines in high performance. Objective of the training programme will be to informe and to teach the machine crews to operate the engines for the best results in performance and longevity. The training should be realised by seminars of 4 weeks. The programme contents theoretical and practical parts and visits on sides. Required skill for machine operation, machine crew and members, for machine maintenance service specialist, mechanics and electricians.

6.4 Financial pre - feasebility

The financial pre - feasebility contents all weaknesses and limitations described in chapter 6 and shows the amounts that are unavoidable necessary to rehabilitate the track line Tbilisi - Senaki - Poti. The cost estimations obtain a general view of direct repair costs and the possibilities to achieve the full scheduled maintenance system by new generation of track engines and equipments. The recommended engines and equipments represent the basic equipment. Within GZD is far - reaching independent for an extensive track maintenance and track renewal and conserve the track for long service life. The table below shows the summary of the financial means distributed of the next ten or fifteen years (see annexes 6.4.1 - 6.4.4).

Summary of financial means to rehabilitate the track line Tbilisi -Poti

Designation	2000	2005	2010	2015
Permanent way 200 km in future 40 km /year	61.500 mio.$	60.000 mio $	88.000 mio $	88.000mio $
Equipments of districts and track engines	18.3400 mio.$	18.230 mio.$	1.240 mio.$	
Bridges	12.200 mio.$			
Construction costs	10.800 mio.$			
Total	102.840 mio.$	78.230 mio.$	89.240 mio.$	88.000 mio $

7 Conclusions for the pilot train

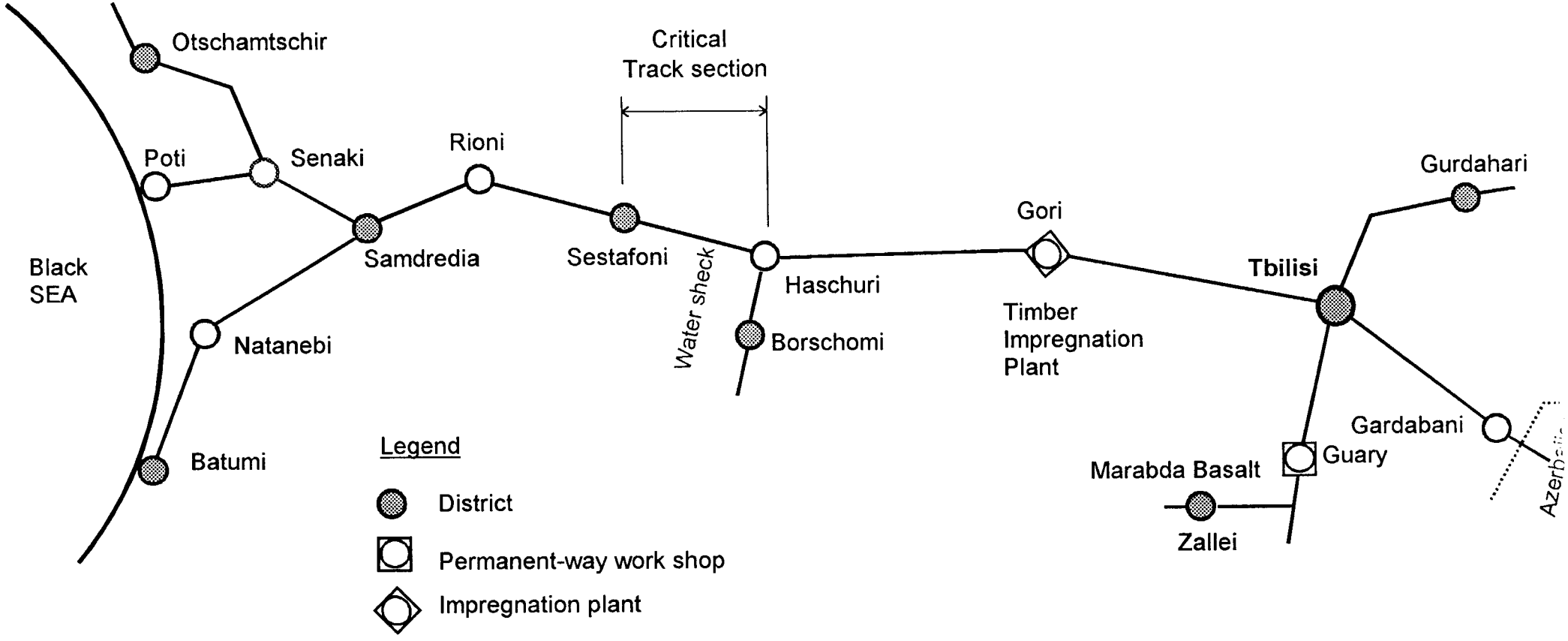
see conclusions report part one „AZD"

Annexes

Annex 5.1	Survey Tbilisi - Poti
Annex 5.3	Organisation chart General Management
Annex 5.3a	Organisation chart district Tbilisi
Annex 5.3b	Basic equipment district Tbilisi
Annex 5.3.1	Organisation permanent way work shop Tbilisi
Annex 6.1.2	Bridge list
Annex 6.2	Inventory of track engines
Annex 6.4	Costs for permanent way
Annex 6.4.2	Costs for bridge renewals
Annex 6.4.3	Quarries and futur concrete sleeper requirements

annex 5.1

Track line Tbilisi - Poti / Batumi of the Georgien Railways (GZD)



item	Definition and short description	Quantity	2000	2005	2010	2015
1	Maintenance permanent way					
	Track line Tbilisi - Senaki - Poti				renewal 40 km /year	renewal 40 km /year
	table on page 8 260 km					
	price / km = 0,400 million $	260	52,000	52,000	80,000	80,000
2	Track line Tbilisi - Poti					
	chapter 6.11 Switches on the main line	400	8,000	8,000	renewal 40 units/year	renewal 40 units/year
	price /unit = 0,040 million $				8,000	8,000
3	crossing timber set					
	price/unit 0,010 million $	150	1,500			
Total maintenance permanent way million $			61,500	60,000	88,000	88,000
	Total maintenance permanent way million $		68,700	68,700	68,700	68,700

item	Definition and short description	Quantity	2000	2005	2010	2015
	Bridges chapter 6.12 - 6.126					
1	Bridge nr. 18 in km 2289+216	1	5,000			
2	Bridge nr. 27 in km 2324+239	1	2,000			
3	Bridge nr. 56 in km 2494+790	1	2,000			
4	Bridge nr. 65 in km 2472+759	1	2,000			
5	Bridge nr. 79 in km 10+144	1	1,000			
6	Bridge nr. 1 -4 and 10,11 and 13	5	0,200			
7	New track lines					
	Section 1 km 2338-2343+section2 2347-2352.6 = 30,00 = 47,000 million $					
	Total in million $		12,200			

item	Definition and short description	Quantity	2000	2005	2010	2015
	Costs of constructions and items of equipments					
	to become independence of track material imports.					
1	Quarry equipments as crusher, riddelsystems,					
	pipes, conveyor belts, wash equipment, bulldozers, excavators and trucks and others					
	lump sum		1,600			
2	prestressed concrete sleeper plant in work employments effectuation. Only the important					
	parts for high quality production will be full mechanised. in million $		8.700			
3	Technical equipment for offices and constructions,lump sum		0,500			
	Total in million $		10,600			

Annex 5.2

Technical pre-feasibility of Rolling stock and workshops

Baku, Tbilisi, Berlin - August 1996

Technical pre-feasibility of the Rolling stock and workshops on both the Azerbaidshan Railways and the Georgian Railways

Technical pre-feasibility of the Rolling stock and workshops on both the Azerbaidshan Railways and the Georgian Railways

1 Introduction

1.1 Project task

Coming from the occured transport situation on the main Transcaucasian railway corridor from the Black Sea to Caspi Sea (Batumi/Poti - Tbilisi - Baku) there were started several projects of technical assistance by the Europian Union (EU) in order to eliminate frequently the constrains exist. One of the projects named „Infrastructure 1 - Railways Pre-investment study and Pilot train Baku - Tbilisi - Batumi - Poti" is of utmost importance because of its basically nature for all the others.

As a first main task among others included in the Pre-investment study the technical situation of the two railway organization in the Transcaucasus, the Azerbaidshan Railway (AZD) and the Georgian Railway (GZD), should be surveyed, the existing technical bottlenecks should be identificated, as well as the volume of repair works should be defined.

In this stream the whole rolling stock and the concerning workshops were investigated. The results found are given in a part one (point 2) for Azerbaidshan and in a part two (point 3) for Georgia.

1.2 Project progress

There were started the first investigations from 20.05.1996 till to 17.06.1996 in Baku and Tbilisi. First talks with railway rolling stock experts took place and first visits were carried out. The first stay was followed by a second one from 22.07.1996 till to 02.08.1996.

The co-operation of the railway authorities on site were very helpfull. For the list of the participated partners of AZD look to annex 1.2.1, of GZD to annex 1.2.2. For the list of visited shops of AZD look to annex 1.2.3, of GZD to annex 1.2.4.

annex 1.2.3

Технические экскурсии АЖД
Technical visits AZD

эксперт по подвижному составу
Expert of rolling stock

Июнь / June 1996

срок date	подвижный состав Rolling stock	
24.05., 10.30	ВРЗ, Баку Tanks repair factory Baku	
29.05., 10.00	ВМПС, Баку Tanks washing factory Baku	
29.05., 12.30	ВЧД, Баку Vagons repair shop Baku	
31.05., 10.00	ТЧ, Баку Locomotive repair shop Baku	

annex 1.2.4

Технические экскурсии ГЖД
Technical visits GZD

эксперт по подвижному составу
Expert of rolling stock

Июнь / Июль 1996
June / July 1996

срок **date**	подвижный состав **Rolling stock**	
07.06., 10.30	ТЧ - 7, Тбилиси Locomotive repair shop Tbilisi	
10.06., 11.30	ВЧД, Тбилиси Vagon repair shop Tbilisi	
11.06., 10.30	ТЭВРЗ, Тбилиси Electrolocomotive repair factory Tbilisi	
12.06., 12.00	ТЧ, Хашури Locomotive repair shop Hashurij	
12.06., 14.30	ВЧД-3, Хашури Vagon repair shop Hashurij	
31.07., 11.00	ТЭС3, Тбилиси, Electrolocomotive Factory Tbilisi	

2 Azerbaidshan Railways

2 Azerbaidshan Railways

2.1 Existing situation

2.1.1 Locomotive stock of AZD

The inventory locomotive stock of AZD amounts to a total volume of 229 electrical engines. This volume is split into 183 VL-8, 43 VL-11M, 1 VL-22 and 2 VL-23. The different types of locomotives and their distribution among the locomotives shops of AZD are shown in annex 2.1.1.1. The age structure of the electrolocos given in annex 2.1.1.2 shows that all VL-8 are older than 30 years while the VL-11 are 5 - 7 years old. The constructions of the types VL-8 and VL-11 are characterized by both outmoded solutions for controlling systems and no using of modern components and elements.

From all 143 electrical locomotives, type VL-10 and VL-11 under operation the part of 94 locos (66%) should be subject to middle repair with lifting (TR-3) for covering the rules of exploatation times of locomotives. 136 VL-8 older than 33 years should be scrapped.

2.1.2 Workshops for locomotives

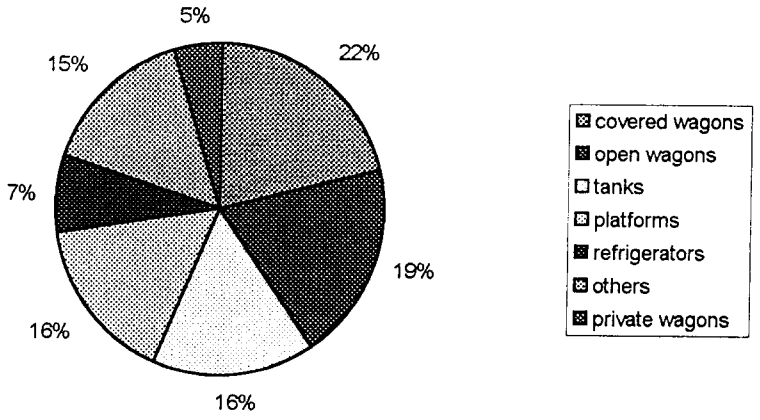
The maintenance system of AZD for locos includes Inspections (TO-1, TO-2, TO-3), Overhauls (TR-1, TR-2, TR-3) and Main repairs (KR-1, KR-2). The periods of these repairs are depending in details on the time under operation respectively on the running kilometres. The different maintenance types are shown in the following overview:

TO-1	daily	-	daily service
TO-2	weekly	-	weekly inspection
TO-3	monthly	11,000 km	monthly inspection
TR-1	after 2 month	22,000 km	first overhaul
TR-2	after 1,5 year	150,000 km	second overhaul
TR-3	after 3 years	300,000 km	overhaul with lifting
KR-1	after 6 years	600,000 km	first main repair
KR-2	after 12 years	1,200,000 km	general repair

From the whole AZD´s stock of 5 locomotive depots only 3 depots are performing maintenance services for the Baku - Poti - Corridor: **Tshd Baladsharij** (121 locomotives), **Tshd Biök Shor** (32 locomotives) and **Tshd Gandja** (76 locomotives). All depots are not equipped with heavy cranes or such lifting installations in order to carry out the „overhaul with lifting" called TR-3. A workshop for the main repair categories KR-1 and KR-2 does not exists. For these reasons 94 locos are waiting to TR-3 while 86 waiting to KR-1 as well as 24 to KR-2.

2.1.3 Wagons stock

The inventory wagon stock of AZD amounts to a total of 30,571 cars, mainly with 2-axle bogies. The distribution into the different types shows the following graphic.



The inventory stock in figures is shown in annex 2.1.3.1.

The age structure of the wagons is not available inside the AZD because of the former centralization of the datas for the whole goods wagons stock in Moscow. Up to now there were not carried out a stock-taking concerning the wagons real technical condition. Independent of this fact the following estimation can be given as a short statement:

- The wagons age is rather high that means more than 20 years with the exeption of covered and some special wagon types for bulk goods and containers.
- In a high amount wooden material is still used for doors, walls, floors and roofs.
- A small amount of bogies is still equipped with sliding bearings for axle-boxes.

2.1.4 Workshops for wagons

The maintenance system of AZD for wagons includes Inspections (TO, OR, TR) and Repairs (DR, KR). For special wagons with unloading or other special equipments the periodic inspection (TR) is more divided in TR-1 and TR-2. The periods of TR-2, DR and KR are depending on the time under operation. These maintenance types are shown in the following overview.

TO	daily inspection in trains
OR	daily inspection and accidental repair outcoupled from trains
TR, TR-1	heavy damages, repair in depots
TR-2	after 3 month, regularly inspection
DR	yearly repair after one or two years in depots
KR	main repair after 10 or 12 years in workshops

From the whole AZD´s stock of 5 wagon repair workshops all 5 workshops are performing services for the Baku - Poti - Corridor: **Vtshd Baladsharij**, **Vtshd Kischli**, **Vtshd Kasi Magomed**, **Vtshd Giandja** and **Vtshd Aliat**. Furthermore there are as main factories **BWRS** - Wagon Repair Factory Baku specialized for tanks repair (KR and heavy repairs) and **BWWSS**- Wagon Washing and Steaming Station Baku for tanks. In May 1996 the repair comprised 693 wagons of annual repair (DR), 1400 wagons of occasionally repair (TR), 40 tanks of main repair (KR), 1440 washed tanks. The details of the actual performanced volume of wagons repair shows the annex 2.1.4.1.

2.1.5 The traction-power-supply system

The whole AZD net is electrifyed by a 3.300 voltage DC-system. The system is served by 57 sub-power stations. A part of 46 stations is serving the main line of the corridor. The supply system is divided into 6 sub-regions. The power is generally taken from the country system with 50 Hz / 3-phase but with different voltage (110/35/10 kV). The sub-power stations are equipped as usual with transformators, rectifiers, fast-action circuit-breakers, accumulators and harmonic traps.

2.2 Bottlenecks of Azerbaidshan Railways rolling stock

2.2.1 Bottlenecks of the locomotives stock

The problems which AZD steadily meet concerning their locomotive stock by daily performing trains, train performances and maintaining the locomotive stock can be focussed on the statistics about damaged locomotives as well as on the list of the equipments needed for the locomotive shops. These problems are relatively smoothed down based on the actual low level of the transport volume.

2.2.1.1 Locomotive stock transport capacity

As the overall AZD stock contents 229 locomotives of different types the actual volume of daily damaged locomotives reached an average of 83 locomotives in May 1996, a part of about 36%, shown in annex 2.1.1.1. For the locomotive types are different concerned by the damages the annex 2.2.1.1 shows the different types damaged. Coming from these facts as the oposite the available stock can be estimate to a level of 146 locomotives - 64%.

The details of the available stock are shown by the table below.

type of locomotive	available in %	number of locomotives
VL-8	59	108
VL-11M	81	35
VL-22	100	1
VL-23	100	2

For the dislocation of the different loco types to certain loco depots on the line from Baku to Bjök-Kasik the daily possible train volume can be estimate as follow.

depot	available number of locos	locos turn round rate	daily available trains
Baladshari	80	0.7	80
Gandsha	48	0.7	48

Because the train operating system is working with a relay method the daily possible train volume is limited by 48 trains per day as the lowest capacity.

2.2.1.2 Locomotive stock maintenance

The general maintenance situation of locos is based on the old fashioned construction and age of the VL-8 type. As already shown before the stock contents 229 locomotives. The different maintenance measures of TO-1 to TR-3 are fullfilled in AZD own locomotive depots. For the absence of a workshop for main categories of repair of locos in Azerbaidshan (KR-1 and KR-2) the AZD do use foreign workshops as in Ukrainia or as in Russia and have to pay for this services with free currency. The price is about 200,000 USD for KR-1 and 300,000 USD for KR-2. Connected with both the delay of spareparts and the lack of money in order to pay for main repair actually only 146 locomotives (64%) are under operation while 83 locomotives are out of order.

From all 43 electrical locomotives of type VL-11 the part of 37 locos (86%) should be subject to overhaul with lifting (TR3) for covering the rules of exploatation times of locomotives.

In order to catch up with the maintaining delay of the locomotive stock there exists a need to carry out the following repairs.

loco type	TR 3	KR-1	KR - 2
VL - 8	57	86	34
VL - 11	37	0	0

Coming from the frequency of the TR-3 with 3 years one of the pressing questions is to create the capacities for TR-3 in order to increase the level of the technical reliability.

Some figures about the actual situation of the technical reliability concerning the locomotive stock to find in annex 2.2.1.1 show that in 77 cases locomotives were going out of order during operation in the 1 - quarter 1996. The main reason were faults of the sliding contacts in 16 cases (21%) followed by insulation ruptures of the armatures in 12 cases (16%). Secondly the different types of armatures are looking as weak points because their part can be assumed with 23 cases (26%).

2.2.2 Bottlenecks of the wagons stock

The problems which AZD steadily meet concerning their wagons stock by daily train operatings, performing loading handlings and maintaining this stock can be focussed on the statistics about damaged wagons, on the list of the equipments needed for the wagons shops, and on the list of needed spare parts.
These problems are relatively smooth down based on the actual low level of the transport volume.

2.2.2.1 Wagons stock transport capacity

As the overall AZD stock contents 29,118 wagons of different types the actual volume of daily damaged wagons reached an average of 18.671 wagons in April 1996, a part of about 61%, shown in annex 2.2.2.1. For the wagon types are different concerned by the damages the annex 2.2.2.2 shows the different types damaged. This overview underlines the general high level of the damaged part of the freight stock because an average of 65% was daily damaged during the last 5 month.

Particularly concerned were covered wagons with 99%, refrigerators with 88% and platforms with 85%.
The other types were daily damaged around the half of their stock. Only the average levels of cereal wagons with 30% and container wagons with 38% were lower.
Coming from these facts as the oposite the available stock can be estimate to a level of 10,217 wagons - 35%. The details of the available stock are shown by the table below.

type of wagon	available in %	number of wagons
covered	1	65
platforms	15	741
open (coal)	53	3,106
tanks	56	2,771
refrigerators	12	274
others	40	1,854
container	62	342
cement	38	317
cereal	70	900

For the different types of freight wagons the actual daily possible freight volume to be loaded can be split as follow.

type of wagon	number of wagons	wagons turn-round rate	daily available wagons	load of wagon in t	daily possible load in t [1]
covered	65	30	2	42	84
platforms	741	14.5	51	50	2,550
open (coal)	3,106	22	141	63	8,883
tanks	2,771	9.6	288	57	16,416
refrigerators	274	11	25	40	1,000
container	342	14.5	24	62	1,488
cement	317	16	20	62	1,240
cereal	900	8	112	42	4,704

The total of the actual daily possible new loading capacity by using the available stock can reach only a level of about 36,400 tons[2]. Coming from the overall available wagons stock 255 trains could be daily operate among them about 30 trains from the daily possible new loading and every train with about 1,213 tons load.

[1] The estimation was carried out by using a loading factor depending on the different wagon types.

[2] This estimation does not consider the so called „other" wagon types, no mentioned in the upper table because under this term is to understand a collection of types with quite different parameters.

This relatively low level of daily new loading capacity based on the available wagon stock reflects the extraordinaire high level of the wagons turn-round rate in the first 7 month of 1996.

2.2.2.2 Wagons stock maintenance

As shown above the wagons stock contents 29,118 units. In order to maintain this stock there exists a need to carry out yearly 12,872 annual repairs (DR) and 2.539 main repairs (KR)[2]. The split of the volume for the different wagon types is shown in the annex 2.2.2.3. For the actual available volume of wagons the needed yearly volume of DR is 3,942 wagons and of KR is 683 wagons.

Learning from the context of these figures with the actual performed repairs it is possible to use the following matrix in order to show the actual maintenance situation.

kind of maintenance	DR	KR
maintenance carried out in May 1996	693	40
actual monthly needed for the available stock	329	57
estimation of capacity	sufficient	not sufficient
monthly needed for the inventory stock	1,073	212
estimation of capacity	not sufficient	not sufficient

So the first pressing problem is the delay of capacities in carrying out the main repair (KR) of all types that is of importance for the maintenance system of all wagon types. With the exception of tanks because the only one existing repair shop is maintaining up to now only tanks in the needed amount.

The second problem is the ocassionally urgent repair of the damaged 18,671 wagons located on all sidings along the main lines. This question is to investigate later together with undertaking the forecast of the future needed wagon stock.

2.2.3 Bottlenecks of the traction-power system

All difficulties of the countries power system concerning the normal and steady delivery of power during the different seasons have a direct influence to the normal function of the railway traction-power system. The AZD does not have special trouble in getting electric power during the whole year.

The standard predict a distance of maximal 60 metres and of 30/35 metres within curves and in sections with steadily blowing wind. Even the steadily blowing wind connected with the bad condition of the locomotives sliding contacts causes a high number of disconnection faults or breakdowns of sliding contact. The wire on the section Kasi-Magomed - Byök-Kasik needs a complete renewing.

2.3 Definition of the volume of repair works

2.3.1 Repair works of the locomotive stock

In order to catch up with the problems the locomotive service did meet during the last few years there exists the need to define the needed locomotive volume followed by investigations how to develope the maintaining capabilities.

