Modernisation of the railway line Volujak-Dragoman

General information

This project regards the **modernisation of the railway line Volujak-Dragoman** and, as a result, the completion of the global project "Modernization of Sofia-Dragoman Railway Line"[1]. The Sofia-Dragoman railway line is part of South-East Axis, the extension of the major TEN-T axes to the Neighbouring Countries (EC, 2005x). This is also the main direction between Europe and Asia and part of the Orient/East-Med CNC. On the Serbian side, the line extends to the Niš-Dimitrovgrad line (see section **Napaka! Vira sklicevanja ni bilo mogoče najti.**).

As part of the cross-border section of the TEN-T, the Volujak-Dragoman modernisation project is of great importance both at national and European level. It also incorporates the necessary measures for the achievement of an **interoperable rail network** by the optimisation of the capacity and efficiency of existing and new infrastructure, improvement of the safety and reliability of the network.

As regards the **relevance of the project**, the modernisation of the railway section Volujak-Dragoman is part of the Strategy for the Development of the Transport System of the Republic of Bulgaria until 2020 (Ministry of Transport, Information Technology and Communications, 2010) and, as part of the cross/border section from Sofia to the state border with Serbia, is of a great significance both for Bulgaria and Eastern Europe.

Figure 7-1 provides with the geographical localisation of the section.

Figure 7-1: Location of the Sofia-Volujak-Dragoman railway line

[1] The project "Modernization of Sofia−Dragoman Railway Line" is divided into two sections, namely from Sofia to Volujak and from Volujak to Dragoman. As regards the first section, the project "Development of Sofia Railway Junction: Volujak−Sofia railway section" obtained a CEF financing.

Source: NRIC

The major **objectives** of the project are the following:

- to ensure the modernisation of the railway infrastructure, improving railway transport in the region;
- to eliminate **bottlenecks** and complete the missing link cross-border section of the Trans-European Railway Network;
- to improve technical parameters and speed of movement in the region, including the creation of conditions for the optimal combination and integration of various transport models and the capacity optimisation;
- to increase the volume of cargo traffic, to improve the comfort of passengers for intercity and international trips conditions and to reduce travel times.

Furthermore, the project will also contribute to the implementation of the following international agreements and initiatives:

- the European Agreement on the International Railway Lines (AGC);
- the European Agreement on the International Railway Lines for Combined Transport (AGTC);
- the Trans-European Railways (TER);
- the EU Directives 1996/48/EC and 2001/16/EC, as amended by Directive 2004/50/EC on the Technical Specification for the Interoperability of the conventional railway network (i.e., TSI).

The **project promoter** is State Enterprise National Railway Infrastructure Company (NRIC)

Technical description

The section Volujak-Dragoman is single-track, with a **length** of approximately **35 km**[2].

The modernisation of the section includes the following **activities**:

- upgrade of the line speed to 160 km/h;
- rebuilding of tracks wholly within the original alignment;
- disconnection and removal of existing signalling and telecommunication equipment including cables;
- removal of existing railway tracks;
- construction and repair works of structures;
- earth works and dewatering[3] activities;
- cable ducts construction on one side of the line between Volujak and km 42+537;
- mast founding between Volujak and km 42+537 for all tracks;
- track works for double track railway line;
- construction of new station buildings in Slivnica (new station) including utilities (e.g., automatic crossing signalling and automatic crossing barriers);
- construction of new overhead contact line system and adaptation of power substations in Aldomitrovtsi and Volujak;

[2] The railway line Sofia-Dragoman is 43 km long. From Sofia to Volujak, the railway line is double-track, with a length of approximately 8 km.

[3] Recovering of contaminated water.

- cabling, installation and connection of new signalling, telecommunication, site protection, GSM-R, low voltage, SCADA, and passenger information systems in stations, stops and on the line sections.

The **estimated investment cost** is € 167.779.270 (without VAT). The maintenance and operating costs are shown in Table 7-1.

