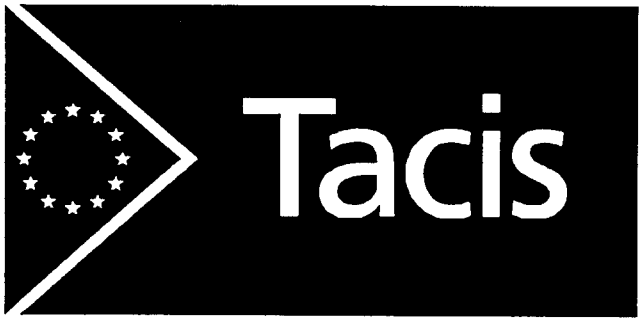


# TRACECA - Railways Inter-State Tariff and Timetable Structure TNREG9501

## INFRASTRUCTURE-I

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# *TRACECA*
# *RAILWAYS INTER-STATE TARIFF AND TIMETABLE STRUCTURE*
# *- INFRASTRUCTURE -*




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## 1. INTRODUCTION

The objectives of my mission, " technical constraints and remedies ", are identified in item 3A5 of our technical proposal, from pages 16 to 19.

Travelling through Uzbekistan, Georgia, Azerbaidjan and Kazakhstan, my purpose was to identify those areas where

- infrastructure related problems can adversely affect transportation costs or the reliability of train schedules and timetables
- lasting, cost effective solutions can be identified

Besides meetings at headquarters, I made sure that I could interview field personnel and unidentified passengers, so as to create a personal opinion about problems (sometimes nagging ones), their causes, and possible lasting solutions.

# 2. IN GENERAL

## 2.1 Organisational structure

Maintenance is organised in the four countries in accordance with rules formerly created by MPS, the Ministry of Transport of the former USSR.

Fieldwork is carried out within so called " distances ", which are in charge of maintenance work for track , catenary and signalling, typically for 100 to 200 km long of track. A distance is further subdivided into 12 to 20 sections (a " master " is in charge), organised in 2 to 3 " brigades ". For electrical supply, the distance is subdivided into brigades covering all aspects (catenary, substations and grid network). All brigades communicate with the distance manager through a dispatcher.

Distances are nearly enterprises in their own right, employing 300 to 400 people, and reporting directly to the several divisions at headquarters in charge of technical specialities : track, signalling and communications, and electrical supply.

## 2.2 Regulations covering maintenance work

All regulations covering maintenance, works, occupational safety, are abundantly documented, and documents are effectively available to field personnel and headquarters alike. The most widely used are :

- regulations covering track maintenance,
- regulations covering the safe movement of track maintenance trains
- the crystal clear, colour illustrated handbook for catenary maintenance personnel,
- among many other books, summaries, and handbooks

Nothing is being left to chance ; everything has been normalised, systematised by former MPS. Apparently recent documents (post 1983, up to 1987) build upon much older ones, with minor modifications.

Those manuals are still available in Russian and are procured from Moscow ; they have no possible substitute.

They are also similar to same purpose documents to be found in Western countries, as thorough, as detailed, and sometimes also similar in shape.

They keep being updated in Moscow by the relevant technical authorities, and still are the very basis of the daily technical practice. **No country seems to be ready to do without them, and I find this very positive !**

# 3. CURRENT SITUATION

## 3.1 Potential capacity of the Traceca corridor

Annex 1 shows an illustration from a " line grafik " in the Traceca corridor. This document is prepared before the fact, and in real time by each dispatcher ; it interestingly delivers key information related to effective speeds and the number of trains passing. It also tells about the incidents occurring on the line in a particular day.