2.3.1.1 The future needed locomotive stock

The needed locomotive volume depends on the future needed train service in the corridor that can be defined based on the concerning traffic forecast.

The total railway goods traffic inside Azerbaidshan needs locos in an amount from 25 in 1997 increasing to 87 in 2015. The complete overview is given in annex 2.3.1.1.1.

The goods traffic on the corridor is a part of the total performances. Coming from the forecasted traffic in both relations of the corridor East-West and West-East the daily needed loco volume in the different sections of the corridor will be increase as follows.

	1997	2000	2010	2015
westbound traffic				
Baku - Gandja	20	40	41	46
Gandja - Border	6	28	34	37
eastbound traffic				
Border - Gandja	2	3	5	7
Gandja - Baku	5	7	9	11

An complete overview is given by the annexes 2.3.1.1.2 and 2.3.1.1.3.

The actual loco volume under operation will be sufficient in order to cover the needed services for goods trains in the corridor up to the year 2010.

2.3.1.2 The future maintaining capabilities for locos

The yearly quantitie of different maintaining levels for 12 locos gives as basically figures 70 times TO-3, 63 times TR-1, 4 times TR-2, 1 time KR-1 and 1 time KR-2. As the AZD is possessing 43 VL-11 and 183 VL-8 the needed total amount of the different maintainance kinds should be yearly reach the following volumes.

type	TO-3	TR-1	TR-2	TR-3	KR-1	KR-2
43 VL-11	251	225	14	**7**	**4**	**4**
183 VL-8	1,068	961	20	**10**	**5**	**5**

For covering the yearly demand of KR-1 and KR-2 AZD should further use the traditional way of co-operation with other railway administrations mainly with the neighbouring GZD.

The urgent need would be to organize the return of the repaired locos from the repair shops in Russia and Georgia (2 VL-11 and 2 VL-8) with costs of 1,2 mio USD.

The capabilities for locos maintaining systems inside the AZD should be improved step by step. First of all the loco depot Baladjari is to upgrade by new equipments for lifting the locos in order to carry out the TR-3 repair level on 2 repair places that results in 24 yearly times for covering the needed volume. For this reason there exists the need to procure 16 mechanic lifting jacks type УДП- 160. Going this way AZD can yearly reduce the backlog in TR-3 with 7 locos. The costs for this short term measurement can be estimate with 160,000 USD.

As above shown the traction motor of locos is mainly involved in occasionally damaging cases. So some small equipment is to be needed for the quick repair of this important component as a middle term measurement:

- Inductive warming up device for the gear 10 pieces
- Hydraulic press for the gear - A 170.01.00 - 5 pieces
- Tigthening device for the gear 15 pieces
- Transportable device for pushing through with 12 kW 4 pieces
- Hydraulic jack with 25 tons 10 pieces
- Hydraulic jack with 10 tons 20 pieces.

The costs for procurement these equipments are to estimate with 0.75 mio USD.

Besides the general problems of maintainance equipment the lack of components and spareparts for locos gives high troubles for the normal performances. The needed amount of components and spareparts is listed of in the annexes 2.3.1.2.1 and 2.3.1.2.2. The needed financial volume for both the main components and the spare parts can be estimated with 3.2 mio USD.

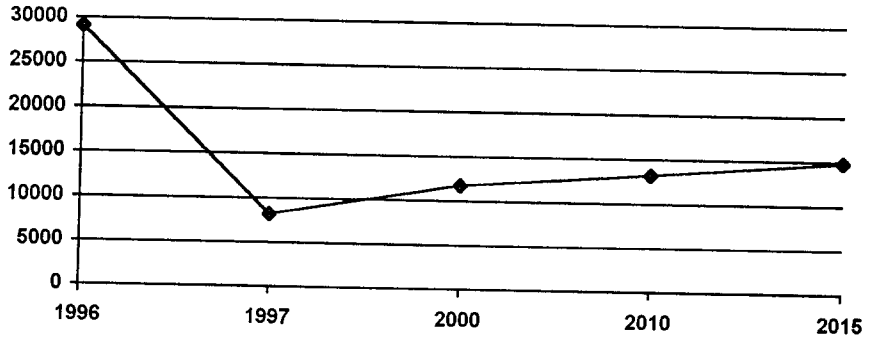
2.3.2 Repair works of the wagon stock

In order to solve the problems the wagon service did meet during the last few years there exists the need to define the needed wagon volume followed by investigations how to develope the maintaining capabilities.

2.3.2.1 The future needed wagon stock

The needed wagon volume depends on the future needed goods train services in the corridor that should be defined based on the concerning traffic forecast. Further the wagons turn-round rate is steadily to short down from the actual level to 8...9 days in 1997, to 6...7 days in 2000 and to 5...6 days after 2010.
So the wagons total volume could be adapt to the following figures.

year	1996	1997	2000	2010	2015
total	29,118	8,243	11,758	13,240	14,831



The data concerning the several wagon types and years are shown in the annexes 2.3.2.1, 2.3.2.1.1, 2.3.2.1.2, 2.3.2.1.3 and 2.3.2.1.4. It should be underlined that this estimation is rather simple because of the rough nature of the traffic forecast.

Coming from these results about the future needed stock the comparison with the existing stock shows the demand to rent or to procure as given in annex 2.3.2.1.5. Following the received figures there is to learn that the tanks stock only should be increased quickly. The demand of covered, platforms and refriges could be covered by increasing the repair rate.

As an urgent need there are to procure 1,000 tanks with costs of about 90 mio USD. For covering the further increasing demand of tanks during the following years the AZD should respectively increase the private tank stock in order to decrease the own costs.

2.3.2.2 The future maintaining capabilities for wagons

In order to organize a normal maitaining system for the wagons stock the respective capabilities are to develop in 3 relation:

- To reestablish the regularly repair capabilities (KR of tanks) as a short term measurement
- To upgrade all existent repair capabilities for occassionally repair (TR) as a short term measurement and depot repair (DR) as a middle term measurement
- To cover the needs of spareparts as a short term and a frequent measurement.

The **Wagon Repairshop Baku** carrying out the KR of tanks should mainly upgraded by reestablish the main assembly hall, create a new colouring cabine, reconstruct the wheelset division and roller-bearings mastery, all accompied by respective procurement of new equipment for riveting, colouring, wheelset reconditioning and checking the roller-bearings. The total for overall capital repair of the repair shop is estimated to 16 mio USD. The costs for delivery an inductive heated stove for rivets are 14,000 USD and a new wheelset lathe 1.2 mio USD.

The **Wagon Depot Baladjari** has an urgent need to purchase a new bridge crane with a breadth of 15,650 mm and a load of 5 tons to a price of about 30,000 USD. The upgrading of the depots along the corridor as well as the refrigarators depot (total 5 depots) as a middle term measurement (first phase) will take an amount of 2.5 mio USD.

The volume of needed spare parts is shown in annex 2.3.2.2.1. The financial volume needed for 1997 is about 2.5 mio USD while the future yearly volume is estimated to about 1.9 mio USD.

2.3.3 Repair works of the traction-power system

The needed repair work can be split into

urgent needed measurement as

- to procure some old equipments went out of order because of there age
- to purchase some auxiliary equipment for checking the line condition and quick repair groups

and middle term measurements as

- to renew the contact wire from Kasi-Magomed to Byök-Kasik in a length of 372 km
- to reconstruct complete some sup-power stations.

The old equipment to be replace is summarizing 6 reducing transformators of 110/35/10 kV, 10 disconnecting switches for high voltage, 20 distributors of 10 kV, 10 rectifiers, 40 feed lines of 3.3 kV, 20 complete accumulator batteries with 0.5 mio USD.

The auxiliary equipment contents 15 draisins of the ADM type, 40 automobiles of GAS-66 type and 6 special research cars. The price can reach 6.2 mio USD.

The advanced wear of 372 km contact wire demands a middle term renewing. Therefore the financial amount of 74.4 mio USD is to be needed.

The price for the complete reconstruction of 15 sub-power stations comprizing 450 mio USD.

2.4 Definition of the training needs

The training needs concerning the AZD`s rolling stock leading personal are originating in the changing demands to the AZD traffic policy that meets the requirements on their clients regarding to quality and punctuality of goods delivery, changing goods structures in the near future.

The basic training need for the upper and middle management should comprize the quality of the operational inspections and of the daily repair work with all types of locomotives and wagons in depots and repairshops.

Annexes

annex 2.1.1.1

Overview of AZD electrical locomotives
Перечень электровозов АЖД
May 1996 г.

Depot Депо	Type of locomotive вид локомотива	amount число			Problems проблемы		
		generally в обще	under operation в експлоатацию	out of order на отстою generally/in the depot/ in the factory	**waiting to rejection**	**waiting to repair TR 3**	**waiting to repair KR1/KR2**
Баладжары Baladsharyj	ВЛ-8 VL-8	86	50	36/26/10 6(JAERS)/4(KRL)	70	24	45/12
Баладжары Baladsharyj	ВЛ - 11М VL-11M	35	30	5/3/2(TEVRS)	2	31	0/0
Бёюк-Щор Bjök-Shor	ВЛ-8 VL-8	30	15	15/14/1(JAERS)	18	13	9/2
Бёюк-Щор Bjök-Shor	ВЛ-23 VL23	2	2	0	2	0	0/2
Гянджа Gjandsha	ВЛ-8 VL-8	67	43	24/20/4 2(JAERS)/1(KRL)/ 1(TEVRS)	48	20	32/10
Гянджа Gjandsha	ВЛ - 11М VL-11M	8	5	3/3/0	0	6	0/0
Гянджа Gjandsha	ВЛ - 22 VL-22	1	1	0	1	0	0/1
Total	**VL-8**	**183**	**108**	**75/60/15**	**136**	**57**	**86/24**
	VL-11M	**43**	**35**	**8/6/2**	**2**	**37**	**0/0**
	VL-22	**1**	**1**	**0**	**1**	**0**	**0/1**
	VL-23	**2**	**2**	**0**	**2**	**0**	**0/2**

JAERS - JaroslavskijElektroRemontnijSavod **TEVRS**- TbiliskijElektroVagonoRemontnijSavod **KRL** - KrasnoLimanLocomotiveDepot

annex 2.1.1.2

Age structure of the AZD-electrolocos - 1996 -

locotype	age	number
VL-8		
	38	6
	37	32
	36	25
	35	29
	34	16
	33	34
	32	27
	31	14
VL-11		
	7	9
	6	28
	5	6

annex 2.1.3.1

Inventory of freight wagons stock of AZD

Парк грузовых вагонов АЖД

May 1996

type of wagon	number
covered wagons	6,453
open wagons	5,860
tanks	4,948
platforms/flats	4,942
refrigerators	2,280
cement	834
cereal	1,285
container	551
others	1,965
Subtotal	**29,118**
private wagons	1453
Total	**30571**

annex 2.1.4.1

Actual performances of AZD wagons repair

May 1996

Factory	Monthly repair of wagons
Baladsharij WTchD - 3	specialisation: tanks and coal wagons **DR: 329+31(private) / TR: 753**
DR:	213 tanks; 14 covered; 16 platforms; 36 coal; 2 cereal; 48 others
TR:	684 tanks; 16 covered; 14 platforms; 21 coal; 18 others
remarks:	a bridge crane is out of order
Kasi Magomed WTchD - 5	specialisation: coal wagons and platforms **DR: 81 / TR: 8**
DR:	63 covered; 15 coal; 3 others
TR:	1 covered; 6 coal; 1 tank
remarks:	
Kischli WTchD - 2	specialisation: containers **DR: 0 / TR: 364**
DR:	0
TR:	58 covered; 2 platforms; 166 coal; 133 tanks; 5 others
remarks:	
Giandja WTchD - 6	specialisation: covered wagons **DR: 213 / TR: 263**
DR:	62 covered; 9 platforms; 98 coals; 4 tanks; 40 others
TR:	18 covered; 27 platforms; 90 coals; 23 tanks; 105 others
remarks:	
Aliat WTchD - 4	specialisation: refrigerators **DR: 70 / TR: 32**
DR:	70 refrigerators
TR:	32 refrigerators
remarks:	
WRS Baku actual performance:	specialisation: tanks **500 tanks per annum**
designed for:	2500 tanks per annum
remarks:	500 wheelsets per annum for other factories
WWSS Baku actual performance:	specialisation: tanks **80 tanks per day**
designed for:	170 tanks per day
remarks:	

DR	Annual Repair
TR	unplanned Repair
WTchD	Wagon Repair Depot
WRS	Wagon Repair Factory
WWSS	Wagon Washing and Steaming Station

annex 2.2.1.1

Occured damages on AZD-electrolocos under operation 1 - quarter 1996

main components	concerned details	cases	per cent
traction motor		**22**	**29**
	insulation ruptures of the armatures	12	
	damaged bearing of the armatures	7	
	damaged bandages of the armatures	2	
	damaged cables	1	
auxiliary engines		**11**	**14**
	insulation ruptures of the armatures of the motor for the compressor	9	
	insulation ruptures of the armatures of the motor for the ventilator	2	
electric equipment		**26**	**34**
	fuse switch	4	
	launching reostat	6	
	broken down the sliding contacts	16	
mechanic components		**8**	**10**
	operating limiting size of the axles bandages	1	
	oil consumption of the train of toothed gears	1	
	wear of the motor bearings	6	
automatic brake		**1**	**1**
	damaged compressors	1	
others		**9**	**12**
Total		**77**	100

annex 2.2.2.1

Daily Damaged Freight Stock of AZD
Неисправные грузовые вагоны АЖД
April 1996 / Апрель 1996 г.

type of wagon вид вагонов	daily damaged в сутке неисправные вагоны	average of the four last month в середине неисправные вагоны по сутке (1)
covered крытие	6,272	6,379
platforms/ платформы	4,305	4,194
coal полувагоны	2,584	2,739
tanks цистерны	2,081	2,200
refrigerators рефрижераторы	611	2,006
others прочие	2,818	2,776
cont-wagons контейнерные	199	208
cement цементовозы	508	521
20´container финтинговы	519	526
cereal зерновозы	728	380
Total	**18,671**	**18,901**

перечен по НОД -1, -2, -3, и в обще и.т.д.

list split into districts 1, 2, 3 and in general

(1) во время последних 5 месяцев

(1) during the last 5 month

annex 2.2.2.2

Comparison of the inventory freight stock with the average of the daily damaged stock of AZD
Сравнение инвентаря грузовых вагонов со средним объёмом неисправних вагонов АЖД

April 1996 / Апрель 1996 г.

type of wagon вид вагонов	inventory volume число вагонов в инвентаре	damaged average of the four last month в середине неисправные вагоны по сутке (1)	part in per-centage доли в про-центах
covered крытие	6,453	6,379	99
platforms/ платформы	4,942	4,194	85
coal полувагоны	5,860	2,739	47
tanks цистерны	4,948	2,200	44
refrigerators рефрижераторы	2,280	2,006	88
others прочие	4,635	2,776	60
cont-wagons контейнерные	551	208	38
cement цементовозы	834	521	62
cereal зерновозы	1,285	380	30
Total	**29,118**	**18,901**	**65**

(1) во время последних 5 месяцев

(1) during the last 5 month

annex 2.2.2.3

Maintenance volume of the freight stock of AZD

Kind of wagon	numbers of inventory	numbers of available	DR-Frist	DR-Volume of inventory	DR-Volume of available stock	KR-Frist	KR-Volume of inventory	KR-Volume of available stock
covered wagons	6,453	65	2	2,904	29	10	645	7
open wagons	5,860	741	1	2,198	278	8	733	93
tanks	4,948	3,106	1	2,024	1,271	11	450	282
platforms/flats	4,942	2,771	1	2,180	1,223	17	291	163
refrigerators	2,280	274	1	2,052	247	10	228	27
cement	834	317	2	379	144	11	76	29
cereal	1,285	900	2	584	409	11	117	82
container	551	342	1	551	342	0	0	0
Subtotal	**27,153**			**12,872**	**3,942**		**2,539**	**683**

annex 2.3.1.1.1

Development of the daily volume of goods trains of the AZD

	wagons type	1997	2000	2010	2015
daily stock	tanks	560	1,092	1,420	1,633
trains		**12**	**24**	**32**	**36**
	platforms	68	127	189	221
trains		**2**	**4**	**5**	**6**
	dumpcars	40	91	122	135
trains		**1**	**2**	**3**	**3**
	open	32	54	86	75
trains		**0.7**	**1.4**	**2**	**2**
	minerals	30	65	116	98
trains		**1**	**2**	**3**	**2**
	cements	10	11	15	16
trains		**0.3**	**0.3**	**0.3**	**0.3**
	cereals	32	35	44	49
trains		**1**	**1**	**1**	**1**
	refrige-rators	13	21	34	41
trains		**0.3**	**0.5**	**1**	**1**
	covered	10	15	25	31
trains		**0.3**	**0.3**	**0.5**	**1**
total forwarding trains		**19**	**35**	**48**	**53**
import goods		894	1,162	1,743	2,265
goods per day		3,548	4,611	6,917	8,988
total of trains with import goods		**4**	**5**	**7**	**9**
transit goods		575	4,024	5,030	6,288
goods per day		2,282	15,968	19,960	24,952
total of trains with transit goods		**2**	**16**	**20**	**25**
daily total of goods trains		**25**	**56**	**75**	**87**

annex 2.3.1.1.2

Development of the daily train volume of the AZD on the Transcaucasian corridor

westbound traffic	1997	2000	2010	2015
trunk line Baku - Gandja				
yearly goods volume in mio tons	5,003	12,245	15,545	17,567
goods per day in tons	19,853	48,591	61,687	69,710
trains per day	**20**	**40**	**41**	**46**
trunk line Gandja - Border				
yearly goods volume in mio tons	1,456	8,505	10,304	11,270
goods per day in tons	5,778	33,750	40,889	44,722
trains per day	**6**	**28**	**34**	**37**

annex 2.3.1.1.3

Development of the daily train volume of the AZD on the Transcaucasian corridor

eastbound traffic	1997	2000	2010	2015
trunk line Border - Gandja				
yearly goods volume in mio tons	589	1,034	1,648	2,074
goods per day in tons	2,337	4,103	6,540	8,230
trains per day	**2**	**3**	**5**	**7**
trunk line Gandja - Baku				
yearly goods volume in mio tons	1,204	2,008	2,849	3,435
goods per day in tons	4,778	7,968	11,306	13,631
trains per day	**5**	**7**	**9**	**11**

annex 2.3.1.2.1

Demand of main components needed for AZD locomotive repair

specification	units	price per unit (USD)	total price (USD)
traction motor HB 406	50	10,000	500,000
motor for the compressor HB 431	50	3,000	150,000
motor for the ventilator HB 430	50	2,500	125,000
wheel sets for VL-8	100	4,000	400,000

annex 2.3.1.2.2

List of urgent needed spareparts for AZD locomotive repair

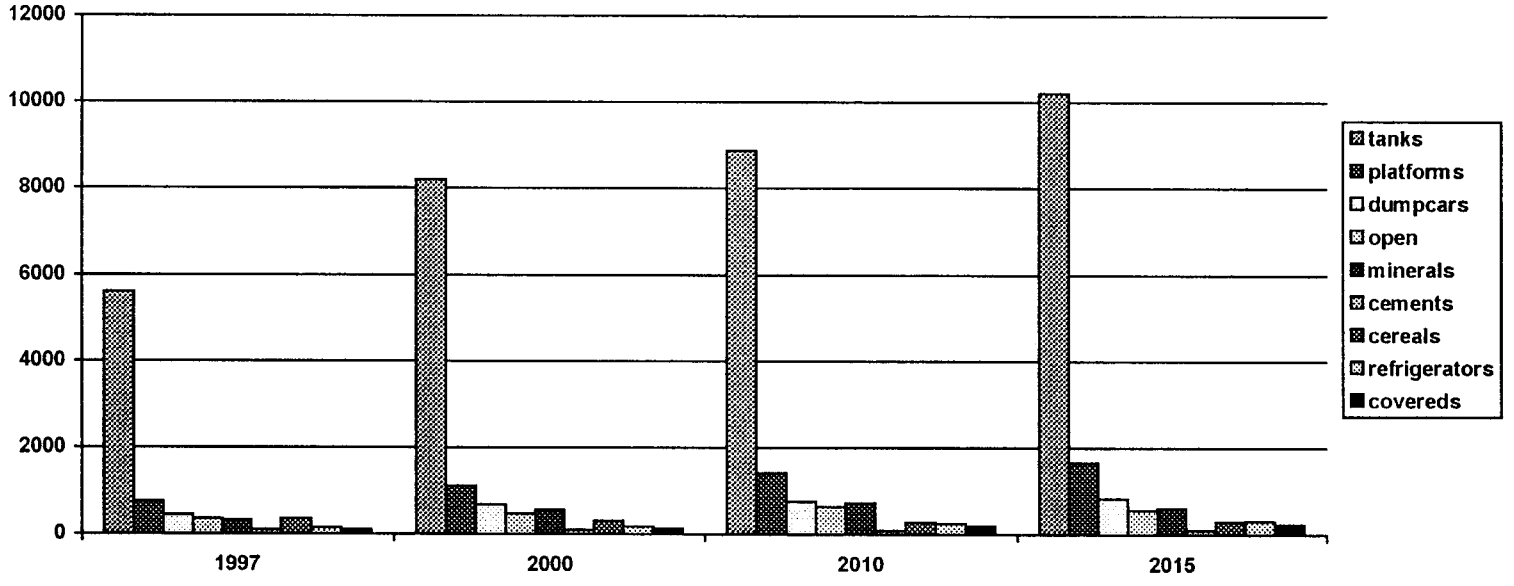
specification	units
brake shoes for locomotives	25,000
brake shoes for wagons	30,000
working cylindres bush	30
bearing shell main- 1,2,3,5,6 rest, 0,1,2,3,4 degree	180
bearing shell main - 4-5 rest, 0,1,2,3,4 degree	40
bearing shell main - 7 rest	40
bearing shell of stick 0,1,2,3,4,6,9 degree	180
piston of the working cylindre	30
sealing	100
blow pipe	50
cleaner for blow pipe	240
cylindre with socket	30
middle bearing shell	20
basic bearing shell	40
disc connecter	800
long cross-beam connector	10
short cross-beam connector	10
cardan GAS-51 vertical	10
cardan GAS-51 horizontal	20
bearing shell MOP under ED118A	30
main bearing shell 4,5,6,7 degree	200
main bearing shell	100
main bearing shell	200
main bearing shell	200
main bearing shell	400
main bearing shell	400
main bearing shell	400

blow pipe	160
neadle cleaner	200
plunger with socket	100
pinion	100
pinion	50
disc connector	600
head of cardan	120
vee belt GOST 1284-68	100
vee belt GOST 1284-68	100
flap	60
flap	60
diaphragma	400
little flap plate	200
big flap plate	200
flap spring	600
carbon brush 2(12,5x32x50) ТЕ-006	1,000
carbon brush 2(12,5x50x52) ЭГТ-200Б	1,600
carbon brush 12,5x44x40	600
carbon brush 12,5x32x64	1,000
carbon brush 2(12,5x32x65,5)	2,000
carbon brush 10x25x40	5,000
carbon brush 2(10x50x60)	16,000
carbon brush 10x25x50	6,000
carbon for sliding contacts type A	10 tons
alcal. accumulators	100 compl.
bearind shell for engin axles	240 compl.
retaining frame for sliding bows compl.	250
conical pipe for sliding contacts	800
sliding contacts	800
profil for contact bar	500
babbit Б - 16	3,000
toothed gear	100
toothed gear	100
quick operating switch БВП - 3А	30

spark quencher chamber	50
elektric oven ПЭТ	200
heating element ТЭН-44	2,000
spark quencher chamber	50
spark quencher chamber	200
spark quencher chamber	50
spark quencher chamber	50
power leadind-in wire СЛ ТЭМ2 (flexible with protection) Typ B-124-2000	150
brush 8x25x50	3,000
brush 16x32x32	2,000
brush 16x32x50	3,000
brush 2(8x50x60)	3,000

annex 2.3.2.1

Development of the needed wagon stock of the AZD 1997 - 2015



annex 2.3.2.1.1

Gross needed wagon stock of AZD

1997

goods			part of load and load per wagon							wagons stock				
kind of goods	total load per year in mio tons	total volume per day in tons	part of load in tons	Factor 1)	type of wagon	utilization in tons		wagons demand for goods		wagons stock needed for loading min	max	turn-round rate	operational needed stock	gross needed stock
						min	max	max	min			d	max	max
										tanks				
oil / нефть	7,342	29,135	29,135	1	tank	52	57	560	511	**511**	**560**	8	**4,482**	**5,603**
building m.	812	3,222	1,289	1	flat	43	50	30	26	**flats**				
			1,933	1	dumpcar	48	55	40	35	**56**	**68**	9	**613**	**766**
iron ore	10	40	16	60	open	51	63	19	15	**dumpcars**				
			24	60	mineral	48	55	30	26	**35**	**40**	9	**363**	**453**
cement	126	500	500	1	cement	52	62	10	8	**open**				
cereal	251	996	996	1	cereal	31	42	32	24	**26**	**32**	9	**287**	**359**
others	548	2,175	650	1	open	49	61	13	11	**minerals**				
			762	1	flat	20	25	38	30	**26**	**30**	9	**268**	**335**
			457	1	refrigerator	35	40	13	11	**cements**				
			305	1	covered	31	42	10	7	**8**	**10**	9	**87**	**108**
										cereal				
										24	**32**	9	**289**	**361**
										refrigerators				
										11	**13**	9	**118**	**147**
										covereds				
										7	**10**	9	**89**	**111**