Table 7-1: Maintenance and operating costs of the railway line Volujak-Dragoman [€]

Unit costs [€]	Scenario	
	Without the project	With the project
Passenger transport		
Fixed costs per km	7.910,13	8.083,75
Variables for group 1 of train·km (regional trains)	0,7049	0,7203
Variables for group 2 of train·km (intercity trains)	0,8074	0,8251
Freight transport		
Fixed costs	7.910,13	8.083,75
Variables of train·km	1,9384	1,9810

Source: NRIC

Project implementation

The project implementation consists of the following **seven key activities**.

- **Activity 1 – Land acquisition:** for the implementation of the proposed action, 1.145.399 m^2 of land shall be expropriated. After the completion and acceptance of the Detailed Spatial Development Plan and the Technical Design, further steps should be implemented in order to start the land acquisition procedures.
- **Activity 2 – Construction works:** executed according to the approved Technical (Detailed) Design. Construction works could start only after the obtaining of a building permit. Since the proposed action includes reconstruction and new construction of infrastructure and adjacent buildings, the building permit is expected to be obtained after the completion of Activity 1.
- **Activity 3 – Supervision of construction works:** contracts for the construction supervision for both the sections Volujak-Petarch and Petarch-Dragoman shall be signed pursuant to Article 168 (2) of the Spatial Developing Act (i.e., SDA). A conformity assessment with the essential requirements for designs will be done by the consultants contracted in the preliminary phase. Therefore, the contract under this activity will cover only the construction works.
- **Activity 4 – Interoperability assessment:** in conformity with the railway transport legislation concerning the achievement of interoperability of the national railway systems of EU members, it is necessary that the design, building, maintenance and control of the constituent elements of the project are carried out in a way which provides security and, at the same time, achieves the level of the envisaged objectives of the system.
- **Activity 5 – Archaeological monitoring during construction works:** the implementation of investment projects in areas for which there is evidence of archaeological sites must be preceded by preliminary archaeological studies, in order to set out whether they will be affected or damaged.
- **Activity 6 – Information and publicity:** as a beneficiary of TEN-T funding, NRIC has a legal obligation to provide the proper publicity to inform the public of the EU financial support. During the construction works, it is envisaged a separate contract for the implementation of the information and publicity activities, after the conduction of tender procedures under Public Procurement Act of Bulgaria.

- **Activity 7 – Technical assistance:** NRIC has adopted rules for the management and implementation of infrastructure projects under which a team is appointed to manage the project implementation (Project Management and Implementation Unit (PMIU)).

The tentative procurement plan for the tenders is summarised in Table 7-2. All the dates are indicative.

Table 7-2: Procurement plan of the project of the railway line Volujak-Dragoman

Activity	Start date	End date
Selection of contractor for Construction works for the modernisation of Voluyak-Petarch railway section	13/06/17	09/12/17
Selection of contractor for Construction works for the modernisation of Petarch-Dragoman railway section	13/06/17	09/12/17
Selection of contractor for Design and construction of telecommunications and signalling for the modernisation of section Volujak-Dragoman	09/04/18	05/10/18
Selection of contractor for Construction Supervision for the modernisation of railway section Volujak-Dragoman	13/06/17	09/12/17
Selection of contractor for Envisaged Obiectives verification and assessment of the conformity to interoperability standards	13/06/17	09/12/17
Selection of contractor for archaeological studies and monitoring during construction	13/06/17	09/12/17
Selection of contractor for the implementation of publicity measures studies and monitoring during construction	13/06/17	09/12/17

Source: NRIC

Transport demand

The **traffic forecasts** cover the period 2017-2044. For the period of construction, 2017-2020, the traffic forecasts for the "do-nothing" scenario are used. Two traffic scenarios have been considered: i) the base case scenario or “Without Project” (i.e., WoP); and ii) the “With Project” (WP) scenario.