### *3.1.1 Capacity of the line*

Summary of the various sections.

| | | Nb of even trains | | Nb of uneven trains | |
|---|---|---|---|---|---|
| | | **planned** | **actual** | **planned** | **actual** |
| Almaty | Tchengueldy | 30 (16)* | 10 (12 ) | 30 (16) | 10 (12) |
| Tchengueldy | Farap | 42 (22) | 16 (14) | 42 (22) | 16 (14) |
| Farap | Turkmenbashi | | | | |
| Turkmenbashi | Baku | 6** ferries, at 28 wagons each<br>Loading + crossing + unloading about 24H | | | |
| Baku | Beyuk-Kiassik | 32 (18) | 20 (9) | 32 (18) | 20 (9) |
| Beyuk-Kiassik | Batoumi | 42 (22) | 14 (7) | 42 (22) | 14 (22) |

** figures between brackets relate to passenger trains. When capacities differ on any section, I chose the larger one. I did not take into consideration pre 1990, uncheckable, much larger figures though.*

*** 2 ferries undergoing repairs, 1 ferry being loaded. I could not see the three others who were at sea at the time.*

The line is visibly far from being saturated. **Even if one anticipates a strong increase in traffic, doubling single tracks does not look like a priority**.

The only black spot is the crossing of the Caspian Sea, for two reasons primarily :

- ferries too few, too old, too small ad too slow
- Turkmenbashi currently unsuitable for night traffic

### 3.1.2 Speed

One must differentiate between three types of speed :

- the **technical speed** is the one allowed by the physical characteristics and shape of the track ; it is reduced accordingly when poor maintenance resulted in poor track condition,

- the **commercial speed** is based on the technical speed ; it additionally takes into consideration any times foreseeably lost changing the crew, changing the locomotive, crossing borders, using less than ideal locomotives, waiting for clearance at single track sections, carrying out technical checks (brakes, couplings, ...)

- the **actual speed** results from unanticipated events occurring daily ; evidently, it can only be measured on the daily, ex post graphik

The **technical speed** results most directly from the shape of the tracks, and therefore is most directly affected by the amount of maintenance and investment. Related issues will be addressed in the chapter dealing with investment.

The **actual speed** results from several types of events. Some are difficult to control (crew showing up late, power outage, ...); others occur repeatedly for technical reasons that may easily be remedied (ageing equipment, poor bulbs in signalling towers, poor electrical isolation of pylons, ...).

Actual and technical speeds can be easily improved. This will be dealt with in the chapter about remedials and investment. The table below shows a sample of related figures.

| Speed ... | technical | commercial | actual |
|---|---|---|---|
| Georgia | 40 Km/h | 32 Km/h | 15 km/h |
| Azerbaïdjan | 56 Km/h | 51 Km/h | 17 km/h |
| Kazakhstan | 50 Km/h | 34 Km/h | 31 km/h |
| Uzbekistan | 44 Km/h | 34 Km/h | 28 Km/h |

## 3.2. Review of the line

In another Traceca project TeWet and DE-Consult/Systra did thoroughly inventory the Traceca corridor. Their reports are comprehensive; a summary of the deficiencies encountered is listed in Annex 2.

It must be stressed that the situation could not deteriorate in six years for lack of materials only. Much of the worsening condition of tracks and constructions is owed to the lack of any maintenance. The critical situation of specific sections of catenary, tracks or signalling equipment will bring about repeated serious incidents if nothing is done about it in the meantime.

**Conclusion**

With the exception of Kazakhstan, the track is slowly worsening on the Traceca corridor, as a result of the slowing down, if not complete stop of the major maintenance operations or renewals, which traditionally allow the railways to keep tracks in proper working, condition.

This situation has no significant impact on the traffic now, and will last for some time, till the infrastructure is in such a poor shape that no maintenance can bring it in proper working condition, and it needs to be replaced, at a considerable cost. it could last for another few years.

## 3.3 Operating incidents

Major incidents are very thoroughly recorded, and I had unlimited access to these records.

For the many smaller incidents that have a significant impact on the daily performance of the trains, information was much less available. Several reasons may explain it :

- no records are kept for incidents resulting in train stoppages below two hours
- because of the low traffic density, incidents would not have noticeable impact on the passing of trains
- it is unpleasant to allow foreigner to be given clues to the poor shape of infrastructures today.

Some incidents occurring repeatedly are listed in Annex 3. One of the primary causes is the poor condition of insulated joints.

Some figures are publicly available, some others not. Even in cases where figures may not be discussed, they reflect a situation that we believe to be true in each country where we could travel.