1) 1=daily
60= every 2 month

annex 2.3.2.1.2

Gross needed wagon stock of AZD

2000

goods			part of load and load per wagon							wagons stock				
kind of goods	total load per year in mio tons	total volume per day in tons	part of load in tons	Factor 1)	type of wagon	utilization in tons		wagons demand for goods		wagons stock needed for loading		turn-round rate	operational needed stock	gross needed stock
						min	max	max	min	min	max	d	max	max
										tanks				
oil / нефть	14,316	56,810	56,810	1	tank	52	57	1,092	997	**997**	**1,092**	6	**6,555**	**8,194**
building m.	1,827	7,250	2,900	1	flat	43	50	67	58	**flats**				
			4,350	1	dumpcar	48	55	91	79	**106**	**127**	7	**891**	**1,114**
iron ore	22	87	35	60	open	51	63	41	33	**dumpcars**				
			52	60	mineral	48	55	65	57	**79**	**91**	6	**544**	**680**
cement	145	575	575	1	cement	52	62	11	9	**open**				
cereal	276	1,095	1,095	1	cereal	31	42	35	26	**44**	**54**	7	**380**	**476**
others	767	3,044	650	1	open	49	61	13	11	**minerals**				
			1,197	1	flat	20	25	60	48	**57**	**65**	7	**458**	**573**
			718	1	refrigerator	35	40	21	18	**cements**				
			479	1	covered	31	42	15	11	**9**	**11**	7	**77**	**97**
										cereal				
										26	**35**	7	**247**	**309**
										refrigerators				
										18	**21**	7	**144**	**180**
										covereds				
										11	**15**	7	**108**	**135**

1) 1 = daily
60 = every 2 month

annex 2.3.2.1.3

Gross needed wagon stock of AZD

2010

goods			part of load and load per wagon							wagons stock				
kind of goods	total load per year in mio tons	total volume per day in tons	part of load in tons	Factor 1)	type of wagon	utilization in tons		wagons demand for goods		wagons stock needed for loading min	max	turn-round rate	operational needed stock	gross needed stock
						min	max	max	min			d	max	max
										tanks				
oil / нефть	18,611	73,853	73,853	1	tank	52	57	1,420	1,296	**1,296**	**1,420**	5	**7,101**	**8,877**
										flats				
building	2,466	9,786	3,914	1	flat	43	50	91	78					
	30		5,871	1	dumpcar	48	55	122	107	**157**	**189**	6	**1,133**	**1,417**
iron ore	39	155	62	60	open	51	63	73	59	**dumpcars**				
			93	60	mineral	48	55	116	101	**107**	**122**	5	**612**	**765**
cement	195	774	774	1	cement	52	62	15	12	**open**				
cereal	345	1,369	1,369	1	cereal	31	42	44	33	**70**	**86**	6	**517**	**646**
others	1,150	4,563	650	1	open	49	61	13	11	**minerals**				
			1,957	1	flat	20	25	98	78	**101**	**116**	5	**580**	**725**
			1,174	1	refrigerator	35	40	34	29	**cements**				
			783	1	covered	31	42	25	19	**12**	**15**	5	**74**	**93**
										cereal				
										33	**44**	5	**221**	**276**
										refrigerators				
										29	**34**	6	**201**	**252**
										covereds				
										19	**25**	6	**151**	**189**

1) 1 = daily
60 = every 2 month

annex 2.3.2.1.4

Gross needed wagon stock of AZD

2015

goods			part of load and load per wagon							wagons stock				
kind of goods	total load per year in mio tons	total volume per day in tons	part of load in tons	Factor 1)	type of wagon	utilization in tons		wagons demand for goods		wagons stock needed for loading min	max	turn-round rate	operational needed stock	gross needed stock
						min	max	max	min			d	max	max
										tanks				
oil / нефть	21,402	84,929	84,929	1	tank	52	57	1,633	1,490	1,490	1,633	5	8,166	10,208
building m.	2,713	10,766	4,306	1	flat	43	50	100	86	flats				
			6,460	1	dumpcar	48	55	135	117	183	221	6	1,325	1,656
iron ore	33	131	52	60	open	51	63	62	50	dumpcars				
			79	60	mineral	48	55	98	86	117	135	5	673	841
cement	215	853	853	1	cement	52	62	16	14	open				
cereal	379	1,504	1,504	1	cereal	31	42	49	36	61	75	6	449	562
others	1,380	5,476	650	1	open	49	61	13	11	minerals				
			2,413	1	flat	20	25	121	97	86	98	5	491	614
			1,448	1	refrigerator	35	40	41	36	cements				
			965	1	covered	31	42	31	23	14	16	5	82	103
										cereal				
										36	49	5	243	303
										refrigerators				
										36	41	6	248	310
										covereds				
										23	31	6	187	234

1) 1 = daily
60 = every 2 month

annex 2.3.2.1.5

AZD - Freight wagon stock available and demand

1997

type	inventory	available in %	available in wagons	needed in 1997	need to repair	demand to rent or to procure
covered	6,453	1	65	111	***46***	
platforms	4,942	15	741	766	***25***	
open	5,860	53	3,106	359	-2,747	
tanks	4,948	56	2,771	5,603	***2,177***	***3,426***
refriges	2,280	12	274	147	-127	
cements	834	38	317	108	-209	
cereals	1,285	70	900	361	-539	
others	4,635	40	1,854	788	-1,066	

2000

type	inventory	available in %	available in wagons	needed in 2000	need to repair	demand to rent or to procure
covered	6,453	1	65	135	***70***	
platforms	4,942	15	741	1,114	***373***	
open	5,860	53	3,106	476	-2,630	
tanks	4,948	56	2,771	8,194	***2,177***	***6,017***
refriges	2,280	12	274	180	-94	
cements	834	38	317	97	-220	
cereals	1,285	70	900	309	-591	
others	4,635	40	1,854	1,253	-601	

2010

type	inventory	available in %	available in wagons	needed in 2010	need to repair	demand to rent or to procure
covered	6,453	1	65	189	***124***	
platforms	4,942	15	741	1,417	***676***	
open	5,860	53	3,106	646	-2,460	
tanks	4,948	56	2,771	8,877	***2,177***	***6,700***
refriges	2,280	12	274	252	-22	
cements	834	38	317	93	-224	
cereals	1,285	70	900	276	-624	
others	4,635	40	1,854	1,490	-364	

2015

type	inventory	available in %	available in wagons	needed in 2015	need to repair	demand to rent or to procure
covered	6,453	1	65	234	***169***	
platforms	4,942	15	741	1,656	***915***	
open	5,860	53	3,106	562	-2,544	
tanks	4,948	56	2,771	10,208	***2,177***	***8,031***
refriges	2,280	12	274	310	***36***	
cements	834	38	317	103	-214	
cereals	1,285	70	900	303	-597	
others	4,635	40	1,854	1,455	-399	

3 Georgian Railways

3 Georgien Railways

3.1 Existing situation

3.1.1 The Locomotive stock of GZD

The inventory locomotive stock of GZD amounts to a total volume of 230.5 electrical engins. This volume is split into 85 VL-8, 103 VL-10 and 42.5 VL-11. The different types of locomotives and their distribution among the locomotive shops (depots) of GZD are shown in annex 3.1.1.1[1]. The age structure of the electrolocos given in annex 3.1.1.2 shows that all VL-8 are older than 29 years, VL-10 from 29 to 22 years old, VL-10^y 13 .. 15 years and VL-11 6 to 16 years old. The constructions of all types are characterized by both outmoded solutions for controlling systems and no using of modern components and elements.

Connected with both the delay of spareparts and the lack of money in order to pay for main repair actually only 76 locomotives (33%) are under operation. 154.5 locomotives are out of order.

From all 83.5 electrical locomotives, type VL-10 and VL-11 under Operation as well as waiting to repair the part of 68.5 locos (82%) should be subject to main repair (KR-1, KR-2) for covering the rules of exploatation times of locomotives.

31 VL-8 older than 34 years should be scrapped.

3.1.2 Workshops for locomotives

The maintenance system of GZD for locos includes Inspections (TO-1, TO-2, TO-3), Overhauls (TR-1, TR-2, TR-3) and Main repairs (KR-1, KR-2).

The periods of these Repairs are depending in details on the time under operation respectively on the running kilometres.

[1] All locomotives are combined of 2 sections. Therefore one section will be acounted as 0.5 locomotive.

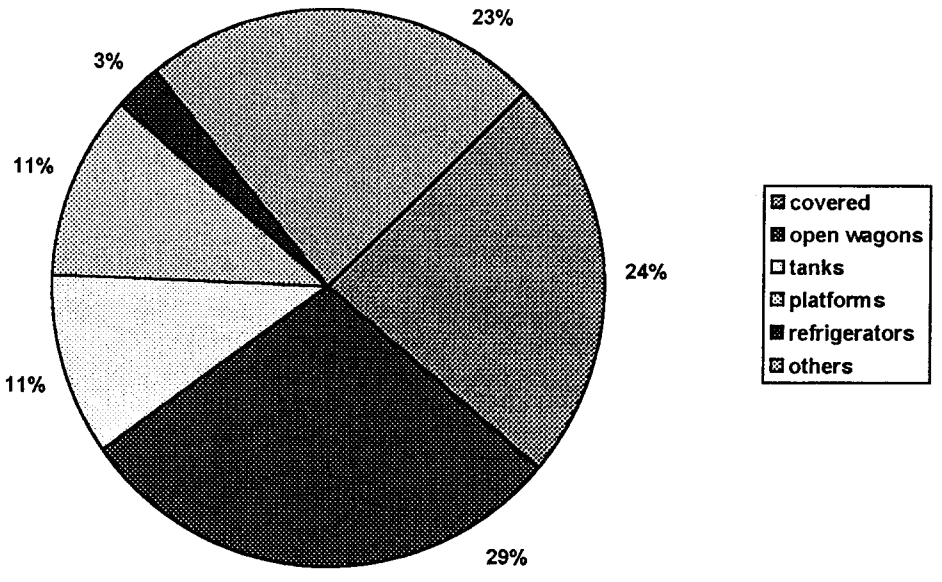
The different maintenance types are shown in the following overview:

TO-1	daily	-	daily service
TO-2	weekly	-	weekly inspection
TO-3	monthly	11,000 km	monthly inspection
TR-1	after 2 month	22,000 km	first overhaul
TR-2	after 1,5 year	15,.000 km	second overhaul
TR-3	after 3 years	300,000 km	overhaul with lifting
KR-1	after 6 years	600,000 km	first main repair
KR-2	after 12 years	1,200,000 km	general repair

From the whole GZD´s stock of 6 locomotive depots only 3 workshops are performing services for the Baki - Poti Corridor: **TshD Tbilisi-Sortir** (62 locomotives, **TshD Hashurji** (65.5 locomotives) and **TshD Samtredia** (54 locomotives). Furthermore there are two large locomotive factories in Tbilisi:
TEVRS - the Electro-Vagon-Repair Factory of Tbilisi and
TƏVS - the Electro-Locomotive Construction Factory of Tbilisi.

3.1.3 Wagons stock

The inventory stock of GZD amounts to a total of 21,095 cars. The distribution into the different types shows the following graphic:



The intory stock is shown in annex 3.1.3.1.

The age structure of the wagons is not available inside the GZD because of the former centralization of the datas for the whole goods wagons stock in Moscow. Up to now there were not carried out a stock-taking concerning the wagons real technical condition. Independent of this fact the following estimation can be given as a short statement:

- The wagons age is rather high that means more than 20 years with the exeption of covered and some special wagon types for bulk goods and containers.
- In a high amount wooden material is still used for doors, walls, floors and roofs.
- A small amount of bogies is still equipped with sliding bearings for axle-boxes.

3.1.4 Workshops for wagons of Georgien Railways

The maintenance system of GZD for wagons includes Inspections (TO, OR, TR) and Repairs (DR, KR). For special wagons with unloading or other special equipments the periodic inspection (TR) is more divided into TR-1 and TR-2. The periods of TR-2, DR and KR are depending on the time under operation. These maintenance types are shown in the following overview.

TO	daily inspection in trains
OR	daily inspection and accidental repair outcoupled from trains
TR, TR-1	heavy damages, repair in depots
TR-2	after 3 month, regularly inspection
DR	yearly repair after one or two years in depots
KR	main repair after 10 or 12 years in workshops

From the whole GZD´s stock of 4 wagon repair workshops (depots) only 3 depots are performing services for the Baku - Poti - Corridor: **Vtshd Samtredia**, **Vtshd Hashurji**, and **Vtshd Tbilisi**. In May 1996 the repair comprized 401 wagons of annual repair (DR), 481 wagons of occasionally repair (TR). The details of the actual performanced volume of wagons repair shows the annex 3.1.4.1.

3.1.5 The traction-power-supply system

The whole GZD net is electrifyed by a3.300 voltage DC-system. From an overall net of 2,875.9 km under wire about 1,599.1 km are on the operational lines. The system is served by 75 sub-power stations but 15 of them are situated in Abchasia. From the rest of 60 power stations a part of 35 stations is serving the main line of the corridor. The supply system is divided into 7 sub-regoins. The power is generally taken from the country system with 50 Hz / 3-phase but with different voltage (110 kV, 35 kV, 10 kV and 6 kV). The sub-power stations are equipped as usual with transformators, rectifiers, fast-action circuit breakers, accumulators and harmonic traps.

3.2 Bottlenecks of Georgian Railways rolling stock

3.2.1 Bottlenecks of the locomotives stock

The problems which GZD steadily meet concerning their locomotive stock by daily performing trains, train performances and maintaining the locomotive stock can be focussed in the statistics about damaged locomotives as well as in the list of the equipments needed for the locomotive shops. These problems are relatively smoothed down based on the actual low level of the transport volume.

3.2.1.1 Locomotive stock transport capacity

As the overall GZD stock contents 230.5 locomotives of different types the actual volume of daily damaged locomotives reached an average of 154.5 locomotives in May 1996, a part of about 67%, shown in annex 3.1.1.1. For the locomotive types are different concerned by the damages the annex 3.2.1.1 shows the different components damaged. Coming from these facts as the oposite the available stock can be estimate to a level of 76 locomotives - 33%.

The details of the available stock are shown by the table below.

type of locomotive	available in %	number of locomotives
VL-8	59	37
VL-10	81	24
VL-11	100	15

For the dislocation of the different loco types to certain loco depots on the line from the Azerbaidshan border to Poti the daily possible train volume can be estimate as follow.

depot	available number of locos	locos turn round rate	daily available trains
Tbilisi	20	0.7	20
Chashurji	14	0.7	14
Samtredia	15	0.7	15

Because the train operating system is working with a relay method the daily possible train volume is limited by 14 trains per day as the lowest capacity.

3.2.1.2 Locomotive stock maintenance

The general maintenance situation of locos is based on the old fashioned construction and age of the VL-8 type. As already shown before the stock contents 230,5 locomotives. The different maintenance measures of TO-1 to TR-3 are fullfilled in GZD own locomotive depots. For maintenance steps KR-1 and KR-2 the GZD do use the workshops in Tbilisi. Connected with both the delay of spareparts and the lack of equipment in the depots as a follow of the civil war only 76 locomotives (33%) are under operation while 154.5 locomotives are out of order.

From all 85 electrical locomotives of type VL-8 the part of 15 locos and 103 VL-10 a part of 16 locos should be subject to overhaul with lifting (TR3) for covering the rules of exploatation times of locomotives.

In order to catch up with the maintaining delay of the locomotive stock there exists a need to carry out the following repairs.

loco type	TR 3	KR-1
VL - 8	15	1
VL-10	16	1
VL - 11	3	24.5

Coming from the frequency of the TR-3 with 3 years one of the pressing questions is to create the capacities for TR-3 inside the depots in order to increase the level of the technical reliability.

Some figures about the actual situation of the technical reliability concerning the locomotive stock to find in annex 3.2.1.1 show that in 408 cases locomotives were going out of order during operation in the 1 - half of 1996. The main reason were faults of the electrical equipments in 112 cases (27%) followed by mechanical components in 106 cases (26%).

3.2.2 Bottlenecks of the wagons stock

The problems which GZD steadily meet concerning their wagon stock by daily performing train operations and maintaining this stock can be focussed in the statistics about damaged wagons, in the list of the equipments needed for the wagons shops, and in the list of needed spare parts.

2.2.2.1 Wagons stock transport capacity

As the overall GZD stock contents 21,095 wagons of different types the actual volume of daily damaged wagons reached an average of 16.449 wagons in June 1996, a part of about 77%, shown in annex 3.2.2.1. For the wagon types are different concerned by the damages the annex 3.2.2.2 shows the different types damaged. Besides the general high level of the damaged freight stock the part of several types is rather higher as of the covered stock an average of 87% and of the platforms 86% were daily damaged.

Coming from these facts as the oposite the available stock can be estimate to a level of 4,646 wagons - 23%. The details of the available stock are shown by the table below.

type of wagon	available in %	number of wagons
covered	12.4	610
platforms	13.8	319
open (coal)	18.2	1,108
tanks	46	1,032
refrigerators	19.1	105
others	19.3	366
container	19.8	87
cement	13	125
cereal	53.9	912

For the different types of freight wagons the actual daily possible freight volume to be loaded can be split as follow.

type of wagon	number of wagons	wagons turn-round rate	daily available wagons	load of wagon in t	daily possible load in t [2]
covered	610	30	20	42	840
platforms	319	14.5	22	50	1,100
open (coal)	1,108	22	50	56	2,800
tanks	1,032	9.6	107	62	6,634
refrigerators	105	11	9	28	252
container	87	14.5	6	60	369
cement	125	16	8	63	504
cereal	912	8	114	60	6,840

The total of the actual daily possible new loading capacity by using the available stock can reach only a level of about 19,400 tons[3]. Coming from the overall available wagons stock 143 trains could be daily operate among them about 11 trains from the daily possible new loading and every train with about 1,763 tons load.
This relatively low level of daily new loading capacity based on the available wagon stock reflects the extraordinaire high level of the wagons turn-round rate in the first 7 month of 1996.

3.2.2.2 Wagons stock maintenance

As shown above the wagons stock contents 21,095 units. In order to maintain this stock there exists a need to carry out yearly 8,594 annual repairs (DR) and 1,815 main repairs (KR)[4]. The split of the volume for the different wagon types is shown in the annex 3.2.2.3. For the actual available volume of wagons the needed yearly volume of DR is 1,893 wagons and of KR is 403 wagons.
Learning from the context of these figures with the actual performed repairs it is possible to use the following matrix in order to show the actual maintenance situation.

[2] The estimation was carried out by using a loading factor depending on the different wagon types.

[3] This estimation does not consider the so called „other" wagon types, no mentioned in the upper table because under this term is to understand a collection of types with quite different parameters.

[4] Here are not considered the so called „other" wagon types as mentioned above.

kind of maintenance	DR	KR
maintenance carried out in May 1996	401	0
actual monthly needed for the available stock	157	34
estimation of capacity	sufficient	not sufficient
monthly needed for the inventory stock	716	151
estimation of capacity	not sufficient	not sufficient

So the first pressing problem is the delay of capacities in carrying out the main repair (KR) of all types that is of importance for the maintenance system of all wagon types. The second problem is the ocassionally urgent repair of the damaged 16,449 wagons located on all sidings along the main lines. This question is to investigate later together with undertaking the forecast of the future needed wagon stock.

3.2.3 Bottlenecks of the traction-power system

All difficulties of the countries power system concerning the normal and steady delivery of power mainly during the winter month have a direct influence to the normal function of the railway traction-power system. Coming from this context the GZD were not able to work normally by electrical power during the last winter time. As a first aid the World Food Programme rented for GZD 10 Diesel locomotives from Russia in order to organize the food help to Armenia. The price for renting one diesel-loco unit was 200 USD per day.

The next problem is the stolen equipment during the last civil war by criminal elements.

Further there are mainly problems of the maintenance as the first sections of the traction-power system are working since 1932. One problem is that the old standard of the line construction with a distance of 70/75 metres between the pylons of the contact line is still existing on several line sections, although the new standard predict a distance of maximal 50 metres and of 30/35 metres within curves and in sections with steadily blowing wind. This causes a high number of disconnection faults or breakdowns of sliding contact.

3.3 Definition of the volume of repair works

3.3.1 Repair works of the locomotive stock

In order to catch up with the problems the locomotive service did meet during the last few years there exists the need to define the needed locomotive volume followed by investigations how to develope the maintaining capabilities.

3.3.1.1 The future needed locomotive stock

The needed locomotive volume depends on the future needed train service in the corridor that can be defined based on the concerning traffic forecast.

The total railway goods traffic inside Georgia needs locos in an amount from 21 in 1997 increasing to 106 in 2015. The complete overview is given in annex 3.3.1.1.1.

The goods traffic on the corridor is a part of the total performances. Coming from the forecasted traffic in both relations of the corridor East-West and West-East the daily needed loco volume in the different sections of the corridor will be increase as follows.