The **WoP** is the so-called “Do Minimum” scenario, where no investments are made for the railway line outside the minimum statutory requirements to ensure operation and safety. The railway line remains along the old route and the level gradually deteriorates leading to lower speed and frequent breakdowns and accidents. All maintenance and operation costs of the existing Volujak–Dragoman railway line aim to ensure maximum safety levels of transport. The weak traffic growth in this scenario is due to the increasing mobility of people as a result of the growth of their income within the years of the forecast and the impact of the network.

The **WP scenario** includes all the planned investments for the modernisation of the section Volujak-Dragoman railway line. The operation and maintenance costs are based on historical data, the type of new investments, the requirements of suppliers and contractors under the projects for supply and construction of similar projects implemented or being implemented by NRIC. As regards the construction of bridges, additional costs are identified outside the railway maintenance costs. The increased traffic in this option is due to both the macroeconomic parameters valid for the BAU option as well as to the increased speed and comfort of travel.

Four investment scenarios have been considered for the development of the Volujak-Dragoman railway line. For each modernisation options, the traffic forecasts have been prepared. These are described below with respect to the approach utilised for the elaboration of the forecasts.

- **Do-Nothing scenario** related to the modernisation of the railway line. The forecast is obtained as a section between the base scenario traffic forecast and the level of crossing capacity;

- **Scenario A:** increased train speed to maximum possible levels. This option will not dramatically improve the level of rail service. Then, the final forecast is obtained as a section of the base scenario forecast and the increased crossing capacity of the railway line after rising train speeds;
- **Scenario B:** increased speed of freight trains to 100 km/h and of passenger trains to 120 km/h and construction of a double-track railway line where it is not doubled. The option distinctly improves train speeds which will improve rail service. The forecast is obtained as a section of the optimistic forecast and the crossing capacity achieved in the presence of double line and already increased train speeds. The forecast is that of the base scenario up to the realisation of the investments;
- **Scenarios C (C1 and C2):** increased speeds to 120 km/h for freight trains and to 160 km/h for passenger trains (200 km/h for tilting trains). Construction of a double-track railway line where the railway line is not doubled. The forecast is identical for both options. Alternative C is developed in the following two sub-options:
  - → **C1 -** A maximum inclination of 15 ‰ and a minimum radius of 1.500 meters are introduced. The route passes through existing stations (without reaching Aldomirovtsi station), connecting the route to the old station of Dragoman. The approaches to the existing station of Dragoman are situated in sharp curves and, if the railway line is doubled, it is almost technically impossible to implement the track layout needed.
  - → **C2 -** A maximum inclination of 12.5 ‰ and a minimum radius of 1.500 meters are introduced. The route in this option partially deviates from the existing railway line in small sections for improving the radii and inclinations. The developed route passes through the stations of Kostinbrod, Petarch, runs north of Slivnitsa station and continues in southwest direction to the new station of Dragoman going around Aldomirovtsi station.

Table 7-3 presents the relevant socio-economic variables used for implementing the multi modal transport model for traffic forecasts by the respective time periods.

Table 7-3: Forecast values for determining performance and traffic of rail passenger transport

Variable	Year				
	2009	2011	2015	2020	2030
Population [inhabitants]	7.540.019	7.469.242	7.345.209	7.212.707	6.994.052
Change in the population compared to the previous year	-0,51%	-0,46%	-0,40%	-0,34%	-0,28%
GDP per capita [€]	6.861,03	9.573,79	12.527,09	16.520,45	25.348,75
Change of per capita GDP compared to the previous year	8,9%	7,49%	6,46%	5,24%	3,80%
Average income per capita [€]	3.663,52	4.202,74	5.324,60	6.792,63	9.900,58
Forecast for ground transportation performance of land transport (road and rail) [million tonnes·km]	18.572,32	18.908,24	19.487,18	20.076,71	20.960,40

Source: NRIC

The traffic forecasts for Scenario C1, covering all the Project period 2015-2044 as reported in Table 7-4 and in Table 7-5.