## 3.4 Possessions

In the countries that we could travel through, the tracks are possessed for three hours per day, in order to allow maintenance of the track. Occasionally, six hours may be allowed with easy administrative procedures, at 48 hours notice, twice a week.

For capital investment bringing about significant field work it would be quite feasible now to allow four to six hours daily under the following conditions :

- such possessions must be officially shown on train and track schedules
- such capital investment should be carried out with state of the art equipment, including rail-road machinery (see section on remedials and investment).

# 4. CAUSES

## 4.1 Structural causes; inheritance from former USSR

USSR was a country of gigantic proportions. Rail transport was primarily freight transport. Passengers, when they could, did travel by plane; people interviewed would even be surprised that one would use railways transportation : trains were often dirty, unsafe, and reserved for an underclass overloaded with luggage. Customer service is often non existing, information scarce, and tickets unavailable in selling offices, which may go that far as to recommend with a smile to purchase the tickets in the train itself. You must be persistent to enquire about the train schedules from Tashkent to Almaty, and eventually learn that it takes about 24 hours to reach the latter; only departure time from the originating station is known with any certainty.

Freight trains travelled slowly and adapted easily to the poor condition of the track. They faced little competition from road transportation, for cultural and practical reasons alike (road were in even poorer condition).

## 4.2 Cultural inheritance

Anything is only attractive if it is "bolchoi" (big). It applies to trains, but also to cities, hotels, theatres, ...

As a result railways infrastructure must be huge, as must be trains tonnage and number of wagons.

Track maintenance is measured according to the number of kilometres renewed, which will later be shown on official statistics. Maintenance equipment is oversized, overall traffic schedules show four times as many trains as would actually run, ...

As a result, investment money is expected to allow the further purchase of railway sleepers, rails and ballast, that will later show up in official statistics, expressed in kilometres renewed.

## 4.3 Events

The breakdown of the Soviet Empire of course surrounded railways people with doubt and uncertainty. Difficult living conditions for ordinary people, as well as new values and a too rapidly changing world induced significant psychological stress.

The formerly centralised decision making in Moscow, the scattered production base in the whole USSR for railways equipment and supplies were a poor starting base for the newly independent states to work with. They defined other priorities, and were quite unwilling to source equipment and supplies from other states, even if they were needed, and would have been reasonably priced.

## 4.4 People

I met many people of all ages, competent and with a strong belief in the future of their railways. All are ready to adapt to the changed circumstances, though they still expect much from the West or from the East for upward momentum to be gained again.

**As a result** I do not believe in the good old time : " Rensche ".

The railways are as they are now, and probably were not much more effective in the past.

Even if headquarters can display modern equipment, at a par with any Western equivalent, it may not be so in the field. the latter looks more like 1940 railways that old time Russia did not want or could not modernise.

What I could see in the Traceca countries closely replicates observations made in 1992 1993 at the Oktabria railways. The track is renewed with new supplies under poor working conditions with inappropriate methods. When the condition of the track worsens, the speed is reduced in small increments, till it requires a major, costly renewal. Regular maintenance is replaced by regular checks of the physical condition of the track and associated equipment.

**THE IMPORTANT QUESTION IS : HOW CAN THE SITUATION BE IMPROVED IN A LASTING WAY ?**

# 5. REMEDIALS

## 5.1 Maintenance

Undeniably all maintenance has been stopped six years ago, at least, primarily as a result of the lack of the proper supplies. Moreover, supplies available were often misallocated.

Minor, labour intensive, maintenance jobs should be reinstituted : joint lubrication, replacing of resilient pads under the rails, selective draining of some joints, localized levelling, bridge support cleaning, tightening of rail fastening, etc.

Maintenance personnel should be instructed to carry out these jobs, and trained if need be; compliance should also be checked.

In addition, specific activities should be carried out using the most appropriate machinery :

- replacing insulated rail joints with reliable supplies
- preparing insulated glued rail joints
- replacing sleepers
- replacing rails

Regular maintenance purpose is to extend the period between two major renewals; field personnel should be trained and instructed to implement this.

For instance, the figure most willingly given by railways managers in a country visited was the length of track renewed each year. It typically represented 7 to 10% of the total track length, a considerable figure by any international standard.