	1997	2000	2010	2015
westbound traffic				
Border - Tbilisi	6	28	34	37
Tbilisi - Samtredia	9	31	37	41
Samtredia - Batumi	6	23	28	31
Samtredia - Poti	3	7	9	10
eastbound traffic				
Poti - Samtredia	5	5	6	7
Batumi - Samtredia	3	3	4	5
Samtredia - Tbilisi	8	8	11	12
Tbilisi - Border	2	3	5	7

An complete overview is given by the annexes 3.3.1.1.2 and 3.3.1.1.3.

The actual loco volume under operation will be sufficient in order to cover the needed services for goods trains in the corridor up to the year 1997. Up to 2000 the available loco stock should smoothly doubled to 100 locos with the split 40 in Tbilisi, 30 in Chashurji and 30 in Samtredia. The complete overview of the future needed loco stock for the corridor shows the following table.

	1997 **available/ inventory**	2000 **available/ inventory**	2010 **available/ inventory**	2015 **available/ inventory**
Tbilisi	20/24	40/48	45/54	50/60
Hashurji	14/17	30/36	35/42	40/48
Samtredia	15/18	30/36	35/42	40/48

3.3.1.2 The future maintaining capabilities for locos

The yearly quantitie of different maintaining levels for 12 locos gives as basically figures 70 times TO-3, 63 times TR-1, 4 times TR-2, 1 time KR-1 and 1 time KR-2. As the GZD is possessing 42.5 VL-11, 103 VL-10 and 85 VL-8 the needed total amount of the different maintainance kinds should be yearly reach the following volumes.

type	TO-3	TR-1	TR-2	TR-3	KR-1	KR-2
42.5 VL-11	251	225	14	**7**	**4**	**4**
103 VL - 10	602	540	34	**17**	**10**	**10**
85 VL-8	502	450	24	**14**	**8**	**8**

For covering the yearly demand of KR-1 and KR-2 GZD should further use the traditional way of co-operation with the factories in Georgia, the **Tbilisi Electro-locomotive Construction Factory** and the **Tbilisi Electrowagon Repair Factory.** The main direction of the maintenance policy should be to develop a repair /maintenance division inside the **Tbilisi Electrowagon Repair Factory.** This repair division of the factory could start into operation step by step. First by a shop for repairing locomotive wheelsets and a traction motors division as urgent measurements with costs of about 10 mio USD.

Second followed by a shop for repairing the other important electric components as a middle term measurement with estimated costs of about 5 mio USD.

The capabilities for locos maintaining systems inside the traditional GZD depot-system should be developed by improving steps within short and middle terms too. First of all the **loco depot Hashurji** is to upgrade

- by new equipments for controlling the wheel lathe
- by a flange welding machine

in order to carry out repair of locomotive wheel sets.

Following equipment is to be needed for the quick repair of this important component:

-	new equipments for controlling the wheel lathe Ksh-1836 for the Hashurji depot	1 pieces	20,000 USD
-	flange welding machine for the Hashurji depot	1 pieces	100,000 USD
-	wheelset lift	2 pieces	40,000 USD.

The total amounts to 160,000 USD.

Besides the general problem of maintainance equipment the lack of equipments and spareparts for locos gives high troubles for the normal performances. The needed amount of equipments for the loco depots and spareparts is listed of in the annexes 3.3.1.2.1 and 3.3.1.2.2. Following these figures the urgent financial demand for procuring the needed equipments is to estimate with about 0.8 mio USD.

The financial volume needed for the urgent repair of locos is estimated with about 2 mio USD.

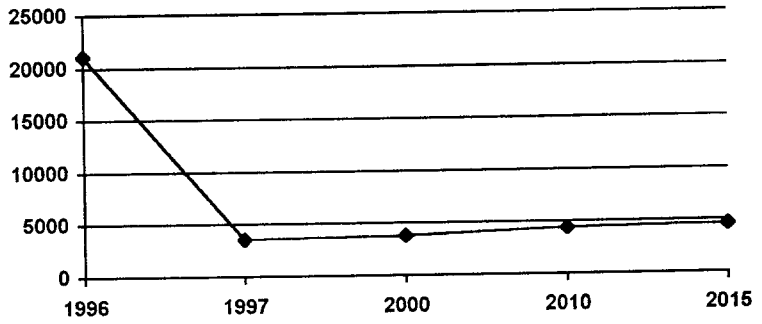
3.3.2 Repair works of the wagon stock

In order to solve the problems the wagon service did meet during the last few years there exists the need to define the needed wagon volume followed by investigations how to develope the maintaining capabilities.

3.3.2.1 The future needed wagon stock

The needed wagon volume depends on the future needed goods train services in the corridor that should be defined based on the concerning traffic forecast. Further the wagons turn-round rate is steadily to short down from the actual level to 8...9 days in 1997, to 6...7 days in 2000 and to 5...6 days after 2010.
So the wagons total volume could be adapt to the following figures.

year	1996	1997	2000	2010	2015
total	21,095	3,537	3,783	4,383	4,642



The data concerning the several wagon types and years are shown in the annexes 3.3.2.1, 3.3.2.1.1, 3.3.2.1.2, 3.3.2.1.3 and 3.3.2.1.4. It should be underlined that this estimation is rather simple because of the rough nature of the traffic forecast.
Coming from the results about the future needed stock the comparison with the existing stock shows the demand to rent or to procure as given in annex 3.3.2.1.5. Following the received results there is to learn that the refrigerators stock only should increase. The demand of the other types could be covered by increasing the repair rate. In the oposite the GZD can rent a part of the tank stock to the AZD.

3.3.2.2 The future maintaining capabilities for wagons

In order to organize a normal maitaining system for the wagons stock the respective capabilities are to develop in 3 relation:

- To upgrade all existent repair capabilities for occassionally repair (TR) and depot repair (DR) as a short term measurement
- To cover the needs of spareparts as a short term and a frequent measurement
- To establish repair capabilities for DR and KR of refrigerators as a middle term measurement
- To establish regularly repair capabilities of KR as a long term problem.

For preparing the normal work of the existing depots there exists a need of about 2,28 mio USD in order to purchase the urgent needed equipments as summarized in annex 3.3.2.2.1. The urgent programme should start with the **Wagon Depot Hashurji** by purchasing four new mechanic lifting jacks with a load of 15 tons to a price of about 30,000 USD.

The volume of needed spare parts is shown in annex 3.3.2.2.2. The financial volume needed for 1997 is about 3.42 mio USD while the future yearly volume is estimated to about 2.87 mio USD.

As a middle term question the **Tbilisi Electrowagon Repair Factory** actually carrying out the KR of EMUs should mainly upgraded in order to create capabilities for maintaining refrigerators by reestablishing the main assembly hall, setting up a new shop for cooling aggregats and another one for diesel engines, reconstructing the wheelset division and roller-bearings shop, reconstructing the bogie division, all accompied by respective procurement of new equipment for colouring, wheelset reconditioning and checking the roller-bearings. The financial total for developing the repairshop is estimated to 20 mio USD.

The long term problem of setting up a new wagon repair factory for maintaining the universal freight wagon stock could be solved by using the place in Tbilisi former foreseen for a new wagon depot for refrigerators. However creating such a new factory should be deeper investigated connected with the future need for maintaining the universal freight wagon stock of all Transcaucasian railways.

3.3.3 Repair works of the traction-power system

The needed repair works can be split into

urgent needed measurements as

- to change 144 km of the contact wire
- to instal 150 km of the stolen boosting wire
- to instal new small power-supply equipments along of 150 km line

and middle term measurements as

- to carry out the complete reconstruction of 226 km line
- to carry out the complete reconstruction of 20 sub-power stations.

The advanced wear of 144 km contact wire demands a quick change in order to ensure the railways liability for tracting normally goods trains. **For the 144 km contact wire is to estimate a total of 28.8 mio USD.**

For replacing the stolen boosting wire in a lenght of 150 km the price could be estimate of 57.6 mio USD.

For an urgent repair of the sub-popwer stations there exists a demand to procure 20 accumulator sets. **The price can reach about 280,000 USD.**

The complete reconstruction of 226 km line contents 166 km on the corridors line namely 56 km from Poti to Abascha via Senaki, 106 km from Batumi to Samtredia and 4 km from Brozeula to Rioni; besides 60 km from Tbilisi to Sadachlo the trunk line to Armenia. For the 166 km reconstruction on the main corridor line **is to estimate a financial total of 200 mio USD.**

The costs for the complete replacement of 20 sub-power stations comprizing 600 mio USD.

3.4 Definition of the training needs

The training needs concerning the GZD`s rolling stock leading personal are originating in the changing demands to the GZD traffic policy that meets the requirements on their clients regarding to quality and punctuality of goods delivery and changing goods structures in the near future.

The basic training need for the upper and middle management should comprize the quality of the daily operational inspections and of the daily repair work with all types of locomotives and wagons in depots and repairshops.

Annexes

annex 3.1.1.1

Overview of GZD electrical locomotives
Перечень электровозов ГЖД
Июнь 1996 г.

Depot Депо	Type of locomotive вид локомотива	amount число		amount число	Problems проблемы		
		generally в обще в инвентаре	under operation /in reserve исправные в експлоатацию / в запасе	out of order generally/in the depot/ in the factory неисправные на отстою в обще/в депо/ в заводе (где?)	**waiting to rejection** **подлежат к списанию**	**waiting to repair TR 3** **ожидают ТР3**	**waiting to repair KR1/KR2** **ожидают КР-1 / КР-2**
Samtredia Самтредия	ВЛ-8 VL-8	54	14/5	35	24	10	1
Chamshuri Хамщури	ВЛ-8 VL-8	1	1/0	0	0	0	0
Chamshuri Хамщури	ВЛ-10 VL-10	56	7/4	45	39	5	1
Chamshuri Хамщури	ВЛ-11 VL-11	8.5	1/1	6.5	0	2	4,5
Tbilisi-Sortir Тбилиси-Сорт.	ВЛ-10 VL-10	41	9/2	30	22	8	0
Tbilisi-Sortir Тбилиси-Сорт.	ВЛ - 11 VL-11	21	6/3	12	0	1	11
Total GZD (with locos from other depots)	**VL-8**	**85**	**29/8**	**48**	**28+4**	**15**	**1**
	VL10	**103**	**17/7**	**79**	**62**	**16**	**1**
	VL-11	**42.5**	**9/6**	**27.5**	**0**	**3**	**24.5**

Remarks: From all electrical locomotives, type VL 10 + VL 11, under operation and in reserve as well as waiting to repair amounting to 83,5 locos the part of 68.5 locos (82%) should be subject to main repair (KR-1, KR-2) for covering the rules of exploatation times of locomotives.

Примечание: электровозы, находяхщиеся в эксплуатации и запасе, а также возможно восстановить ВЛ 10 и ВЛ 11 из всего 83,5 локомотив - по срокам эксплуатации - подлежат 68,5 локомотив КР-1 и КР-2, т.е. 82%.

annex 3.1.1.2

Age structure of the GZD-electrolocos - 1996 -

locotype	age	number
VL-8		
	38 ... 35	11
	34 ... 33	36
	32 ... 31	22
	30	23
	29	8
VL-10		
	29 ... 26	41
	24 ... 22	44
VL-10^{Y}		
	15	4
	14	6
	13	8
VL-11		
	16	5
	13	2
	12	5
	10	11
	7	12.5
	6	6
	1	1

annex 3.1.3.1

Freight wagons stock of GZD

Парк грузовых вагонов ГЖД

17, June 1996

type of wagon	number
covered wagons	4,982
open wagons	6,076
tanks	2,243
platforms/flats	2,303
refrigerators	549
cement	961
cereal	1,693
container	440
others	1,848
Total	**21,095**

annex 3.1.4.1

Actual performances of GZD wagons repair
Актуальный ремонт грузовых вагонов ГЖД
May 1996 / Май 1996 г.

Factory завод	Monthly repair of wagons месячный ремонт грузовых вагонов по родам
Batumi WTchD - 1	specialisation/специализация: tanks **DR: 83 / TR: 25**
DR/ДР:	2 covered, 2 open, 22 tanks, 57 cereals,
TR/TP:	7 covered, 7 tanks, 1 platforms, 10 cereals,
remarks/замечания:	5 places for repair
Samtredia WTchD - 2	specialisation/специализация: **DR: 154 / TR: 15**
DR/ДР:	33 covered, 47 open, 2 tanks, 30 platforms, 42 cereals
TR/TP:	2 covered, 8 tanks, 5 cereals,
remarks/замечания:	8 places for repair
Hashurii WTchD - 3	specialisation/специализация: **DR: 164 / TR: 18**
DR/ДР:	30 covered, 111 open, 10 tanks, 5 platforms, 2 cement 4 cereals, 2 others
TR/TP:	2 covered, 1 open, 11 tanks, 4 cereals
remarks/замечания:	12 places for repair
Tbilisi WTchD - 4	specialisation/специализация: containers **DR: 0 / TR: 423**
DR/ДР:	0
TR/TP:	66 covered, 115 open, 130 tanks, 48 platforms, 64 cereals
remarks/замечания:	unplanned repairs only
WWP Poti actual performance:	specialisation/специализация:
designed for/преду-смотренно для:	
remarks/замечания:	
EVRS Tbilisi actual performance:	specialisation/специализация: coaches, EMU`s, covered wagons for World Food Programme
designed for/преду-смотренно для:	
remarks/замечания:	

DR/ДР	Annual Repair	Деповской ремонт
TR/TP	unplanned Repair	Текущий ремонт
WTchD/ВЧД	Wagon Repair Depot	Вагонный Депот
EVRS/ТЕБРЗ	Electro-Wagon Repair Factory	Електро-Вагонно-Ремонтный Завод
WWP	Wagon Washing Station	Вагонно-Промывочный Пункт

annex 3.2.1.1

Occured damages on GZD-electrolocos under operation 1 - half of 1996

main components	cases	per cent
traction motor	70	17
auxiliary engines	76	19
electric equipment	112	27
mechanic components	106	26
others	46	11
Total	408	100

annex 3.2.2.1

Daily Damaged Freight Stock of GZD
Неисправные грузовые вагоны ГЖД
June 1996 / Июнь 1996 г.

type of wagon вид вагонов	daily damaged в сутке неисправные вагоны
covered крытие	4,372
platforms/ платформы	1,984
open/coal полувагоны	4,986
tanks цистерны	1,211
refrigerators рефрижераторы	444
others прочие	1,482
cont-wagons контейнерные	353
cement цементовозы	836
cereal зерновозы	781
Total	**16,449**

annex 3.2.2.2

Comparison of the inventory freight stock with the average of the daily damaged stock of GZD
Сравнение инвентаря грузовых вагонов со средним объёмом неисправних вагонов ГЖД

June 1996 / Июнь 1996 г.

type of wagon вид вагонов	inventory volume число вагонов в инвентаре	daily damaged неисправные вагоны по сутке	part in per-centage доли в про-центах
covered крытие	4,982	4,372	88
platforms/ платформы	2,303	1,984	86
open/coal полувагоны	6,076	4,968	82
tanks цистерны	2,243	1,211	54
refrigerators рефрижераторы	549	444	81
others прочие	1,848	1,482	81
cont-wagons контейнерные	440	3,53	80
cement цементовозы	961	836	87
cereal зерновозы	1,693	781	46
Total	**21,095**	**16,449**	**77**

annex 3.2.2.3

Maintenance volume of the freight stock of AZD

Kind of wagon	numbers of inventory	numbers of available	DR-Frist	DR-Volume of inventory	DR-Volume of available stock	KR-Frist	KR-Volume of inventory	KR-Volume of available stock
covered wagons	4,982	602	2	2,242	271	10	498	60
open wagons	6,076	1,090	1	2,279	409	8	760	136
tanks	2,243	1,030	1	918	421	11	204	94
platforms/flats	2,303	139	1	1,016	61	17	135	8
refrigerators	549	105	1	494	95	10	55	11
cement	961	125	2	437	57	11	87	11
cereal	1,693	912	2	770	415	11	154	83
container	440	87	1	440	87	0	0	0
Subtotal	**19,247**			**8,594**	**1,815**		**1,893**	**403**

annex 3.3.1.1.1

Development of the daily volume of goods trains of the GZD

		wagons type	1997	2000	2010	2015
	daily stock	tanks	23	28	37	1,633
trains			**1**	**1**	**1**	**36**
		platforms	63	96	142	221
trains			**2**	**3**	**4**	**6**
		dumpcars	13	22	33	135
trains			**0**	**0**	**1**	**3**
		open	80	110	144	75
trains			**2**	**3**	**4**	**2**
		minerals	65	82	98	98
trains			**2**	**3**	**2**	**2**
		cements	2	3	4	16
trains			**0.3**	**0.3**	**0.3**	**0.5**
		cereals	23	28	34	49
trains			**1**	**1**	**1**	**1**
		refrige-rators	34	48	68	41
trains			**1**	**1**	**1**	**1**
		covered	15	22	31	31
trains			**0.3**	**0.3**	**1**	**1**
total forwarding trains			**9**	**12**	**15**	**53**
import goods			820	943	1,179	1,267
goods per day			3,254	3,742	4,679	5,028
total of trains with import goods			**3**	**4**	**5**	**5**
transit goods			2,245	8,420	10,525	12,104
goods per day			8,909	33,413	41,766	48,032
total of trains with transit goods			**9**	**33**	**42**	**48**
daily total of goods trains			**21**	**49**	**61**	**106**

annex 3.3.1.1.2

Development of the train volume of the GZD on the transcaucasian corridor

westbound traffic	1997	2000	2010	2015
trunk line Border - Tbilisi				
yearly goods volume in mio tons	1,456	8,505	10,304	11,270
goods per day in tons	5,778	33,750	40,889	44,722
trains per day	**6**	**28**	**34**	**37**
trunk line Tbilisi - Samtredia				
yearly goods volume in mio tons	2,170	9,229	11,277	12,361
goods per day in tons	8,611	36,623	44,750	49,052
trains per day	**9**	**31**	**37**	**41**
trunk line Samtredia - Batumi				
yearly goods volume in mio tons	1,494	7,020	8,565	9,379
goods per day in tons	5,929	27,857	33,988	37,218
trains per day	**6**	**23**	**28**	**31**
trunk line Samtredia - Poti				
yearly goods volume in mio tons	676	2,209	2,712	2,982
goods per day in tons	2,683	8,766	10,762	11,833
trains per day	**3**	**7**	**9**	**10**

annex 3.3.1.1.3

Development
of the train volume of the GZD
on the transcaucasian corridor

eastbound traffic	1997	2000	2010	2015
trunk line Border - Tbilisi				
yearly goods volume in mio tons	589	1,034	1,648	2,074
goods per day in tons	2,337	4,103	6,540	8,230
trains per day	**2**	**3**	**5**	**7**
trunk line Tbilisi - Samtredia				
yearly goods volume in mio tons	1,974	2,424	3,203	3,755
goods per day in tons	7,833	9,619	12,710	14,901
trains per day	**8**	**8**	**11**	**12**
trunk line Samtredia - Batumi				
yearly goods volume in mio tons	805	988	1,301	1,503
goods per day in tons	3,194	3,921	5,163	5,964
trains per day	**3**	**3**	**4**	**5**
trunk line Samtredia - Poti				
yearly goods volume in mio tons	1,169	1,436	1.902	2.252
goods per day in tons	4,639	5,698	7.548	8.937
trains per day	**5**	**5**	**6**	**7**

annex 3.3.1.2.1

Demand of main equipments needed for GZD locomotive repair

specification	units	price per unit (USD)	total price (USD)
Schmieraggregat für Stromabnehmer	6	3,500	21,000
elektrischer Destillator A468	8	2,500	125,000
Defektoskopstand für Radsätze A1370	2	3,000	6,000
lifting jacks, 40 tons	8	10,000	80,000
lifting jacks, 35 tons	10	15,000	150,000
lifting jacks, 25 tons	10	3,000	30,000
electric truck, 2 tons	6	10,000	60,000
electric truck, 5 tons	2	15,000	30,000
electrolift, 0.5 tons	4	3,000	12,000
electrolift, 1 tons	4	4,500	18,000
electrolift, 3 tons	5	7,500	37,500
electrolift, 5 tons	5	10,000	50,000
oil pump A-1326	6	3,500	21,000
welding rectifier VDM-1001	4	4,000	16,000
welding transformator TDM-401	7	3,500	24,500
electrical loader, 1 tons	4	20,000	80,000