Table 7-4: Passenger transport forecasts of the railway line Volujak-Dragoman

Year	Base Scenario	Scenario C1	Base Scenario	Scenario C1	Base Scenario	Scenario C1
	passengers·km	passengers·km	passengers·h	passengers·h	trains·km	trains·km
2015	17.109.373	17.109.373	285.442	285.442	499.211	499.211
2020	16.546.884	16.546.884	276.057	276.057	534.354	534.354
2025	16.638.414	38.375.474	277.584	305.294	537.185	1.111.644
2030	16.073.686	40.301.686	268.163	320.618	516.354	1.142.523
2035	16.046.499	41.650.427	267.709	331.348	507.280	1.157.963

2040	15.475.584	42.590.640	258.185	338.828	497.068	1.142.523
2044	15.215.798	43.318.324	253.850	344.617	488.724	1.146.128

Source: NRIC

Table 7-5: Freight transport forecast of the railway line Volujak-Dragoman

Year	Base scenario		Scenario C1	
	tonnes·km	trains·km	tonnes·km	trains·km
2015	205.683.751	534.456	205.683.751	534.456
2020	199.028.675	515.532	199.082.675	515.532
2025	203.390.579	512.701	390.473.809	929.489
2030	201.439.733	518.093	441.098.698	1.022.438
2035	207.129.094	527.166	489.007.387	1.115.387
2040	206.219.671	521.939	536.460.063	1.185.099
2044	205.702.464	530.283	539.881.040	1.181.494

Source: NRIC

Traffic forecasts, both for freights and passengers, take into account the traffic growth for existing traffic and the modal shift from road transport.

On the consulted documents, there is no information available with respect to the assumed values of key drivers of traffic growth and there is not additional information on the demand components (i.e., long and short distance, induced and diverted).

Financial analysis

The base year for the estimates of the financial analysis is 2014 and all market prices are for this year. The project time horizon period is 30 years, from 2015 to 2044 including the 6-year period of construction (from 2015 to 2020). The model is elaborated in constant prices in euro (excluding VAT).

The **financial profitability** analysis of the project has been elaborated according to the Guide to CBA of Investments project (EC, 2014). The financial profitability analysis has been prepared using the incremental approach. To determine the incremental revenues and costs, two main options were clearly defined: (i) with project and (ii) without project. The method of discounted cash flows is applied for determining the financial indicators. A discount rate of 4% is employed in the financial analysis in accordance with the instructions of EC (2014).

The total amount of eligible costs is € 167.779.270. The residual value is determined by calculating the Net Present Value (i.e., NPV) of investment cash flows, replacement of machinery and equipment in the remaining years of economic life after the end of the construction period. The discounted residual value is equal to € 36.826.583.

The **financial performance indicators** of the project are summarised in Table 7-6.

Table 7-6: Financial Performance Indicators of the railway line Volujak-Dragoman - Option C1

Indicator	Without EU grant	With EU grant
FIRR	-0,40%	10,40%
FNPV [€ million]	-77,866	35,294

Source: NRIC

The **financial sustainability** aims to prove that it is possible, in the long-term, to cover all project costs by identified sources. In this particular case, they are defined as follows:

- investment costs are covered by the sources of financing according to the Project Financial Plan;

- operation and maintenance costs are covered by government subsidies and the amounts of charges for the access to the railway infrastructure.

The cumulative cash flow for each year of the project forecast period must be positive in order to achieve the financial stability of the project. In this case, the cumulative cash flow is nil as the amount of subsidy disbursed is equal to the amount of operation and maintenance costs.

Economic analysis

According to EC (2014), a social discount rate of 5% has been applied for the economic analysis and market prices of materials and services used in the financial analysis are converted into economic values using the **conversion factors** (see Table 7-7).

Table 7-7: Assumed conversion factors

Item	Conversion factor
Equipment	95%
Materials	83%
Labour	90%
Others	83%

Source: NRIC

A quantitative assessment is made of the benefits resulting from the change of travel time savings. The benefits of travel time savings are accumulated by both reduced distance and increased speed as a result of improved conditions of the railway line.