This measure of performance should be inverted : a more desirable objective should become to increase the time-to-renew closer to international standards, while keeping the infrastructure in adequate condition.

Management should encourage and help field personnel in this cultural revolution. Performance measurement should be made on a wider period (i.e. six months), and with due reference to the means that were made available to carry out the job.

Twice yearly checks on the track using track recording coaches are strongly recommended as a way to check on the job carried out and to plan future maintenance work.

## 5.2 Organisational structure

The current organisation on a geographical basis is very effective and could be reinforced.

Reinforcement could be brought on three lines :

- increased autonomy and responsibility
- improved management and information tools
- improved equipment

Training could be carried out by professionals and new training aids developed.

Increased autonomy could include joint decision making in allocating budgetary resources to adapt the means available to the local conditions.

This improved financial autonomy would include :

- setting proper qualitative, but measurable objectives
- appropriate accounting systems and practices.

## 5.3 Staff

There are too many employees; they are underpaid. Improved mechanised work, after appropriate training would mean a more interesting job, possibly better paid.

Field personnel should quickly perceive the many direct advantages in their daily life. They already quickly switched from electropneumatic to thermal engine driven equipment for cutting machines and sleeper-screw drivers.

Changes may be less easy for management to accept, for a variety of reasons :

- nobody willingly accepts to put himself fundamentally in question; open or more passive resistance is often encountered in such situations

- any method relying on managing scarce resources requires managers to work hard at making and implementing decisions, often without very visible or immediately visible results.

Switching to new practices cannot be done halfway; real commitment is expected, and appropriate support will be needed as long as visible results are not observed in the state of the tracks.

## 5.4 Work methods

Several methods need to be worked out, modernised, or modified :

- uniform, 800m long bars (LB) consistently creates expansion problems
- the installation of insulated glued joints should spread rapidly, using reliable components
- the system of double rail to sleeper fastening is a very costly practice, and should be replaced by reliable, field proven, but more simple fixtures
- monitoring rail defects with effective modern equipment would have a significant impact on specific causes for trains to slow down
- track renewal is carried out carelessly and should be carefully reviewed, taking into account all components of the track : the sleepers/rail/ballast system, the formation, the drainage system, curvature corrections, should be carefully designed and planned, and used ballast and soil should not end up in the old ditches, or ... in the neighbouring track.

## 5.5 Materials

Major investment should not take place as long as technical solutions are not identified regarding choice of materials and the technological processes used to produce them :

- ballast : ballast plants should deliver a clean, washed and calibrated ballast in adequate quantities, so as to ensure a lasting stability of the track
- concrete sleepers : are of mediocre quality; the concrete is brittle, crumbles and exposes the reinforcing bars, which can then corrode quickly
- catenary masts are of poor quality
- the procurement of signalling equipment (wires, signal lamps,...) could be improved,
- Insulated rail joint and glued joint components used should be carefully reviewed

# 6. INVESTMENTS

As remedials are well known, and have been field proven in other places, investment should not take place before changes in behaviour has taken place. Investments can be sorted to four classes :

1) **short term investments** in each country, which are needed for maintenance work to actually resume

2) **materials producing plants,** indispensable for the reliable supply of the main materials and components, mainly concrete and ballast.

3) **management and training,** purposing to modernise work and management practices

4) **major investments of high priority,** actually needed in the next five years.

## 6.1 Short term investments in each country

Maintenance teams should steadily, progressively resume their actual maintenance activities.

In each country in the Traceca corridor mobile units should be created within each distance brigade for such activities as track renewal, sleepers renewal, levelling, manufacturing of insulated joint.

These units should be endowed with modern mechanised equipment, and be able to rely on an inventory of materials for about six months work.

Thus the conditions would be created for their managers to challenge one another to a superior performance; this would greatly contribute to the remediation of several of the defects mentioned in this report.