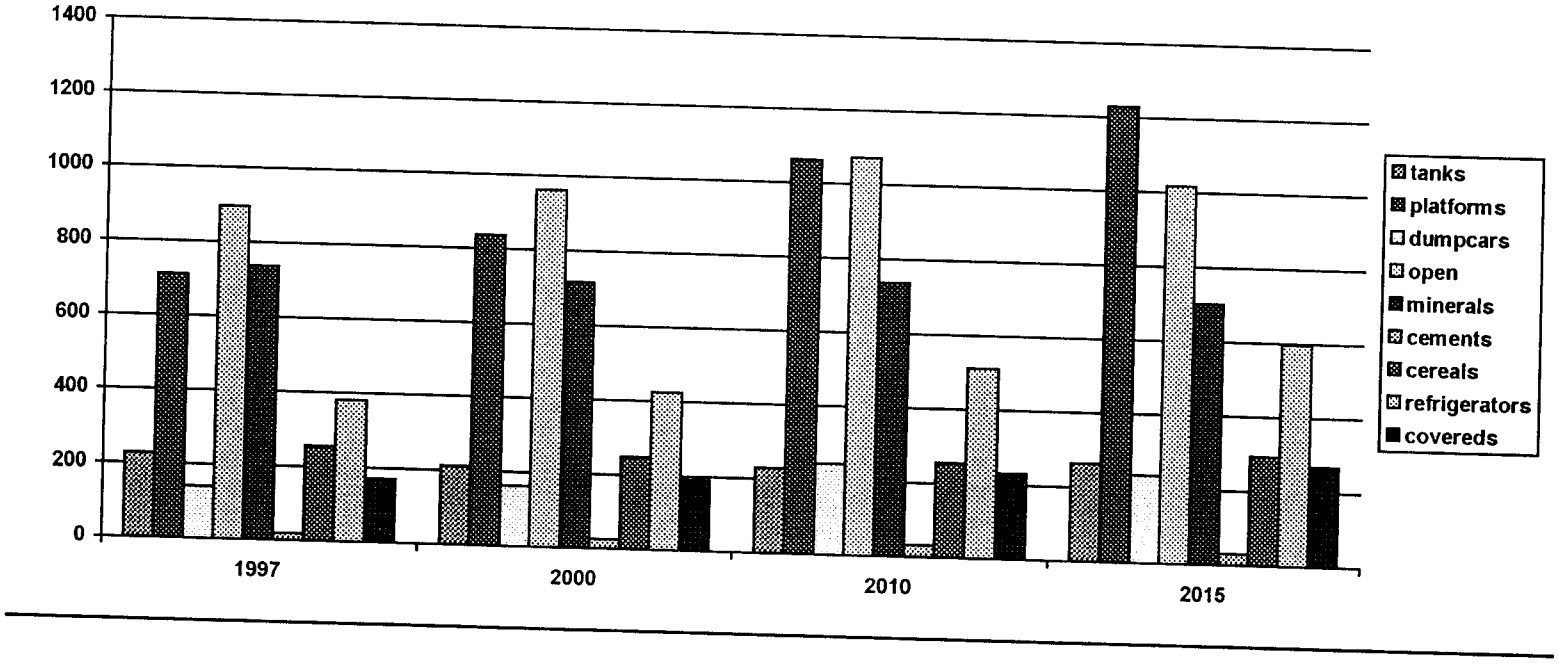
annex 3.3.1.2.2

List of urgent needed spareparts for GZD locomotive repair

specification	units
compressor NB-431	100
wheelset VL-10	100
wheelset VL-8	40
wheel tire	200
accummulators NK-120	10
sliding contacts P 5	50
traction motors TL-2k, NB-406	40
brake shoes	10,000
electro pneumatic contactors	25
electro magnetic contactors	25
carbon brushes	2,500
ventilators NB-430, TL-110	10
quick circuit switch BWP-5, BWP-3a	15
profiled copperor for contactors 10x34x41	200 kg
plating for sliding contacts	1,000
trolley for sliding contacts	je 60
induktive reostatIsch-2k, Isch-406	100
group switch PKG-4a, PKF-6b	10
insulating color NU - 929	150 kg
spring VL-8	40
coupling gears VL-8	10
spark quencher chamber BWP-5, BWP-30	10
suspension of cradle, complete	3
safety fuse PK 6/75	120
babbit B-16, B-83	1,500 kg
electric oven PET-IUZ	150

annex 3.3.2.1

Development of the wagons stock of the GZD 1997 - 2015



annex 3.3.2.1.1

Gross needed wagon stock of GZD

1997

goods			part of load and load per wagon							wagons stock				
kind of goods	total load per year in mio tons	total volume per day in tons	part of load in tons	Factor 1)	type of wagon	utilization in tons		wagons demand for goods		wagons stock needed for loading min	max	turn-round rate	operational needed stock	gross needed stock
						min	max	max	min			d	max	max
coal/уголь	50	198	198	7	open	51	63	27	22	**tanks**				
oil / нефть	297	1,179	1,179	1	tank	52	57	23	21	**21**	**23**	8	**181**	**227**
building m.	252	1,000	400	1	flat	43	50	9	8	**flats**				
			600	1	dumpcar	48	55	13	11	**52**	**63**	9	**569**	**711**
iron ore	88	349	140	15	open	51	63	41	33	**dumpcars**				
			210	15	mineral	48	55	65	57	**11**	**13**	9	**113**	**141**
cement	22	87	87	1	cement	52	62	2	1	**open**				
cereal	177	702	702	1	cereal	31	42	23	17	**64**	**80**	9	**716**	**895**
others	736	2,921	550	1	open	49	61	11	9	**minerals**				
			711	1	flat	20	25	36	28	**57**	**65**	9	**589**	**737**
			1,185	1	refrigerator	35	40	34	30	**cements**				
			474	1	covered	31	42	15	11	**1**	**2**	9	**15**	**19**
metal	199	790	790	1	platforms	43	50	18	16	**cereal**				
										17	**23**	9	**204**	**255**
										refrigerators				
										30	**34**	9	**305**	**381**
										covereds				
										11	**15**	9	**138**	**172**

1) 1=daily
15=every 2weeks
7=weekly

annex 3.3.2.1.2

Gross needed wagon stock of GZD

2000

goods			part of load and load per wagon			utilization in tons		wagons demand for goods		wagons stock				
kind of goods	total load per year in mio tons	total volume per day in tons	part of load in tons	Factor 1)	type of wagon					wagons stock needed for loading min	max	turn-round rate	operational needed stock	**gross needed stock**
						min	max	max	min			d	max	max
coal/уголь	87	345	345	7	open	51	63	47	38	**tanks**				
oil / нефть	371	1,472	1,472	1	tank	52	57	28	26	**26**	**28**	8	**170**	**212**
building m.	441	1,750	700	1	flat	43	50	19	14	**flats**				
			1,050	1	dumpcar	48	55	22	19	**79**	**96**	9	**670**	**837**
iron ore	110	437	175	15	open	51	63	51	42	**dumpcars**				
			262	15	mineral	48	55	82	71	**19**	**22**	9	**131**	**164**
cement	39	155	155	1	cement	52	62	3	2	**open**				
cereal	222	881	881	1	cereal	31	42	28	21	**89**	**110**	9	**770**	**962**
others	994	3,944	550	1	open	49	61	11	9	**minerals**				
			1,018	1	flat	20	25	51	41	**71**	**82**	9	**573**	**716**
			1,697	1	refrigerator	35	40	48	42	**cements**				
			679	1	covered	31	42	22	16	**2**	**3**	9	**21**	**26**
metal	309	1,226	1,226	1	platforms	43	50	29	25	**cereal**				
										21	**28**	9	**199**	**249**
										refrigerators				
										42	**48**	9	**339**	**424**
										covereds				
										16	**22**	9	**153**	**192**

1) 1=daily
15=every 2weeks
7=weekly

annex 3.3.2.1.3

Gross needed wagon stock of GZD

2010

goods			part of load and load per wagon					wagons demand for goods		wagons stock				
kind of goods	total load per year in mio tons	total volume per day in tons	part of load in tons	Factor 1)	type of wagon	utilization in tons				wagons stock needed for loading		turn-round rate	operational needed stock	gross needed stock
						min	max	max	min	min	max	d	max	max
coal/уголь	130	516	516	7	open	51	63	71	57	**tanks**				
oil / нефть	483	1,917	1,179	1	tank	52	57	37	34	**34**	**37**	8	**184**	**230**
building m.	661	2,623	400	1	flat	43	50	24	21	**flats**				
			600	1	dumpcar	48	55	33	29	**117**	**142**	9	**849**	**1,062**
iron ore	132	524	140	15	open	51	63	62	50	**dumpcars**				
			210	15	mineral	48	55	98	86	**29**	**33**	9	**197**	**246**
cement	58	230	87	1	cement	52	62	4	4	**open**				
cereal	266	1,056	702	1	cereal	31	42	34	25	**116**	**144**	9	**862**	**1,077**
others	1,341	5,321	550	1	open	49	61	11	9	**minerals**				
			711	1	flat	20	25	72	57	**86**	**98**	9	**589**	**737**
			1,185	1	refrigerator	35	40	68	60	**cements**				
			474	1	covered	31	42	31	23	**4**	**4**	9	**27**	**33**
metal	494	1,960	790	1	platforms	43	50	46	39	**cereal**				
										25	**34**	9	**204**	**255**
										refrigerators				
										60	**68**	9	**409**	**511**
										covereds				
										23	**31**	9	**185**	**231**

1) 1=daily
15=every 2weeks
7=weekly

annex 3.3.2.1.4

Gross needed wagon stock of GZD

2015

goods			part of load and load per wagon							wagons stock				
kind of goods	total load per year in mio tons	total volume per day in tons	part of load in tons	Factor 1)	type of wagon	utilization in tons		wagons demand for goods		wagons stock needed for loading min	max	turn-round rate	operational needed stock	gross needed stock
						min	max	max	min			d	max	max
coal/уголь	149	591	591	7	open	51	63	81	66	**tanks**				
oil / нефть	555	2,202	2,202	1	tank	52	57	42	39	**39**	**42**	8	**212**	**265**
building m.	760	3,016	1,206	1	flat	43	50	28	24	**flats**				
			1,810	1	dumpcar	48	55	38	33	**136**	**164**	9	**984**	**1,230**
iron ore	151	599	240	15	open	51	63	70	57	**dumpcars**				
			360	15	mineral	48	55	112	98	**33**	**38**	9	**188**	**236**
cement	66	262	262	1	cement	52	62	5	4	**open**				
cereal	306	1,214	1,214	1	cereal	31	42	39	29	**132**	**163**	9	**814**	**1,018**
others	1,542	6,119	550	1	open	49	61	11	9	**minerals**				
			1,671	1	flat	20	25	84	67	**98**	**112**	9	**562**	**702**
			2,785	1	refrigerator	35	40	80	70	**cements**				
			1,114	1	covered	31	42	36	27	**4**	**5**	9	**25**	**31**
metal	568	2,254	2,254	1	platforms	43	50	52	45	**cereal**				
										29	**39**	9	**235**	**294**
										refrigerators				
										70	**80**	9	**477**	**597**
										covereds				
										27	**36**	9	**216**	**269**

1) 1=daily
15=every 2weeks
7=weekly

annex 3.3.2.1.5

GZD - Freight wagon stock available and demand

1997

type	inventory	available in %	available in wagons	needed in 1997	need to repair	demand to rent or to procure
covered	4,982	12	598	172	-426	
platforms	6,076	14	851	711	-140	
open	2,243	18	404	895	***491***	
tanks	2,303	46	1,059	227	-832	
refriges	549	19	104	381	***277***	
cements	961	13	125	19	-106	
cereals	1,693	54	914	255	-659	
others	1,848	20	370	878	***508***	

2000

type	inventory	available in %	available in wagons	needed in 2000	need to repair	demand to rent or to procure
covered	4,982	12	598	192	-406	
platforms	6,076	14	851	837	-14	
open	2,243	18	404	962	***558***	
tanks	2,303	46	1,059	212	-847	
refriges	549	19	104	424	***320***	
cements	961	13	125	26	-99	
cereals	1,693	54	914	249	-665	
others	1,848	20	370	880	***510***	

2010

type	inventory	available in %	available in wagons	needed in 2010	need to repair	demand to rent or to procure
covered	4,982	12	598	231	-367	
platforms	6,076	14	851	1,062	***211***	
open	2,243	18	404	1,077	***673***	
tanks	2,303	46	1,059	230	-829	
refriges	549	19	104	511	***407***	
cements	961	13	125	33	-92	
cereals	1,693	54	914	255	-659	
others	1,848	20	370	981	***611***	

2015

type	inventory	available in %	available in wagons	needed in 2015	need to repair	demand to rent or to procure
covered	4,982	12	598	269	-329	
platforms	6,076	14	851	1,230	***379***	
open	2,243	18	404	1,018	***614***	
tanks	2,303	46	1,059	265	-794	
refriges	549	19	104	597	***445***	***152***
cements	961	13	125	31	-94	
cereals	1,693	54	914	294	-620	
others	1,848	20	370	938	***568***	

annex 3.3.2.2.1

List of needed equipments for GZD wagon repair in depots

specification	remarks	units	price	volume	price
bridge cranes, width of crane track -22,5 m	10 tons				
	Vchd Samtredia	1	30,000	1	30,000
	Vchd Hashurji			1	30,000
bridge cranes, width of crane track -19,5 m	10 tons				
	Vchd Batumi	1	30,000	1	30,000
gantry crane width 12,5 m	5 - 10 tons				
	Vchd Tbilisi	1	10,000	2	20,000
wheel lathe					
	Vchd Samtredia	1	1.2 mio	1	1.2 mio
planing machine	quadrilateral				
	Vchd Samtredia	1	65,000	1	65,000
	Vchd Hashurji			1	65,000
	Vchd Tbilisi			1	65,000
air presser 8 atm	10 m^3/min				
	Vchd Samtredia	1	200,000	1	200,000
	Vchd Hashurji			1	
	Vchd Tbilisi -1			1	

electric hoist block	2 tons				
	Vchd Samtredia	1	1,000	2	2,000
	Vchd Hashurji			2	2,000
	Vchd Tbilisi			2	2,000
	Vshd Batumi			2	2,000
electric hoist block	5 tons				
	Vchd Samtredia	1		1	1,000
	Vchd Hashurji			1	1,000
	Vchd Tbilisi			1	1,000
	Vshd Batumi			1	1,000
electric hoist block	10 tons				
	Vchd Samtredia	1		1	1,000
	Vchd Hashurji			1	1,000
	Vchd Tbilisi			1	1,000
	Vshd Batumi			1	1,000
electrical lifting jacks					
	Vchd Samtredia	1 compl.	30,000	2 compl.	60,000
	Vchd Hashurji			2 compl.	60,000
	Vchd Tbilisi			2 compl.	60,000
	Vshd Batumi			2 compl.	60,000
hydraulic lifting jack	20 - 25 tons				
	Vchd Samtredia	1	100	8	800
	Vchd Hashurji			8	800
	Vchd Tbilisi			8	800
	Vshd Batumi			8	800
shop for repairing axle roller-bearings					
	Vchd Samtredia	1	200,000	1	200,000
	Vchd Hashurji			1	200,000
centrifugal pump 10 - 20 qm/h	for washing machines	1	1,200	10	12,000
mechanic lifting jack	15 tons				
	Vchd Hashurji	1	7,500	4	30,000

annex 3.3.2.2.2

List of urgent needed spareparts for GZD wagon repair

specification	unit	price USD	volume 1997	costs 1997 USD	volume yearly	costs yearly
wooden material	qm	150	3000	450,000	1,200	180,000
wheelsets	pieces	3,200	500	1,600,000	500	1,600,000
bogies type ZNII-H3	dto.	2,285	200	457,000	100	228,500
composed brake shoe inserts	dto.	5	18,000	90,000	60,000	300,000
lubricating grease for axle boxes	tons	311	25	7,775	20	6,220
lubricating grease for brakes	tons	309	1	309	1	309
lubricating grease for slide bearing	tons	295	60	17,700	120	35,400
corner bracings 50x50	tons	556	5	2,780	5	2,780
corner bracings 63x45	tons	556	10	5,560	10	5.560
auxiliary reservoir	pieces	30	50	1,500	50	1,500
distributor valve 483, bracket	dto.	150	800	120,000	100	15,000
distributor valve 483	dto.	150	200	30,000	100	15,000
air brake hose	dto.	28	1,000	28,000	300	8,400
pins M12x50	tons	1,000	5	5,000	3	3,000
pins M12x70	tons	1,000	10	10,000	5	5,000
pins M12x100	tons	1,000	10	10,000	5	5,000
doors for covered wagons	pieces	274	500	137,000	50	13,700
doors for open wagons	dto.	260	120	31,200	15	3,900

auto coupler with draft gear	pieces	205	20	4,100	50	10,250
brake slack adjuster	dto.	80	50	4,000	50	4,000
automatic brake position device	dto.	85	50	4,250	50	4,250
welding electrode	tons	1,270	5	6,350	5	6,350
miner`s lamp	pieces	40	300	12,000	30	1,200
diesel fuel	tons	187	200	37,400	1,110	207,570
diesel lubrication	tons	792	50	39,600	200	158,400
freon (cooling liquide)	tons	8,730	10	87,300	5	43,650
special for 8-axled tanks						
automatic coupler	pieces	215	100	215,000		
auxiliary reservoir	dto.	35	50	1,750		

Annex 5.3

Technical pre-feasibility of Signalling and Telecommunication

Baku, Tbilisi, Berlin - August 1996

WP 1300

Signalling and Telecommunication

Content

1 SIGNALLING AND TELECOMMUNICATION OF THE STATE RAILWAYS OF AZERBAIJAN AND GEORGIA

1.1 AZERBAIJAN STATE RAILWAYS

1.1.1 SIGNALLING PLANTS

1.1.1.1 TECHNICAL DATA

For operating the stations on the line Baku - Bejuk-Kjasik there are working panel operated signal boxes of Russian construction types BMRZ, BSZ, SZ and MRZ of 1961 - 87.The stations Baladshari and Baladshari-hump have been equipped with new technology of the type BMRZ in 1993-94. Route setting was realized by means of entrance-exit buttons. After running the train the route will be released automatically. In the case of faults or accidents auxiliary releases are possible. On free sections of the line there is an automatic section blocking. Light signals are used for signalling in which duplicate filament lamps are used. Four of the existing stations are still equipped with floodlight signals. There is electric point drive. There are only six stations where point drive is hand-operated. Track-release necessary for the automatic blocking is realized over d.c. circuits at 220 V/ 50 hertz. Power supply for signalling over an overhead line which is fastened to catenary supports. For a free from interference power supply of the signalling installations a second power supply system on wooden supports outside the track system exists.

The stations situated on the line Baku - Bejuk-Kjasik are shown in tables in Annexes 1 and 2.

Table 1.1-1: Selected Plants on the Line Baku - Bejuk-Kjasik

Plants	Number of Plants
Points	1475 (124 of them hand-operated)
Light Signals	1393 (36 of them floodlight signals)
Track Circuits	752
Interlocking Cabins	45
Level Crossings	8 automatic plants 11 electrically driven plants 11 mechanical plants

Table 1.1-2: Stations with Floodlight Signals

Station	Number of Floodlight Signals	Number of Points
Puta	5	12
Atbulak	11	14
Navagi	8	16
Pirsagat	12	15

Table 1.1-3: Stations with hand-operated Points

Station	Number of hand-operated Points
Kürdamir	30
Alabaschli	28
Scamkir	21
Dölljar	21
Dsegjam	13
Kowljar	11

1.1.1.2 CONDITION OF THE EXISTING PLANTS

The technical condition and operability of the plants of the station and section are satisfactory. The necessary substitution of worn signal plants has been realized only to a slight extent during the last few years whereas the plants have been always replaced by means available. The increasing age of the technique used will result in a decline in the technical conditions and an increasing number of breakdowns of the plants. The amount of breakdowns with signalling plants in 1995 and 1996 (until April) is shown in Annex 3. However, there is no detailed evaluation of the breakdowns. After the drop in the transport volume the capacity of the sections and stations has been decreased and therefore the breakdowns do not have such consequences. This result even has been positively influenced by the few interlocking operations of switches and signals.

The maintenance of the relay installations of the stations is carried out and defective parts are replaced by spare parts if available.

Some of the plants have already reached or passed working life. The following table contains data about some selected installations.

Table 1.1-4: Working Life of some selected signalling plants

Plants	Period
cables	30 years
light signals	35 years
point drives	16 years
track circuits	20 years
panel operated signal boxes	25 years
relay stations of the automatic signalling	28 years

1.1.1.2.1 SIGNALLING

The outside appearance of the signals and ground signals shows the influence of corrosion on posts and signal hood. Visibility of some signals is restricted for the locomotive crew. This is also caused by the bad condition of the signalling installations mainly used. The repeated signalling in the driver's cab makes it possible for the driver to realize the signal in time and to react to it. The function of the installations is also reduced because of damages by a third party and theft of necessary parts, e.g. relays of the automatic signalling installations or cables of the signal posts of the section blocking and for the power supply of the automatic signalling.

1.1.1.2.2 POINT MECHANISMS

Point mechanisms of the types SP-6 and SP-3 have been used. The condition and operability of the existing electrical point drives will be mainly influenced by the bad condition of the points. The required quiet position of the point mechanism necessary is not given because of the existing track layout. The outside condition of

the point mechanisms is only satisfactory because of corrosion. The electric motors, point switches and the internal wiring with 60 % of the point mechanisms have reached the limit of service life.

1.1.1.2.3 TRACK CIRCUITS

There are 725 track circuits in the section Baku - Bejuk-Kjasik with a total length of 970 km. The condition of the track installations is the basis for a trouble-free work of the track circuits. Because of the unsufficient insulation resistance of the tracks and switches failure rate of the track circuits is rather high. Work of these installations is also influenced by damages or theft of necessary parts, e.g. chokes, connection ropes and connectors. The chokes used and the necessary connection ropes are in a bad condition. Therefore, the workability of the insulation connectors is restricted.

An analysis of the appearing irregularities shows the following percentage share of the various divisions of Azerbaijan State Railways:

60 - 70 %	Track division
15 - 20 %	Signalling
5%	Power supply
5%	others

1.1.1.2.4 CABLE SYSTEMS

Cables for supply of outdoor equipment are buried. The cable connecting stands installed in buildings are in good condition. Distribution boards are used for the connection of individual branch cables and the connection of the main cables among each other. The condition of the distributers and lineside boxes is not satisfactory. Failure of the outdoor equipment is influenced by that fact, too.

1.1.1.2.5 LEVEL CROSSINGS

For the safety at crossings in the section Baku - Bejuk-Kjasik the following installations are :

- 8 automatic barriers
- 11 barriers with electric drive
- 11 mechanical barriers

At all crossings there is staff. In the case of irregularities or total breakdown the barriers will be operated by hand. Most irregularities at the barriers result from outside influence, e.g. dismantling of signal bells and light signals of road signals. Another main problem regarding the disturbance of the work is the electrically operated motor.

1.1.1.3 NECESSARY MEASURES

Due to the increasing transport volume the reliability and operability of signalling have to be improved. The renewal of signalling is required in the short and medium term. The short-term measures relate to the replacing of important parts of existing plants and because of the conditions existing it is more advantagous to apply the available Russian equipment in future, too, which has proved its reliability and robustness. In this case the demands made on the the operating and service staff would not change. Studies have shown that the supply with spare parts is possible at any time provided that the respective financial means from Russia are supplied.
The stations shown in the following table have to be completely replaced by new installations within the next 5 - 10 years.

station	km	year of construction	number of points
Kasimagomed	417	1961	69
Mugan	405	1967	12
Gadshiewo	391	1967	11
Kürdamir	342	1968	30
Ewlach	250	1966	53
Geran	225	1969	12
Kürektschai	214	1966	14
Bejuk-Kjasik	45	1975	47

Furthermore, it is necessary for the increase of the passage of the section Baku - Bejuk-Kjasik to replace the following signal boxes with hand-operated switches by new panel operated signal boxes. The realization of this measure is decisively influenced by the volume of goods transport in the section Baku to Georgia. The financial means required are shown in the cost survey in Annex 4.

Station	km	Year of Construction	Number of Points
Kürdamir	342	1968	30
Alabaschli	170	1963	30
Schamkir	159	1962	16
Dölljar	149	1962	21
Dsegjam	136	1961	13
Kowljar	122	1961	17

For restoration to the full operability of the signalling system the following short-term measures are required.

1.1.1.3.1 SIGNALS

- Replacement of 23 complete light signals
- Replacement of 32 complete ground signals
- Replacement of 1500 light signal lenses
- Replacement of branch cables for 10 signals
- Replacements of signal lamps for 300 signals
- Replacement of 50 light signal hoods

Furthermore, all signals have to be newly painted.

1.1.1.3.2 POINTS

- Replacement of the electric motors with approx. 1000 point drives
- Replacement of approx. 400 complete point drives
- Replacement of internal wiring with appr. 300 point drives
- Replacement of the closing devices with 300 point drives

Furthermore, all point drives have to be newly painted.

1.1.1.3.3 TRACK CIRCUITS

With the equipment of the track circuits the connectors, connecting ropes and impedance bonds with secondary winding have to be replaced.

- Substitution of 300 impedance bonds with secondary winding of different types
- Substitution of approx. 500 complete unit connection ropes and connectors

1.1.1.3.4 LEVEL CROSSINGS

With barriers at the crossings the following parts have to be renewed:

- replacement of 80 gate motors
- light signals for signals
- alarm equipment

Furthermore, maintenance of the power supply installations of automatic block equipment as renewal of wiring for power supply, substitution of transformer stations and renewal of masts for power supply route are necessary.

1.1.1.4 SUPPLY OF SPARE PARTS

Before political changes in the former Soviet Union signalling equipment was produced in other Soviet Republics. The signalling equipment was also supplied and used in Azerbaijan. Therefore, the provision with spare parts needed and of complete installations for signalling is only possible from Russia. There is no production of spare parts in the field of signalling technics in Azerbaijan. Because of financial problems no spare parts have been bought during the last few years and the parts required for repairs and maintenance have not been supplied. Necessary spare parts have been refurbished frrom old material and used.

1.1.2 TELECOMMUNICATION PLANTS

1.1.2.1 TECHNICAL DATA

On the line Baku - Bejuk-Kjasik there is used a telecommunication system with 60 channels „K-60". Connection is realized via wires and overhead lines. The type of cable is MKPAB-7*4*1, 05+5*2. Connections are carried out automatically or through operators.

1.1.2.2 CONDITIONS OF THE EXISTING PLANTS

The main problems are the unstable connections in the telecommunication sector. This fact has considerable influence on railway traffic, too.

On the line Baku - Bejuk-Kjasik, section Baku - Aljat, on a length of 67 km there are used air lines. This installation was built in the beginning of the 1980ies; all other connections are realized via overhead lines which were built in the 30ies. The sleeves needed for the connection of the lines have been used since 1983 and partly have become porous. This condition has influence on the function of the telecommunication installations. The main line is the section Kischly - Baladschari.

A survey of total failures of telecommunication technics in 1995 and 1996 (until April) is included in Annex 5.

Furthermore, because of the through electrification of the line the influence on telecommunication technics by electric fields is a problem which has to be considered with the renewal of the telecommunication installations and the new cable line resulting from it.

1.1.2.2.1 DISPATCHING INSTALLATIONS

The existing installations have been built in the period from 1970 - 1990. As a result of financial bottlenecks the installations have not been maintained regularly and the necessary substitution of parts has not been realized.

1.1.2.2.2 TELEPRINTING INSTALLATIONS

The installations used have been installed in the period from 1965 - 1990. There are the following devices:

Type of device	number
T-63	75
STA-CTA-67	39
F-1100 and F-2000	45

Devices T-63 and STA-CTA-67 will not be used any more because of their technical condition. Use of types F-1100 and F-2000 is strongly restricted because of the lack of spare parts.

1.1.2.2.3 RADIO PLANTS

Radio-control of trains facilitates the exchange of information between the stations and the railcars. Furthermore, the railcars which are on the line section can be reached by the service staff of the stations. Accordingly, the stations of the line Baku - Bejuk-Kjasik and the railcars are equipped with radio-control installations. There are also portable radio telephones for the train formation staff. The available installations are working, but have a reduced transmission quality.

1.1.2.3 MEASURES REQUIRED

The aim of the measures to be executed is the improvement of the condition of the installations in the short term. It is also necessary to put into use new modern installations to meet the requirements of the increased transport volume. Another important fact with the realization of the transport volume and the safety of passenger and goods transport is a stable telecommunication network between all those involved in the transport process.

Important installations as power supply, air-conditioning, information systems as well as watches are included in the further annexes in the cost survey.

1.1.2.3.1 CABLE SYSTEMS

The requirements to the transmission lines have to be met by a modern and efficient cable installation. According to this the use of glass-fibre cables is intended for the section Baku - Bejuk-Kjasik, for the main line there will be used a glass-fibre cable with 147 fibres. This dimension will meet all future requirements to the transmission network so that it will not be necessary to exchange the glass-fibre cable in case of an increase of the demand. To secure the full availability of the system there shall be laying of two cables along the line. A survey about the equipment is included in Annex 6.

1.1.2.3.2 COMMUNICATION EQUIPMENT

The communication system required has

- to cover the high needs to the transmission lines

- to guarantee the permanent availablility of the connections

It is intended to use a SDG-system (Synchrone Digital Hierarchy) with 155 Mbits/s. Through the use of Add/Drop-Multiplexer (ADM) with optical STM1-points of intersection it is possible to form a STM1-ring and to make the transmission lines fully available.

The ADM also allow to decouple signals between the network junctions from the STM1-ring.and to newly seize the vacancies.

The STM1-ring facilitates connections of 1920 channels per fibre of the glass-fibre cable. The Cross Connect Multiplexer (CCM) in Baku facilitates a connection with other networks than those of the railways. Annex 7 shows how the STM1-ring is assembled as well as the use of CCM and ADM.

With the use of the STM1-system there will be also sufficient channels for other services and users outside the railways.

1.1.2.3.3 SWITCHING EQUIPMENT

At first maintenance of the available transmission system has to be improved. Furthermore, longer-term measures are required.

In order to meet the growing requirements of telecommunication the gradual exchange of existing connections by operaters and automatic connections with analogue equipment by digital equipment, e.g. quasi-digital switching installations, is essential. This would allow to connect analogue telephones through analogue concentrators to the digital switching installation. Building up of a switching centre could be realized in several stages beginning with some subscribers up to 100 000 subscribers.

1.1.2.3.4 RADIO PLANTS

Due to the necessary growing requirements to radio transmission between the various stations and the locomotive crew a new installation in the section Baku - Bejuk-Kjasik is needed.

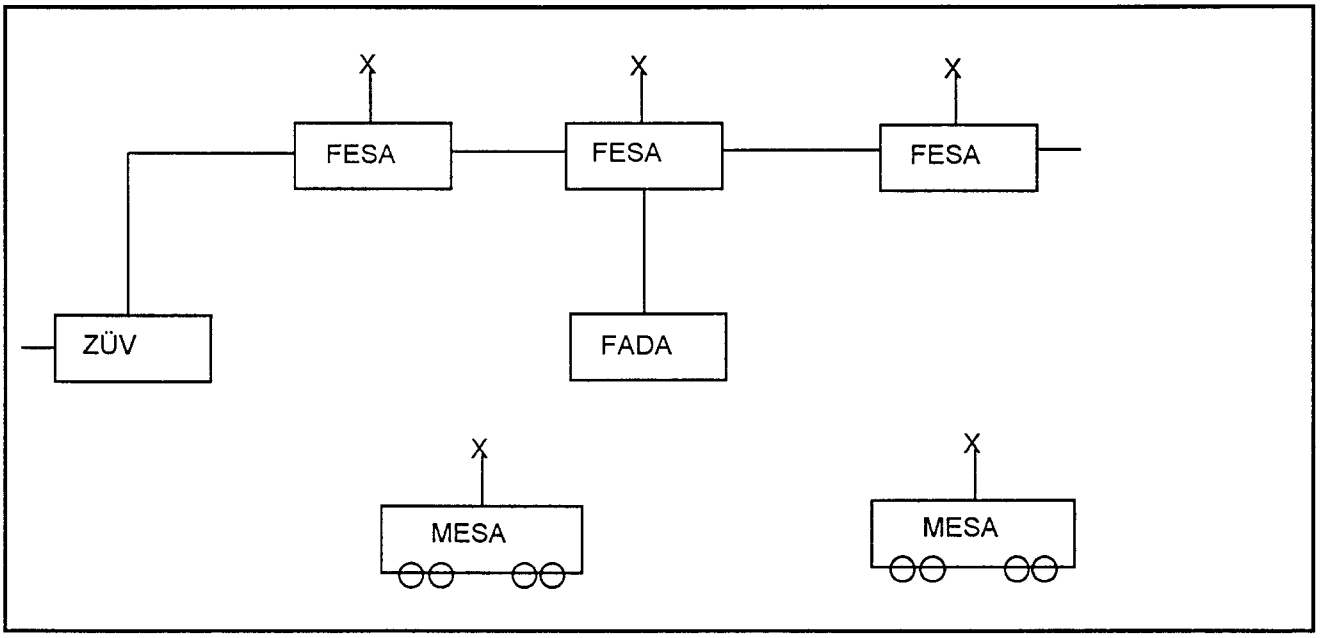
It is suggested to use the system „Train Radio 2002" which is a microcomputer-controlled radio system of a modular construction for voice and data in conformity with European Standards.

The system provides for the line permanent lineside radio installations (FESA). They consist of radio stations and directional radio aerials fixed to concrete poles. When connecting operators of stations the traffic controller installations (FADA)are installed.

An important part is the ZÜV 2002 (supervision of train running) which includes the installations of the responsible traffic controller and facilitates the transmission of information to the future central control.

The tractive units shall be equipped with mobile railway radio installations (MESA). Shunting staff will use portable radio sets.

Plan of the system „Train Radio 2002":



1.1.2.4 SUPPLY OF SPARE PARTS

The spare parts needed for short-term measures to increase the maintenance condition of telecommunication equipment have to be procured after provision of financial means.

Agreements concerning the supply of spare parts for new installations shall be included in the delivery contract within the framework of the first installation with the corresponding companies.

1.1.3 MAINTENANCE

1.1.3.1 ORGANIZATION AND EQUIPMENT

There are no central workshops divided into signalling and telecommunication workshops, the existing central workshops form a unit. The central workshops in the various departments are responsible for maintenance and repair of signalling and telecommunication installations. The technical parameters of the parts and installations shall be checked and recorded in the controlling centre (KVP).

Tasks which result from the suppression of the installations are recorded by the dispatcher and coordinated. For the analysis all irregularities have to be recorded and evaluated in the departments. For the exchange of information the maintenance staff and the dispatcher are connected with each other by an internal network.

There are the following central workshops for signalling and telecommunication installations:

- Baku
- Baladschari
- Kazimagomed
- Ewlach
- Gjandsha
- Akstafa

The locations of these workshops are included in Annex 1. The existing workshops are provided with the equipment needed for repairs, maintenance and inspections of the required technical parameters. However, it is necessary to introduce modern measuring instruments and other tools. The complete rehabilitation and equipment of the central workshops in Baku, Kasimagomed, Ewlach and Gjandsha are essential. In order to carry through a quick and efficient maintenance and suppression it is important to replace the existing rolling stock.

1.1.3.2 STAFF

In the signalling and telecommunication department there are working 2317 employees. 30 of them are working in the central workshops. The working groups consist of 2 - 4 employees who are responsible for maintenance and inspection of repaired parts regarding the compliance with mechanical and electrical standards.
For the signalling installations on-site there are responsible 912 employees, for telecommunication installations 663.

1.1.4 COST ACCOUNTING

1.1.4.1 SIGNALLING PLANTS

The necessary financial means are indicated in annual rates as follows:

year	expenses in mio USD
- 2000	16,5
2001	27,5
2002	15,8
2003	13,1
2004	16,2
2005	18,6
2006	12,7
2007	8,1
2008	10,1
total	**138,6**

The financial means needed for all measures are shown in detail in Annex 4.

1.1.4.2 TELECOMMUNICATION PLANTS

The necessary financial means are indicated in annual rates as follows:

year	expenses in mio USD
- 2000	12,0
2001	5,6
2002	5,1
2003	4,6
2004	4,0
2005	3,5
2006	2,8
2007	2,8
2008	2,7
total	**43,1**

The financial means needed for all measures are shown in detail in Annex 8.

2.1 Georgian State Railway

2.1.1 Signalling Plants

2.1.1.1 Technical Data

Signal boxes with push-buttons of Russian construction from the period 1960 - 1991 are used for operation on railway stations. The routes are set up by means of start and target keys. After the train ride will be terminated the route will be released automatically. In the event of an accident occurring auxiliary releases are possible. On free line sections an automatic section block is available. Only light signals are used for signalling. The announcement that the track is free is passed on to the automatic block through track circuits. Power supply of the signalling systems on the track is implemented through an overhead line which is fixed at the railway poles. A second power supply line is available for a troublefree power supply of the signalling equipment.

A survey of the stations situated at the Tbilisi-Poti/Batumi line is contained in Annexes 9 and 10.

Table 2.1-1 Selected Plants at the Tbilisi - Poti/Batumi line

Plants	Plants altogether
Points	1397
Light signals	2044 (1100 signals thereof are not operative)
Track circuits	2682 on the line (2256 thereof are not operative) 2226 on the stations (1911 thereof are not operative)
Interlocking cabins	69
Level crossings	30 2 automatic plants 4 mechanical plants 24 plants are not operative

2.1.1.2 Condition of the Existing Plants

The technical condition and the operatability of the systems of railway station and line equipment still existing is satisfactory. A semi-automatic section block exists on the line sections between Gardabani-Tbilisi-Uslovaia and Kaspi-Samtredia, i.e. train traffic is only possible between adjacent stations. An operative automatic section block exists between the Tbilisi-Uslovaia- Kaspi stations. The signalling equipment on the Samdredia - Poti and Samtredia -Batumi sections is no longer operative. Point mechanisms and choke transformers are to be regarded as the priority of the equipment used.

An emergency unit is available on the Gardabani - Sestafoni section to ensure a troublefree power supply of the signalling equipment. Yet, a problem of power supply is the instable supply of power in the period between November and May.

A survey of the line sections is contained in Annex 11.

2.1.1.2.1. Signals

As to the outer condition of the signalling and dwarf signalling equipment you can detect corrosion at the poles and signal screens caused by outer influences. The visibility of some signals is limited for the staff of the locomotive. Yet, this is also caused by the bad condition of the signal lenses predominantly used. Functioning of the equipment is affected by damages caused by third persons and theft of required elements, e.g. the relay systems of the block cupboards of the automatic block and the branch cables at the signal poles and the lines for the power supply of the equipment of the automatic section block.

2.1.1.2.2 Point Mechanisms

The condition and the operatibility of the existing electric point mechanisms is predominantly affected by the bad conditions of the points. The required quiet position of the point mechanism is not given by the existing track layout. Due to corrosion the outer condition of the point mechanisms is only satisfactory. In approx. 70 % of the point mechanisms the electric motors used, the point switches and the internal wiring reached the limit of their service lives.

2.1.1.2.3 Track Circuit

In stations there exist 2226 and on line sections 2682 track circuits of the Tbilisi-Poti/Batumi line. 1911 track circuits thereof in stations and 2256 on line sections are no longer operative due to various elements having been stolen. The basis for a troublefree functioning of the track circuits is the condition of the tracks. Owing to the bad resistance of insulation of the tracks and points the still existing track circuits break down again and again. The chokes used and the connection ropes and connectors required for connection to the track are in a bad condition.

2.1.1.2.4 Cable Systems

All cables supplying electric power to outdoor installations are buried. The cable connecting stands installed in buildings are in a good state. Distribution boards are used for the connection of individual branch cables and the connection of the main cables among each other. The condition of the track connecting boxes was not satisfactory.

2.1.1.2.5 Level Crossings

For safety reasons 30 level crossings exist on the Tbilisi-Poti/Batumi line. Yet, only 2 automatic gate installations are still operative, 4 installations are mechanical gate installations. The safety facilities of the other installations have been dismounted due to vandalism.

2.1.1.3 Measures Required

To increase the present traffic volume the operatability of the signalling equipment has to be improved and the dismounted facilities have to be replaced. It will be necessary to replace the signalling plants in the short and medium term. Short-term measures relate to replacing of existing plants and to achieving their operatability to increase reliability. After having inspected the existing signalling plants and studied the conditions prevailing here it would seem to be more advantageous to apply Russian equipment also in future. It has proved its reliability and robustness in the last years. Thus, the demands made on the operating and service staff would not change. Studies have always confirmed that given the respective financial funds a supply of spare parts from Russia will be possible at any time. Replacing the existing track circuits by wheel counting devices and their adaptation to the existing equipment is envisaged as a medium-term measure.

In addition, it will be necessary to undertake further actions such as to restore the automatic section block and to complete the equipment required in this connection to increase the passage of the line.

The Georgian State Railway has already charged the existing planning office with preparing the plans for the Samtredia - Poti and the Samtredia - Batumi line sections. That means, that the stations existing in this section shall be put into operation with restricted functions. A semi-automatic block will be installed between the individual stations. No longer existing outdoor installations will be put out of operation or repaired using still available spare parts. The Signal and Telecommunication Equipment Department has already laid a glass fibre cable provided by EU in the Samtredia - Poti and the Samtredia - Batumi sections. Adaptation elements have been developed for the transmission of the required information. For the time being, financial funds are still lacking to implement this measure. The funds required for this are contained in the survey.

The following short-term measures will have to be implemented in the individual afore-mentioned parts of the system to reach the full functioning of the signalling system and to replace the dismounted equipment.

2.1.1.3.1 Signals

* replacement of 262 complete light signals
* replacement of 1200 light signal lenses
* replacement of branch cables for 100 signals
* replacement of signal lamps for 500 signals
* In addition, all existing light signals are to be newly painted.

2.1.1.3.2 Points

* replacement of electric motors for 250 point mechanisms
* replacement of 500 point switches
* replacement of internal wiring for approx. 980 point mechanisms
* replacement of locking facilities of 500 point mechanisms
* replacement of 100 complete point mechanisms
* In addition, all existing point mechanisms have to be newly painted.

2.1.1.3.3 Track Circuits

Connectors, connecting ropes and 400 choke transformers have to be replaced in the facilities of the still existing and operative track circuits. A complete equipment of 1911 track circuits in stations and 2226 track circuits on line sections will be required.

2.1.1.3.4 Level Crossings

The following components have to be replaced in gate installations of level crossings:

* gate motors
* light signal lenses for road signals
* alarm systems

The signalling equipment of 20 former automatic gate installations which are no longer operative due to various components having been dismounted has to be completely replaced.

Furthermore, power supply facilities of automatic block facilities have to be serviced, i. e. supply mains, transformer stations and poles for the power supply line have to be replaced. A second line has to be installed in the Samdredia - Poti and the Samdredia - Batumi sections for an emergency power supply.

2.1.1.4 Supply of Spare Parts

Before the political change has taken place in the former Soviet Union all signalling plants in other Soviet republics had been repaired. Signalling equipment had also been sent to Georgia and installed there. That is why so far it is only possible to get the required spare parts and complete plants for the signalling systems only from Russia. Owing to the financial squeeze spare parts have not been bought in the last few years. Elements required for repair and maintenance were not completed. Spare parts required were taken from waste material.

As of 1997 it is envisaged that the „TEWS" company will produce spare parts for signalling plants in Georgia. It is planned to produce parts of the electric point mechanisms, signal screens and chokes. To this end, samples of the parts to be produced were handed over to „TEWS". For the time being, it is considered which of the available machines may be used and where the production will have to be changed to meet the new demands. After implementing this measure it will be possible for the „TEWS" company to take over the production of spare parts also for the Azerbajan State Railway on the basis of contractual arrangements.

2.1.2 Telecommunication Plants

2.1.2.1 Technical Data

A system involving 60 „K-60" channels and a system involving 30 channels will be used on the Tbilisi-Batumi/Poti section for the telecommunication traffic. A system with 12 channels exists between Garbadani and Tbilisi. The communication path will be implemented by cables. Predominantly MKPAB-7*4*1.2+5*0.9+1*0.7 is used as cable type. MAVM-K-7*4*1.2+5*0.9+1*0.7 cables are used on the Batumi-Lanchkhuti-Samtredia sections. Automatic and manual exchanges are used to build up telecommunication.

2.1.2.1 Condition of the Existing Plants

A priority are the unstable connections of the telephone network. This fact has also a remarkable influence on the train traffic. The whole telecommunication line of the Tbilisi-Batumi/Poti line was cabled. The plants between Tbilisi - Gardabani were installed in 1984, between Tbilisi - Khashuri in 1982, between Khashguri - Sestphoni in 1979 and between Sestaphoni and Samtredia in 1980. The cables required for the connection were dismounted on various sections due to vandalism. This condition had a remarkable influence on the operativeness of the telecommunication facilities.

Cables are no longer to be found in the following sections:

from	to	km	type	
Senaki	Abasha	13.4	MKPAB-7*4*1.2+5*0.9+1*0.7	
Gardabani	border	9.1	MKPAB-7*4*1.2+5*0.9+1*0.7	
Marneuli	Sadakhlo	29.1	MKPAB-7*4*1.2+5*0.9+1*0.7	
Batumi	Lanchkhuti	73.5	MAVM-K-7*4*1.2+5*0.9+1*0.7	*)
Lachkhuti	Samtredia	30.5	MAVM-K-7*4*1.2+5*0.9+1*0.7	*)
Senaki	Poti	38.3	MAVM-K-7*4*1.2+5*0.9+1*0.7	*)

*) The Railway has already laid glass fibre cables in these sections.

2.1.2.2.1 Radio Plants

Radio service on trains allows the connection between the stations and traction vehicles. In addition, traction vehicles which are on open track sections may be contacted by the operating staff of the stations. The stations of the Tbilisi - Batumi/Poti line and the traction vehicles are equipped with radio-service plants for trains. Apart from that, portable wireless equipment provided by EU is available.

2.1.2.3 Measures Required

When envisaging the measures to be undertaken it has been always proceeded on the fact that the condition of the plants of the Tbilisi-Batumi/Poti line has to be improved in the short term.

In addition, it is necessary to use modern equipment to satisfy the demands connected with the transport volume. An important fact in coping with the transport volume and providing safety in the passenger and goods traffic is a stable communication connection between all participants of the transport process.

The facilities required such as power supply, air conditioning plants, communication plants and clock plants form part of the cost survey under the item „Miscellaneous Facilities".

2.1.2.3.1 Cable Systems

The demands on communication paths have to be secured by a modern and efficient cable plant. Following this necessity it is envisaged to use glass fibre cables on the Tbilisi - Batumi/Poti line section. It is envisaged to use two glass fibre cables with 147 fibres on the main line between Tbilisi and Samdredia. On the Samtredia - Batumi/Poti sections the existing glass fibre cables already laid by the Georgian Railway will be used. This cable system will take the future demand for communication paths into account. That means, that it will not be necessary to

replace the glass fibre cable in the event of the demand rising. To ensure the full availability of the cable system on the main line two cables will be laid along the line. Annex 13 includes a survey of the cable equipment.

2.1.2.3.2 Communication Equipment

The required communication system has to

* satisfy the high demand for communication channels,
* ensure a constant availability of communication.

An SDH (synchronous digital herarchy) system with 155 Mbit/s is envisaged. By using add/drop multiplexers (ADM) with optical STM1 interfaces an „STM1 ring" is formed and thus the full availability of the communication channels is given.

The ADM allow to decouple signals between the network junctions from the STM1 ring and to newly seize the vacancies.

The chosen STM1 ring allows to make connections over approx. 1900 channels per fibre of the glass fibre cable. The cross connect multiplexers CCM stationed in Tbilisi and Samdredia allow to establish a connection also to networks outside the railway.

Setting up the STM1 ring and using CCM and ADM is represented on the system drawing in Annex 14.

2.1.2.3.3 Switching Equipment

A first step is to improve the conditions of maintenance of the existing exchanges. In addition, longer-term measures will have to be taken.

To satisfy the grown demands for switching services in telephone traffic the existing manual exchanges and automatic exchanges with analogue equipment are to be gradually replaced by digital exchanges. It is recommended to use quasi-digital exchanges. In these switching systems analogue telephone sets may be connected to a digital exchange via analogue concentrators. An exchange may be extended in a few stages, from a small number of subscribers to 100 000 subscribers.

2.1.2.3.4 Radio Plants

A new plant will be required for the Tbilisi-Batumi/Poti line section to satisfy the higher demands for radio communication between the individual stations and the locomotive staff.

The train radio-service system 2002 is recommended here. This system is a microcomputer-controlled radio system of a modular construction for voice and data communication in conformity with European standards.