*A table at the end of this chapter summarises the investments needed.*

### 6.1.1 Tooling

#### 6.1.1.1 Mechanising the replacement of sleepers

2 sleepers laying machines, 2 sleeper-screw driving/pulling machines, 1 cutting machine (for wood), 1 screw driving/pulling and bolting machine, 1 excavating machine equipped with a re-ballasting girder, 1 track tamping machine -fourth level, 1 lorry for carrying material and track maintenance gang, 1 small cross-country van,

**investment (for each country)** **1,4 million $**

In the first three months could be created a training department, possibly with outside expert assistance, dedicated to the training of workers to using the new equipment, and of managers to the organisation and supervision of such works.

Expected productivity : after a three-months training period, the productivity could reach 50 Tba/ hour, with five drivers and 10 field workers.

This unit could replace the works presently carried out under the name " *sredigne remont* ".

#### 6.1.1.2 Rail replacement

2 sleepers-screw driving/pulling machines, 1 screw-driving/pulling and bolting machine, 1 rail cutting machine, manual gantries, 6 hydraulic jacks, 1 lorry for carrying material and track maintenance gang,

**investment (for each country)** **0,5 million $**

A 12-man team can replace three rails per hour without special training.

#### 6.1.1.3 maintenance of insulated joints

These works can be carried out by the team in charge of replacing the rails outside of possessions. Only a greasing unit is needed.

**investment (for each country)** **0,2 million $**

#### 6.1.1.4 manufacturing of insulated glued joints

1 screw-driving/pulling and bolting machine, 1 rail cutting machine, 2 jacks, 1 cross-country small van,

Insulated glued rail joints should be reserved for those joints particularly difficult to maintain (curves, braking areas, ...). They should be prepared off the track, and welded into place by the team in charge of regular insulated joint.

Their preparation employs two specialists, thoroughly trained by the supplier of the insulated glued joints.

**investment (for each country)** **0,1 millions $**

### 6.1.2 Materials

#### 6.1.2.1 First year

| | |
|---|---|
| Sleepers 1840 by Km (20 000 x 25 $) | 0,5 million $ |
| Rails type R65 (40 km à 800 $ per ton) | 2,0 millions $ |
| Misc. (rail fastenings, sleeper screws, rail base plates,..) | 0,1 million $ |
| Ballast 20$ per m3 | 0,1 million $ |
| Preparation of insulated joint | 0,2 million $ |
| Preparation of insulated glued joints | 0,1 million $ |
| | **3 millions $** |

#### 6.1.2.2 Next two years :

2 years each with 3 millions $ materials **6 millions $**

**Expected results**

This first investment package, possibly adapted for each country, should after two to three years, remove about 80% of all incidents that today slow down the trains, and bring commercial and actual speeds in line. It should be accompanied by the practices described under § 6.3

## 6.2 Materials plants

Re-building or construction

### *6.2.1 Ballast quarry* — *2 millions $*

### *6.2.2 Concrete sleepers plant* — *2 millions $*

## 6.3 Investment in training and management

Together with the actual reinstatement of maintenance practices, management training of leading personnel is needed.

It should include revamping of work methods and training of personnel at all levels.

Modernising work habits is probably the most difficult task, but is needed for major investment to be carried out successfully.

**overall investment** — **3 millions $**

## 6.4 Major investments of high priority

### *6.4.1 Tooling for track related work*

Considerable efforts are needed to modernize the means of all kinds to be made available to the personnel : tooling, transport conditions, amenities,... The personnel cannot always be blamed for bad quality results when they work under poor conditions.

Investment in light tooling : 0,2 million $ per distance and 5 distances per country on the Traceca corridor — **1 million $**

Supplying of a 2nd level tamping and lifting machine — **1,5 million $**

### 6.4.2 Catenary

**Azerbaïdjan**

| | |
|---|---|
| 200 km (non standard) à 6 000 $ | 1,2 million $ |
| 1000 catenary masts | 1 million $ |
| Misc. : brackets, paint | 0,2 million $ |
| Track car | 0,3 million $ |
| **Total Azerbaïdjan** | **2,7 millions $** |

**Georgia :** Replacement of the catenary between Poti and Batoumi :

| | |
|---|---|
| 300 km (non standard) at 6 000$ | 1,8 million $ |
| 1 000 catenary masts | 1 million $ |
| Misc. : brackets, paint, | 0,4 million $ |
| **Total Georgia** | **3,2 millions $** |

Kazakhstan does not need major investment now, as the last electrification works between Almaty and Otrar are underway. The same applies to Uzbekistan, currently using 27500V alternating current between Tchenguildi and Tashkent.