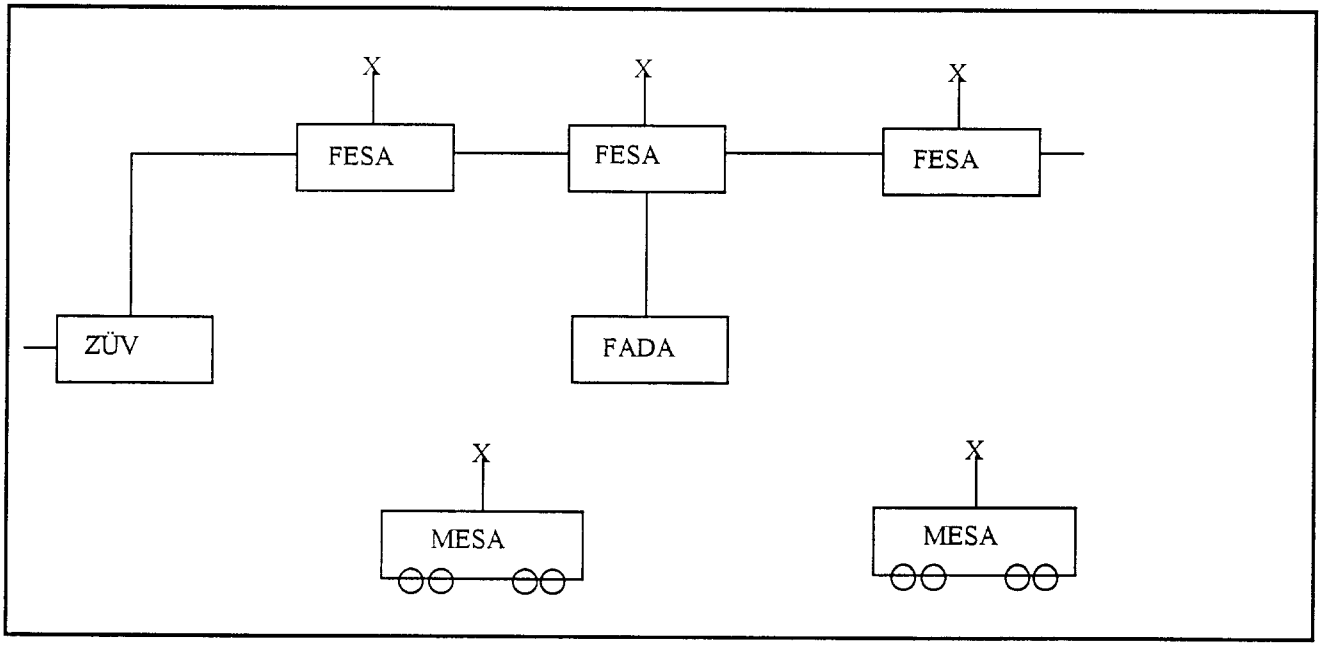
This system envisages stationary railway line radio plants FESA on this line. They consist of radio stations and radio-link antennas installed on concrete poles. If operators of stations have to be connected so-called FADA (station master) plants have to be installed.

An important component is ZÜV 2002 containing the facilities of the traffic controller. They allow to transmit information to a later operations management centre.

Traction vehicles will be equipped with mobile railway line radio plants MESA.

Portable wireless equipment will be used for the shunting area.

Train radio-service 2002 system drawing



2.1.2.4 Supply of Spare Parts

After the financial funds will be provided the spare parts required for the implementation of short-term measures to improve the maintenance condition of telecommunication plants are to be purchased. The supply of spare parts for the new plants is to be agreed upon with the respective companies in the framework of the original equipment on the basis of supply contracts.

2.1.3 Maintenance

2.1.3.1 Organization

Central repair shops specialized separately in signalling equipment and in telecommunication equipment do not exist, the existing central repair shops form a unity. The central repair shops in the individual sectors are responsible for the maintenance and repair of signalling and telecommunication equipment. The technical parameters to be observed for the elements and the equipment used in signalling and telecommunication systems are verified and documented in the central repair shops.

There are the following central repair bases for the equipment of signalling and telecommunication systems:

* Tbilisi
* Samtredia
* Khashuri

The locations of the repair bases are contained in Annex 9.

The existing repair shops are equipped with the appliances required for repair, maintenance and checking whether the technical parameters are observed. Yet, it is necessary to gradually purchase modern measuring instruments and other tools. To carry through a fast and effective maintenance and screening it is imperative to replace the available rolling stock by new cars and construction equipment (e.g. cranes and elevators, excavators for earth work).

2.1.3.2 Staff

1100 persons are employed in the Signalling and Telecommunication Equipment Department.

148 of them fall to central workshops for signalling and telecommunication equipment. 57 staff members are employed for repair and testing of the necessary relays. 91 staff members are employed for the repair and maintenance of the equipment of the department.

2.1.4 Cost Accounting

2.1.4.1 Signalling Plants

The financial funds required are subdivided into annual rates in the following survey:

Year	Expenses in US $ million
- 2000	23.8
2001	24.5
2002	12.8
2003	10.6
2004	12.2
2005	14.2
2006	8.7
2007	8.6
2008	8.6
total	**124.0**

The financial funds required for the implementation of all measures are broken down in greater detail in Annex 15.

2.1.4.2 Telecommunication Plants

The financial funds required are subdivided into annual rates in the following survey:

Year	Expenses in US $ million
-2000	8.3
2001	4.5
2002	4.0
2003	3.3
2004	3.1
2005	3.0
2006	2.8
2007	2.7
2008	2.7
total	**34.4**

The financial funds required for the implementation of all measures are broken down in greater detail in Annex 16.

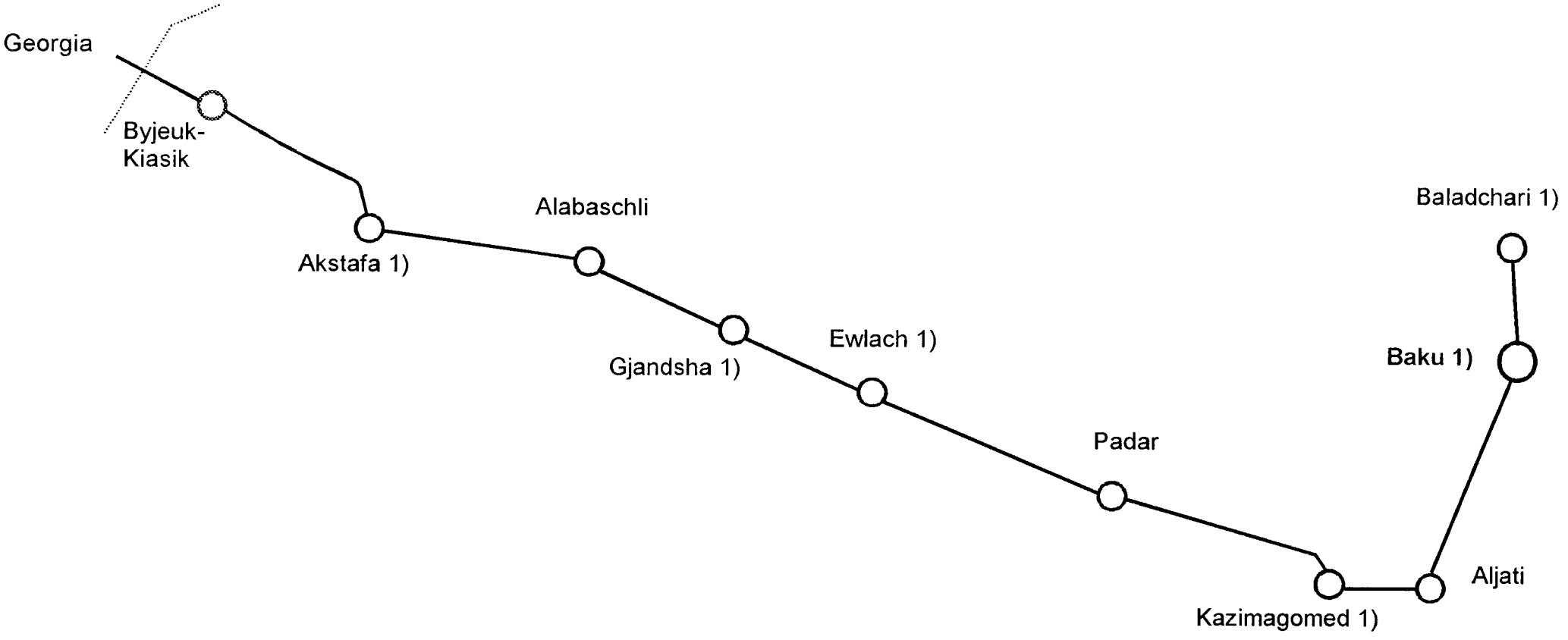
annexes

annex 15 costs summary of signalling equipments and installations of the Georgean Railways

annex 16 costs summary of telecommunications installations of the Georgean Railways

annex 1

Line Baku - Byjeuk-Kiasik of the Aserbaidchanian Railways



1) repair location for signalling and telecommunication

annex 2

Stations of the Aserbaidshanian Railways Baku - Byjeuk-Kiasik

Nr.	station	km	type	points	originating year	condition
1	Baku - storage sidings	2661	BMRZ	51	1987	sufficient
2	Baku - goods station	2659	BMRZ	65	1963	sufficient
3	Kishli - main station	2654	BMRZ	66	1963	sufficient
4	Kishli - station „A“	2654	BSZ	24	1976	sufficient
5	Baladshari	2646	BMRZ	193	1994	sufficient
6	Baladshari - hump region	530	BMRZ	36	1993	sufficient
7	Ejbat	518	SZ	15	1965	sufficient
8	Puta	510	SZ	12	1965	sufficient
9	Karadag	498	BMRZ	24	1963	sufficient
10	Songatschali	484	SZ	20	1965	sufficient
11	Duwani	475	SZ	20	1965	sufficient
12	Aljati - main station	461	BMRZ	65	1975	sufficient
13	Agbulag	447	SZ	14	1975	sufficient
14	Nawagi	436	SZ	16	1965	sufficient

annex 2

Nr.	station	km	type	points	originating year	condition
15	Pirsagat	427	SZ	15	1965	sufficient
16	Kasimagomed	417	MRZ	69	1961	bad
17	Mugan	405	SZ	12	1967	bad
18	Gadshiewo	391	SZ	11	1967	bad
19	Padar	379	SZ	24	1978	good
20	Sagiri	366	SZ	12	1967	good
21	Kerrar	352	SZ	13	1964	good
22	Kürdamir	342	MRZ	30	1968	bad (manual-points)
23	Karabudshag	331	SZ	12	1967	good
24	Müßüli	321	SZ	15	1969	good
25	Barguschet	308	SZ	15	1971	sufficient
26	Udshari	295	MRZ	44	1971	good
27	Alikend	286	SZ	12	1965	good
28	Yjaki	275	SZ	18	1965	good

annex 2

Nr.	station	km	type	points	originating year	condition
29	Malai	264	SZ	14	1972	good
30	Ewlach	250	MRZ	53	1966	bad
31	Mingetschaur - main station	238	SZ	19	1966	good
32	Geran	225	SZ	12	1969	bad
33	Küretschai	214	SZ	14	1966	bad
34	Dalimamedli	200	SZ	11	1966	good
35	Sasali	193	SZ	19	1966	good
36	Gjandsha	183	BMRZ	108	1987	good
37	Alabaschli	170	MRZ	30	1963	hand-points
38	Schamkir	159	MRZ	16	1962	hand-points
39	Dölljar	149	MRZ	21	1962	hand-points
40	Dsegjam	136	MRZ	13	1961	hand-points
41	Kowljar	122	MRZ	17	1961	hand-points
42	Taus	109	SZ	27	1982	good

annex 2

Nr.	station	km	type	points	originating year	condition
43	Tatly	98	SZ	10	1975	good
44	Akstafa	88	MRZ	47	1969	good
45	Poili - main station	74	SZ	24	1966	good
46	Salogli	65	SZ	23	1975	good
47	Sojug - Bulag	56	SZ	27	1975	good
48	Bejuk - Kjasik	45	MRZ	47	1975	bad

annex 3

Number of failures on the signalling installations of the Aserbaidshanian Railways

year	signals	elektric points	track circuits	automatic level crossings
1995	23	15	413 *1)/78 *2)	- *3)
- 04.96	7	1	18	- *3)

*1) Σ total failures that occured on track circuits

*2) part in responsibility of the signalling department

*3) no comments

annex 4

Costs summary of signalling installations of the Aserbaidshanian Railway

installations / year	-2000	2001	2002	2003	2004	2005	2006	2007	2008	lumpsum
signals	4.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	***7.6***
elektric drive of points	5.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	***8.6***
track circuits	2.5	2.0	1.0	0.5	0.5	0.5	0.4	0.4	0.4	***8.2***
automatic level crossings	1.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	***13.0***
spare parts, cabels	2.0	1.0	0.5	0.5	0.5	0.4	0.4	0.4	0.4	***6.1***
complete interlocking boxes 1)	0	14.0	4.0	4.0	7.0	11.0	4.5	5.0	7.0	**56.5**
replacement of manual stations	0	7.0	7.0	5.0	5.5	4.0	5.0	0	0	***33.5***
lumpsum of technical installations	*15.5*	*26.5*	*15.0*	*12.3*	*15.8*	*18.2*	*12.4*	*7.9*	*9.9*	***133.5***
equipments for the central repair shops	0.5	0.5	0.5	0.5	0.2	0.2	0.2	0.1	0.1	***2.8***
renewal of the rolling stock for maintenance and fault clearance	0.5	0.5	0.3	0.3	0.2	0.2	0.1	0.1	0.1	***2.3***
Total [in US $]	***16.5***	***27.5***	***15.8***	***13.1***	***16.2***	***18.6***	***12.7***	***8.1***	***10.1***	***138.6***

1) replacement of the weared signalling equipments

all figures in Mio. US $

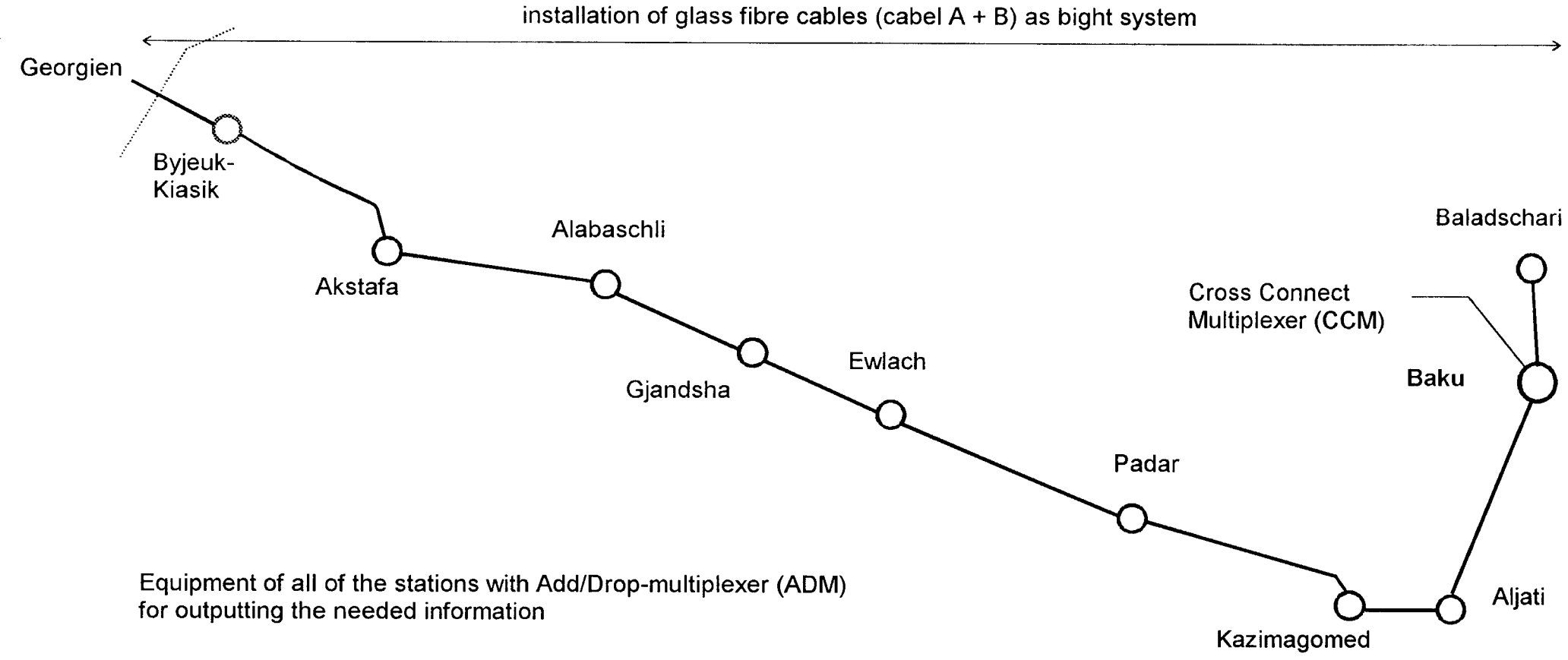
annex 5

Number of failures on the telecommunications installations of the Aserbaidshanian Railways

year	cabel installations	dispatching net	teletype-installations	telefon installations	radio installations
1995	18	74	4	33	16
- 04.96	9	14	2	8	4

annex 6

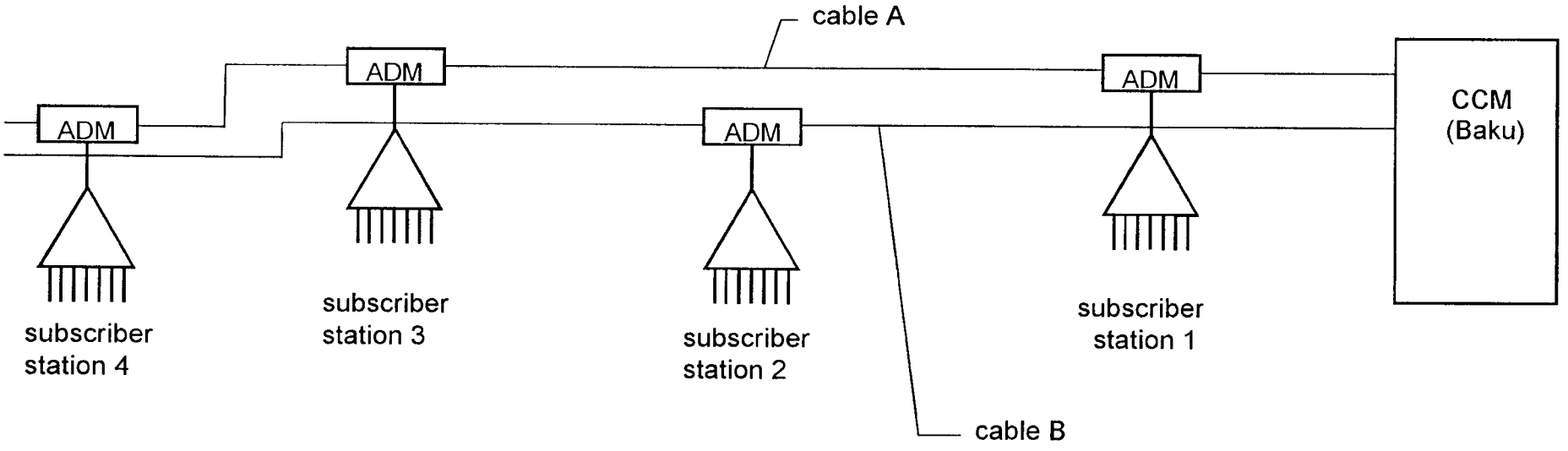
Overview of the lines with telecommunication equipment of the Aserbaidshanian Railways



Equipment of all of the stations with Add/Drop-multiplexer (ADM)
for outputting the needed information

annex 7

Overview of the telecommunication systems for the Aserbaidshanian Railways



ADM - Add/Drop-Multiplexer
CCM - Cross Connect Multiplexer

annex 8

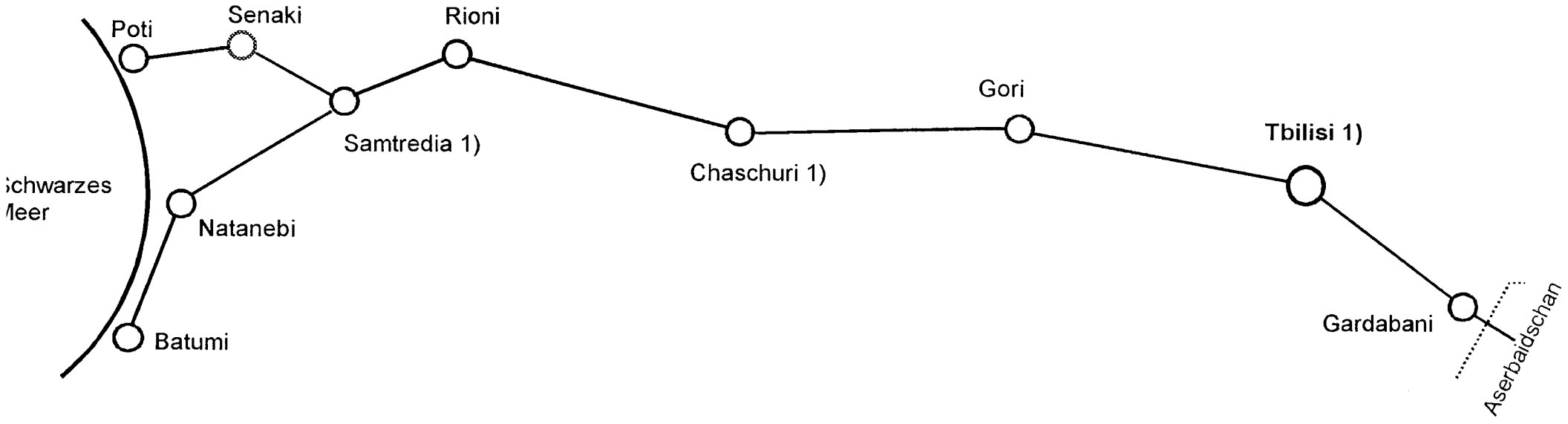
Costs summary of telecommunications installation of the der Aserbaidshanian Railways

installations / year	-2000	2001	2002	2003	2004	2005	2006	2007	2008	lumpsum
glass fibre cables	5.0	2.0	2.0	2.0	1.5	1.5	1.0	1,0	1.0	***17.0***
communication installation	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0,5	0.5	***5.0***
exchange installations	1.0	0.5	0.5	0.5	0.5	0.4	0.4	0,4	0.3	***4.5***
radio installations	2.5	1.5	1.0	0.8	0.8	0.5	0.5	0,5	0.5	***8.6***
other installations	1.0	0.4	0.4	0.4	0.4	0.3	0.2	0,2	0.2	***3.5***
lumsum of technical installations	*10.5*	*4.9*	*4.4*	*4.2*	*3.7*	*3.2*	*2.6*	*2.6*	*2.5*	***38.6***
equipments for the central repair shops	1.0	0.4	0.4	0.2	0.1	0.1	0.1	0.1	0.1	***2.5***
renewal of the rolling stock for maintenance and fault clearance	0.5	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	***2.0***
Total [in US $]	***12.0***	***5.6***	***5.1***	***4.6***	***4.0***	***3.5***	***2.8***	***2.8***	***2.7***	***43.1***

all figures in mio US $

annex 9

Line Tbilisi - Poti / Batumi of the Georgian Railways



1) repair location for signalling and telecommunication

annex 10

Stations of the Georgian Railways Gardabani - Poti / Batumi

Nr.	station	km	type	points	originating year	condition [2]
1	Gardabani	32.9	MRZ-13	36	1973	24 reactors / 8 light signals
2	Rustavi - goods station	24.6	MRZ-13	46	1973	10 reactors / 14 light signals
3	Rustavi - passenger station	21.5	EZ-9	19	1967	2 reactors / 2 light signals
4	Gatschiani	15.1	MRZ-13	33	1976	31 reactors / 12 light signals
5	Weli	9.6	EZ-9	22	1970	6 reactors / 4 light signals
6	Tbilisi - marshalling yard		MRZ-13	76	1990	40 reactors / 6 light signals
7	Tbilisi - marshalling sidings		-	-	1978	- reactors / 6 light signals
8	Tbilisi - junction	2509.2	MRZ-13	75	1964	12 reactors / 12 light signals
9	Tbilisi - passenger station	2502.9	MRZ-13	78	1976	1 reactors / 3 light signals
10	Tbilisi - goods station	2500.6	TP-47	47	1963	3 reactors / 7 light signals
11	Didube	2499.0	EZ-9	14	1977	4 reactors / 2 light signals
12	Awtschala	2492.5	EZ-9	12	1957	24 reactors / 4 light signals
13	Sahessi	2489.4	EZ-9	19	1977	4 reactors / 4 light signals
14	Mzcheta	2481.5	EZ-9	15	1976	1 reactors / - light signals

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Nr.	station	km	type	points	originating year	condition [2]
15	Dsegwi	2475.0	EZ-9	23	1978	13 reactors / 6 light signals
16	Ksani	2469.9	EZ-9	19	1979	7 reactors / 3 light signals
17	Kawtischewi	2459.8	EZ-9	21	1980	7 reactors / 3 light signals
18	Kaspi	2454.3	EZ-9	30	1980	1 reactors / - light signals
19	Metechi	2447.2	EZ-9	19	1981	24 reactors / 6 light signals
20	Grakali	2441.8	EZ-9	19	1981	16 reactors / 3 light signals
21	Uplisziche	2434.5	EZ-9	16	1978	35 reactors / 4 light signals
22	Gori	2427.3	MRZ-13	35	1978	23 reactors / 3 light signals
23	Skra	2419.2	EZ-9	14	1974	7 reactors / 2 light signals
24	Kareli	2409.1	EZ-9	18	1980	7 reactors / 2 light signals
25	Agara	2402.7	EZ-9	29	1981	33 reactors / 2 light signals
26	Gomi	2394.0	EZ-9	17	1965	19 reactors / 2 light signals
27	Chaschuri	2383.2	TP-47	59	1968	28 reactors / 4 light signals
28	Lichi	2375.0	EZ-2	14	1975	14 reactors / 2 light signals

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Nr.	station	km	type	points	originating year	condition [2]
29	Zipa	2366.7	EZ-9	11	1979	21 reactors / 2 light signals
30	Moliti	2359.6	EZ-2	8	1969	18 reactors / 2 light signals
31	Marelissi	2352.6	EZ-2	11	1969	13 reactors / 4 light signals
32	place 2347 km	2347.0	EZ-9	-	1969	4 reactors / 1 light signals
33	Charagauli	2343.1	EZ-9	12	1969	9 reactors / 2 light signals
34	place 2338 km	2338.1	EZ-9	-	1970	9 reactors / 2 light signals
35	Dsirula	2333.4	EZ-2	10	1974	13 reactors / 2 light signals
36	place 2328 km	2328.5	EZ-9	-	1969	12 reactors / 2 light signals
37	Schoropani	2323.9	EZ-9	12	1969	13 reactors / 3 light signals
38	Sestaphoni	2320.1	MRZ-13	52	1990	50 reactors / 7 light signals
39	Argwata	2313.3	EZ-9	29	1980	20 reactors / 6 light signals
40	Swiri	2306.9	EZ-9	16	1978	43 reactors / 2 light signals
41	Adshameti	2297.1	EZ-9	21	1978	53 reactors / 6 light signals
42	Rioni	2289.9	EZ-9	25	1991	29 reactors / 6 light signals

annex 10

Nr.	station	km	type	points	originating year	condition [2]
43	Brozeula	2285.7	EZ-9	22	1960	40 reactors / 7 light signals
44	Muchiani	2280.1	EZ-9	20	1978	34 reactors / 2 light signals
45	Kopitnari	2271.5	EZ-9	19	1978	45 reactors / 6 light signals
46	Samdredia II	2262.4	MRZ-13	106	1988	92 reactors / 11 light signals
47	Samdredia I	2259.1	TP-43	58	1975	8 reactors / 2 light signals
48	Kolobani	2251.4	EZ-9	12	1988	4 reactors / 2 light signals
49	Abascha	2245.6	EZ-9	4	1963	9 reactors / 2 light signals
50	Agur Kachana	2238.9	EZ-2	6	1963	9 reactors / 3 light signals
51	Senaki	2232.2	EZ-9	15	1964	24 reactors / 10 light signals
52	Kwaloni	10.1	EZ-9	8	1969	16 reactors / 4 light signals
53	Tschaladidi	23.2	EZ-2	4	1968	16 reactors / 3 light signals
54	Poti	38.3	EZ-9	2		4 reactors / 2 light signals
55	Sadshawacho	96.0	EZ-2	12	1966	4 reactors / 3 light signals
56	place 2256 km	-	-	-	-	[1]

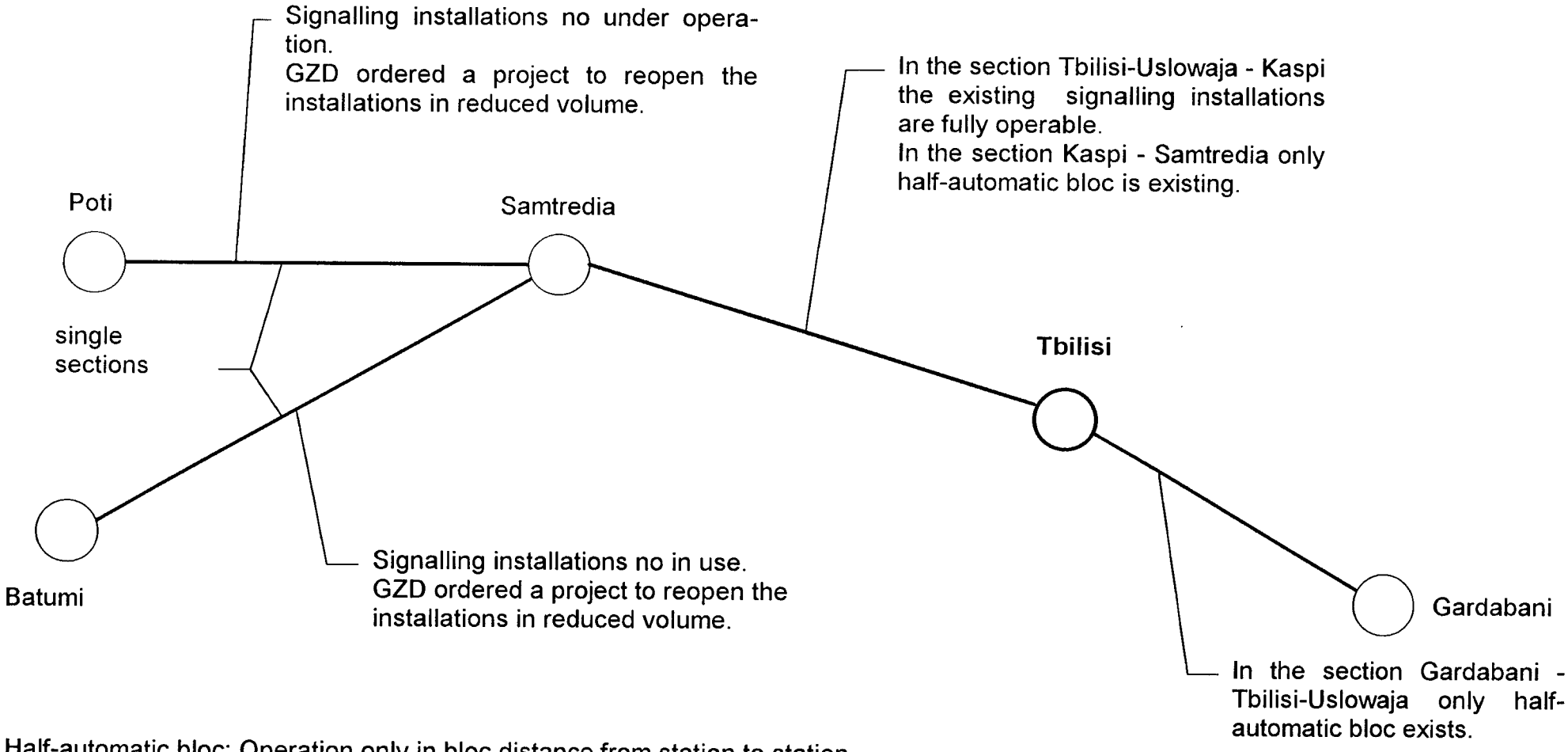
annex 10

Nr.	station	km	type	points	originating year	condition [2]
57	place 101 km	-	-	-	1987	[1]
58	Dshapana	88.1	EZ-9	3	1987	8 reactors / 2 light signals
59	Nigoete	81.8	EZ-2	5	1987	4 reactors / 2 light signals
60	Lantschchuti	75.1	EZ-2	6	1980	5 reactors / 2 light signals
61	Dshumati	63.4	EZ-2	6	1980	5 reactors / 2 light signals
62	Supsa	54.5	EZ-2	5	1966	4 reactors / 3 light signals
63	Ureki	48.0	EZ-9	7	1966	2 reactors / 3 light signals
64	Natanebi	39.5	Ez-2	8	1966	2 reactors / 2 light signals
65	Otschchamuri	30.3	EZ-2	9	1967	2 reactors / 3 light signals
66	Kobuleti	23.5	EZ-2	11	1965	4 reactors / 2 light signals
67	Tschakwa	13.9	EZ-2	11	1965	2 reactors / 2 light signals
68	Machindshauri	6.9	EZ-9	4	1965	13 reactors / 1 light signals
69	Batumi	1.6	EZ-9	35	1965	6 reactors / 8 light signals

[1] Stations in km101 und 2256 are replace because of stolen equipments.
[2] Listet are all installations that were dismantled by theft.

annex 11

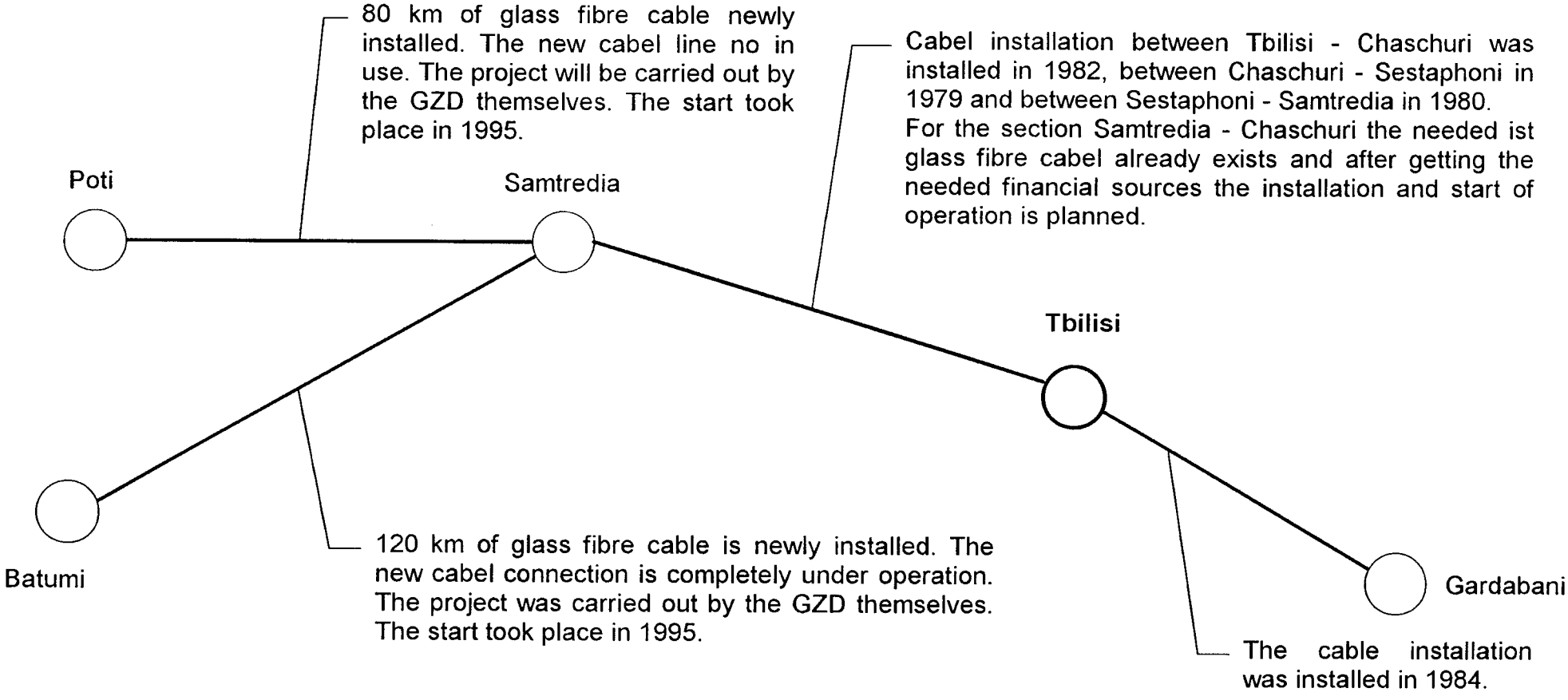
Overview of the lines with signalling installations on Georgian Railways



Half-automatic bloc: Operation only in bloc distance from station to station.

annex 12

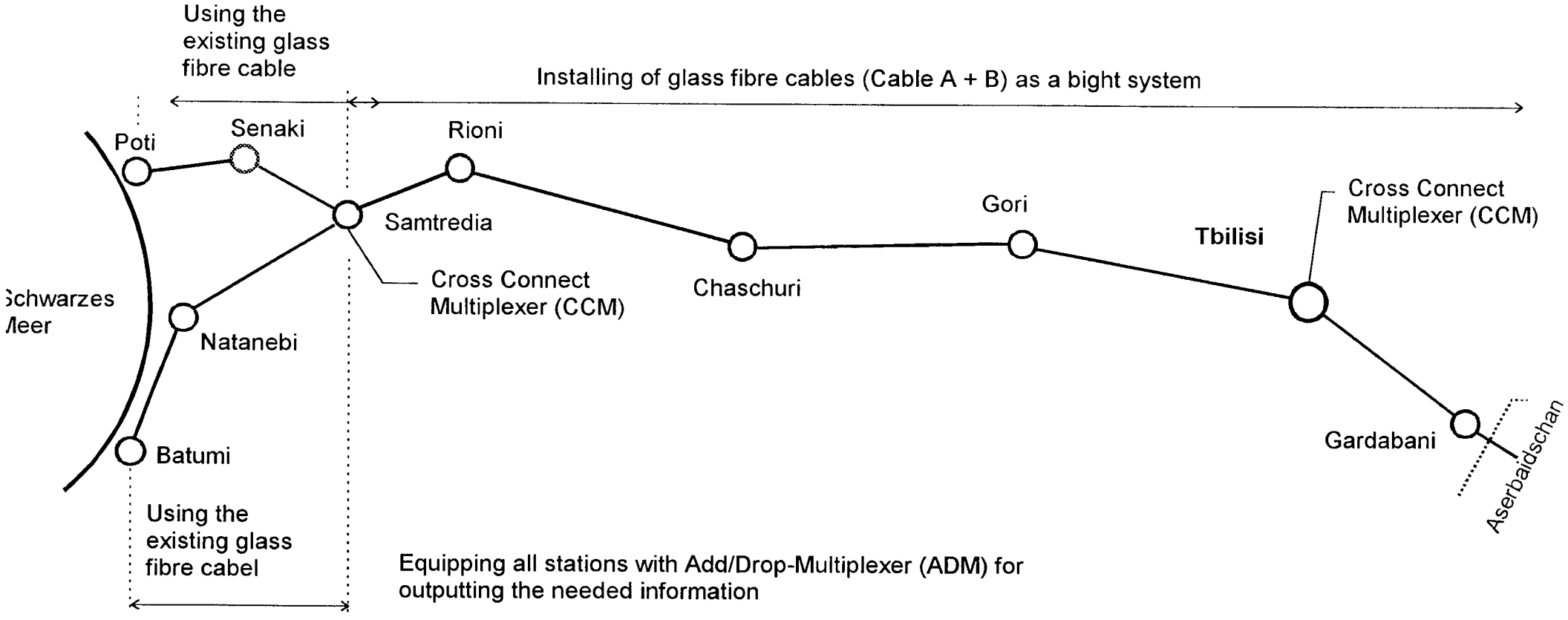
Overview of the lines with telecommunikation installations



Installed cabel type for installations of the telecommunication: MKPAB-7*4*1,2+5*0,9+1*0,7

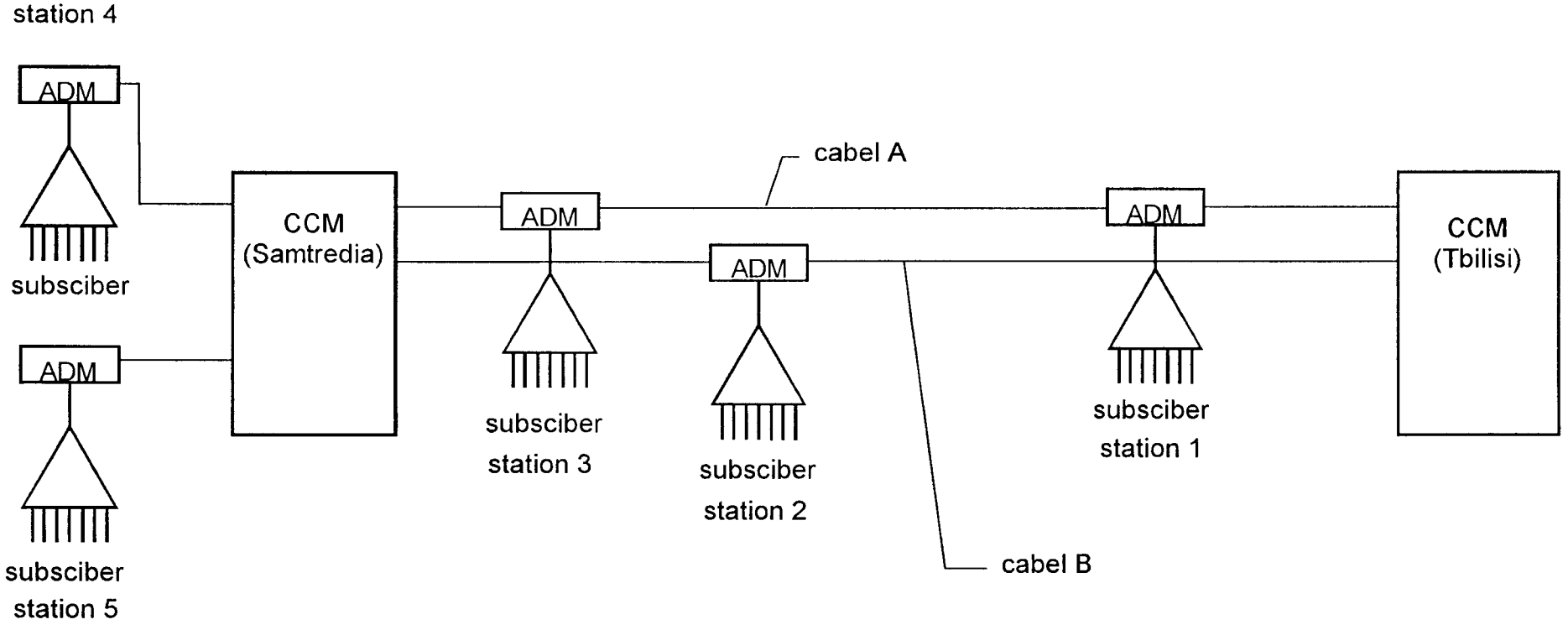
Anlage 13

Overview of the lines with telecommunication equipment of the GZD



annex 14

Overview of the telecommunication systems of the Georgian Railway



ADM - Add/Drop-Multiplexer
CCM - Cross Connect Multiplexer

annex 15

Costs summary of signalling installations of der Georgian Railways

installations / year	-2000	2001	2002	2003	2004	2005	2006	2007	2008	lumpsum
signals	5.0	2.5	1.0	0.4	0.4	0.4	0.3	0.3	0.3	***10.6***
elektric point support	3.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	***6.6***
track circuits	4.5	2.0	1.5	1.0	0.5	0.5	0.4	0.4	0.4	***11.2***
automatic level crossings	4.8	2.5	2.5	2.0	2.0	2.0	2.0	2.0	2.0	***21.8***
spare parts, cabels	3.0	2.0	1.5	1.0	0.5	0.5	0.4	0.4	0.4	***9.7***
complete interlocking boxes 1)	0	14.0	5.0	5.0	8.0	10.0	5.0	5.0	5.0	**57.0**
Equipment Samtredia - Poti / Batumi 2)	2.0	0	0	0	0	0	0	0	0	***2.0***
lumpsum of technical installations	*22.8*	*23.5*	*12.0*	*9.8*	*1.8*	*13.8*	*8.4*	*8.4*	*8.4*	***118.9***
Equipment for the central repair shops	0.5	0.5	0.5	0.5	0.2	0.2	0.2	0.1	0.1	***2.8***
Renewal of the stock for maintenance and fault clearance	0.5	0.5	0.3	0.3	0.2	0.2	0.1	0.1	0.1	***2.3***
Total [in US $]	***23.8***	***24.5***	***12.8***	***10.6***	***12.2***	***14.2***	***8.7***	***8.6***	***8.6***	***124.0***

1) replacement of the weared signalling installations

2) Projects of minor equipments had already been ordered by the Georgian Railways.

All figures in mio US $

annex 16

Costs summary of telecommunication installations of the Georgian Railways

installations / year	-2000	2001	2002	2003	2004	2005	2006	2007	2008	lumpsum
glass fibre cables	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	***10.0***
communication installations	1.0	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	***4.5***
exchange installations	1.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	***5.3***
radio installations	1.5	1.5	1.0	0.6	0.6	0.6	0.5	0.4	0.4	***7.1***
other installations	1.0	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	***3.0***
lumpsum of technical installations	*6.8*	*3.8*	*3.3*	*2.9*	*2.8*	*2.7*	*2.6*	*2.5*	*2.5*	***29.9***
equipments for the central repair shops	1.0	0.4	0.4	0.2	0.1	0.1	0.1	0.1	0.1	***2.5***
renewal of the rolling stock for maintenance and fault clearance	0.5	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	***2.0***
Total [in US $]	***8.3***	***4.5***	***4.0***	***3.3***	***3.1***	***3.0***	***2.8***	***2.7***	***2.7***	***34.4***

All figures in mio US $