### 6.4.3 Signalling

| | Azerbaidjan | Kazakhstan | Georgia | Uzbekistan |
|---|---|---|---|---|
| traction current return | 2M$ | 0,2 M$ | 2 M$ | |
| replacement of wires | | 0,2M$ | 0,4 M$ | |
| repair of level crossings | 2 M$ | | 2 M$ | |
| replacement of switch motor and misc. | 3 M$ | 0,2 M$ | 4 M$ | |
| replacement of signals | 2 M$ | | 2 M$ | |
| **Total** | 9 M$ | 0,6 M$ | 10,4 M$ | 10 M$* |

* *In Uzbekistan : overall project of replacement of Automatic Lighting Blocks between Djizak and Farap (studies carried out before 1940 and installation completed in 1964)*

### 6.4.4 Track

| | Azerbaidjan | Kazakhstan | Georgia | Uzbekistan |
|---|---|---|---|---|
| Track renewal | 96 M$ | | 75 M$ | 60 M$ |
| Replacement of switch gear | 4 M$ | | 4 M$ | 4 M$ |
| **Total** | 100 M$ | | 79 M$ | 64 M$ |

### 6.4.5 Telecommunications

As telecommunications do not fall directly within our scope of work, I carried out only limited investigations.

Among the most visible needs, let us note :

<u>Kazakhstan</u> :

- replacement of the Almaty/Tchou cable **3,5 millions $**
- replacement of the "hot boxes" alarm device **1 million $**

<u>Uzbekistan</u>

Replacement of the aerial line between Samarkand and the Turkmen border by optical-fiber cable **16 M$**

**Expected results**

If major works are carried out with modern equipment, reliable materials and new work practices, by trained and competent teams, led by well-motivated managers, technical speeds should come close to those encountered in western countries.

# 6. INVESTMENTS

## Summary table - investments

| Georgia | Azerbaidjan | Uzbekistan | Kazakhstan | Total |
|---|---|---|---|---|

### 6.1 Immediate investments (millions $)

| | | | | | |
|---|---|---|---|---|---|
| Sleeper replacement<br>- tooling<br>- materials | <br>1,4 M$<br>0,5 M$ | <br>1,4 M$<br>0,5 M$ | <br>1,4 M$<br>0,5 M$ | <br>1,4 M$<br>0,5 M$ | <br>**5,6 M$**<br>**2 M$** |
| Rail replacement<br>- tooling<br>- materials | <br>0,5 M$<br>2 M$ | <br>0,5 M$<br>2 M$ | <br>0,5 M$<br>2 M$ | <br>0,5 M$<br>2 M$ | <br>**2 M$**<br>**8 M$** |
| Preparation of<br>insulated rail joint<br>- insulated glued joint | <br>0,2 M$<br>0,1 M$ | <br>0,2 M$<br>0,1 M$ | <br>0,2 M$<br>0,1 M$ | <br>0,2 M$<br>0,1 M$ | <br>**0,8 M$**<br>**0,4 M$** |
| Supply of materials (2 years) | 6 M$ | 6 M$ | 6 M$ | 6 M$ | **24 M$** |
| **Total** | **10,7 M$** | **10,7 M$** | **10,7 M$** | **10,7 M$** | **42,8M$** |

### 6.2 Materials plants (millions $)

| | | | | | |
|---|---|---|---|---|---|
| Ballast quarries | 2 M$ | 2 M$ | 2 M$ | 2 M$ | 8 M$ |
| Concrete sleepers plants | 2 M$ | 2 M$ | 2 M$ | 2 M$ | 8 M$ |
| **Total** | **4 M$** | **4 M$** | **4 M$** | **4 M$** | **16 M$** |

### 6.3 Investment in training and management (millions $) 3 M$

### 6.4 Major investments of high priority (millions $)

| | | | | | |
|---|---|---|---|---|---|
| tooling for track works | 2,5 M$ | 2,5 M$ | 2,5 M$ | 2,5 M$ | **10 M$** |
| catenary | 3,2 M$ | 2,7 M$ | | | **5,9 M$** |
| signalling | 10,4 M$ | 9 M$ | 10 M$ | 0,6 M$ | **30 M$** |
| track | 79 M$ | 100 M$ | 64 M$ | | **243 M$** |
| telecommunication | | | 16 M$ | 4,5 M$ | **20,5 M$** |
| **Total** | **95,1 M$** | **114,2 M$** | **92,5 M$** | **7,6 M$** | **309,4 M$** |

| | | | | | |
|---|---|---|---|---|---|
| **Grand total** | **109,8 M$** | **128,9 M$** | **107,2 M$** | **22,3 M$** | **361,2 M$** |

## 7. CONCLUSION

Under the above assumptions, for two to three years one can guarantee that:

- heavy trains will run unhindered
- it would take no more than eight days between Almaty and Poti
- speed will be acceptable for freight haulage
- traffic regularity will be ensured since the existing lines are far from saturation.

However if nothing is undertaken in the short term, the slow but irreversible decay of the equipment on all networks will inevitably lead to serious disorders, themselves leading to massive and disorderly crash investments in order to allow the continuing passing of trains.

Such massive unprepared crash investment programmes would only give temporary relief.

The single most important problem relates to the maintenance of fixed installations, and most efforts should be dedicated to introduce modern equipment and modern practices for the related maintenance activities.

The solutions proposed here would allow, quickly and lastingly,

**in the next three years :**

- to eliminate most slowing downs due to poor track condition, and therefore to increase the speed and reliability of freight haulage
- demoralised teams to regain self confidence and energy
- costs induced by such a maintenance to be much more than offset by savings in capital investment

**in a subsequent period :**

Major investments would eliminate all remaining black spots that cannot be addressed with only improved maintenance practices. This would ensure traffic regularity and safety, even if it increases significantly.

Most importantly, they would help create the Railways of the next century.

# *ANNEXES*

# *ANNEX 1*

## EXCEPT FROM LINE GRAFIK ALMATY/UZBEK BORDER

| | | Almaty / Otar | Otar / Tchu | Tchu / Djamboul | Djamboul / Tulkenbasse | Tulkenbasse / Aric | Aric / Tchemgueldni |
|---|---|---|---|---|---|---|---|
| | length | 156 km | 156 km | 240 km | 152 km | 282 km | 77 km |
| Peculiarities | type | VU/BA | VU/BA | DV/BA | VU/BA | DV / BA | DV/BA |
| | traction | diesel | El | El | diesel | El. | El. |
| | profile | | | | 12/°° | 3 locs | |
| Planned capacity | down<br>freight.<br>up freight | 22<br>24 | 21<br>23 | 21<br>23 | 30<br>30 | 30<br>30 | 24<br>24 |
| idem | Passenger | 19 | 19 | 17 | 16 | 16 | 16 |
| Nb of trains on 12/06 | Freight imp<br>Freight pair. | 8<br>9 | 9<br>9 | 9<br>9 | 10<br>10 | 10<br>11 | 12<br>12 |
| | | | | | | | |
| Technical S. | | 50 km/h | 42 | 47 | 48 | 46 | 46 |
| Commercial S. | | 34 km/h | 31 | 41 | 37 | 37 | 37 |
| Planned tonnage | down<br>up | 3200 T<br>2 700 T | 3200 T<br>2 700 T | 3200 T<br>2 700 T | 4 500<br>2 100 | | 4500<br>2700 |
| Feasible tonnage | down<br>up | 3 800<br>3 000 | 3 800<br>3 000 | 3 800<br>3 000 | | | 6 000<br>6 100 |

## 1. THE TRACK

- 70% fitted with reinforced concrete sleepers laid with double-fastening base plates; during random investigations, I noted 30% inefficient fastenings..
- 30% fitted with reinforced concrete sleepers laid with base plates secured by means of rails, 50% of which do not adhere to the rail
- rails are of the type R65 (60%) and R50 (20%); the steel types are regular or hardened; they are replaced systematically after the passage of a certain tonnage; if the replacement does not occur, top speeds are reduced in accordance with regulations. Defective rails are monitored using an outdated electromagnetic process; if not replaced, they will be inspected daily using the same electromagnetic process, for little practical benefit
- the ballast is made largely of uncalibrated gravel; this does not allow mechanised maintenance; stones used are usually of good quality, but the ballast also includes soil
- 60% of the formation is polluted by fuel originating from wagons or diesel locomotives; more seriously even, it is polluted by soil coming from nearby civil works carried out by maintenance workers. Previous major renewals were not taken advantage of for the platform to be put higher.
- four hole fish-plating not monitored
- insulating joints in bad condition (procurement problems) cause of daily incidents; service life of about one year.
- Insulated glued joint is supposed to be common practice, though I could not see any, in spite of repeated requests. The current practice of making 25m insulated glued joint in a central factory does not give the results expected.

## 2. MAJOR CIVIL WORKS

- all were built with the line (in the last century); no replacement of metal structures was planned
- on recent bridges, rebars are heavily rusted
- metal bridges were never re-painted, and the structures are in places heavily corroded; more seriously, the metal rollers that allow the structure to thermally expand were never greased nor cleaned
- tracks sides are never stripped of their bushes
- running water often took away the soil from bridge pillars.

## 3. CATENARY

There are two types of catenary masts : ageing metal ones without protective paint coating, progressively replaced by poor quality concrete masts with visible rebars.
Brackets must also be replaced.
The salt laden atmosphere rapidly corrodes insulators located close to the Black Sea.
The catenary does not meet the technical standards in many places, between Baku and the Black Sea.

## 4. SIGNALLING

With the possible exception of Georgia, track segments are regulated by single-track/double-track automatic blocks, but

- no spare parts for electric motors; wiring and engines themselves should systematically be replaced
- signalling lamps are too often and too quickly out of order
- wires are too old, of poor quality, and with numerous insulation defects
- traction current return is of poor quality

In Georgia, no automatic blocks are operating anymore, as anything of value has been looted away during the civil war.

**The poor condition of equipment of poor quality, poorly installed, and ageing, is the primary cause of many incidents, and therefore of the difference between actual and commercial speeds.**

## 5. TELECOMMUNICATIONS

outdated and in poor condition.

# *ANNEX 3*

**Shunting and operating incidents (1996)**

| Incident record (> 2 hours) | | | | | |
|---|---|---|---|---|---|
| | Azerbaïdjan number | Kazakhstan number. | Georgia | Uzbekistan hours | |
| Derailings | 1 | 1 | | | |
| Equipment breakdowns | 2 | 0 | | | |
| Mistakes | | 36 (24) | | | |
| Locomotive breakdowns | 2 | 0 | | 4182 H | |
| Problems with wagons | | 1 | | 2278H | |
| Problems with catenary | | | | 406H | |
| Problems with track | | | | 227H | |
| Signalling and telecommunications | | | | 12H | |
| Signal crossings | | | | | |
| Cattle | | | | | |
| | | | | | |
| Derailing at shunting yard | | | | | |
| **between one and two hours** | | | | | |
| locomotives | 138 | | | | |
| wagons | 27 | | | | |
| forcing open the points | 33 | | | | |
| Track | 14 | | | | |
| Catenary | 29 | | | | |
| Sabotage | 20 | | | | |
| **< 1 hour** | | | | | |
| locomotives | 115 | | | | |
| wagons | 63 | | | | |
| Catenary | | | | | |
| Sabotage | | | | | |
| Track | 8 | | | | |
| Signalling | 1583 | | | | |

additional information :

**Uzbekistan :** number of incidents (official record)

| year | SES | track | power supply | other services | Total |
|---|---|---|---|---|---|
| 1994 | 341 | 1151 | 687 | 421 | 2500 |
| 1995 | 177 | 715 | 524 | 518 | 1958 |
| 1996 | 176 | 838 | 593 | 520 | 2152 |

**Kazakhstan :** between 5 and 10 incidents per day

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