The business trips to other types of trips ratio is determined on the basis of data from the National Study for determining the Value of Time in Bulgaria (Ecorys, 2015). The unitary **values of time** are taken from the Report on the National Study for Determining the Value of Time in Bulgaria (i.e., NSDVT) (see Table 7-8).

Table 7-8: Value of time for passenger transport

Travel purpose	Unit of measurement	Value
Business trips	€/passengers·hour	9,22
Leisure trips	€/passengers·hour	3,69

Source: NRIC

Since the NSDVT does not include the identification of freight transport value of time, it has been borrowed Guidelines for preparation of CBA in the transport sector, Bulgaria, JASPERS, 2010, updated in 2015 (see Table 7-9).

Table 7-9: Value of time for freight

Travel purpose	Unit of measurement	Value
Freight transport	€/tonnes·hour	0,77

Source: NRIC

The **vehicle operating cost** savings are resulting from the transfer of traffic from the road to the railway transport (see Table 7-10).

Table 7-10: Assumed values for vehicles operating costs of rail mode

Transport mode	Scenario	
	Without-project	With-project
Passengers	0,0277 €/passengers·km	0,0263 €/passengers·km
Freight	0,0279 €/tonnes·km	0,0265 €/tonnes·km

Source: NRIC

The unitary value of VOC benefits, calculated as the difference between the operating costs for railway transport and those for road transport are reported in Table 7-11.

Table 7-11: Vehicle operating costs

Transport mode	Transport mode	Unit of measurement	Value
Road	Road passenger	€/passengers·km	0,0194
	Road freight	€/tonnes·km	0,0198
Railway	Railway passenger	€/passengers·km	0,0014
	Railway freight	€/tonnes·km	0,0014

Source: NRIC

To determine the safety-derived benefits it is employed the number and type of accidents, provided by the system Smart Safety 2.1. of NRIC concerning the entire network. The number of accidents along Sofia-Dragoman line is calculated multiplying the number of accidents per train-km, by the "work done" (sum of number of passenger and tonnes) according to the traffic forecasts for both scenarios (see Table 7-12).

Table 7-12: Accident rates with and without the investment

Type of accident	Without-project scenario			With-project scenario		
	Number of accidents	Number of accidents/train·km	Workload [Units]	Number of accidents	Number of accidents/train·km	Workload [Units]
Fatalities	43	0,0000016	27.058.640	16,48	0,00000056	29.345.250
Slight Injuries	51	0,0000019		11,83	0,00000040	
Severe Injuries	95	0,0000035		32,33	0,00000110	

Source: NRIC

The incidence of each benefit is reported in the Table 7-13.

Table 7-13: Incidence of the benefits

Structure of total benefits	
Value of Time	48,9%
Vehicle Operating Costs	25,7%
Accidents	0,9%
Air pollution	17,1%
Climate changes	6,8%
Noise	0,7%

Source: NRIC

The **economic performance indicators** are calculated using an economic discount rate of 5%. As shown in Table 7-14, they suggest that the project is economically viable.

Table 7-14: Economic performance indicators

Indicator	Value
ENPV	€ 60.492 million
EIRR	5,0024%
B/C	1,00

Source: NRIC

The **sensitivity analysis** shows that all the investigating variables can turn the ENPV negative. The switching values are shown in Table 7-15.

Table 7-15: Economic sensitivity analysis (switch values)

Variable	Switch value [%]
Time benefits	-0,08
Vehicle Operating Costs	-0,14
Accident benefits	-4,15
Noise	-5,10
Air pollution	-0,22
Climate change	-0,55
Investment costs	-0,03
Operating and maintenance cost	-0,27

Source: NRIC

Environmental analysis

The project will contribute to the achievement of a modern railway network designed for a good climate change resilience by the modernisation of the existing tracks and the construction of new up-to-date adjacent facilities, the rehabilitation or replacement of existing drainage systems and – where necessary − the construction of new ones.

The **EIA has been carried out** in compliance with the Environmental Protection Act and the Regulation on the compatibility assessment with the protected areas for the global project which involves the section from Sofia to Dragoman. In general, a positive EIA Decision is issued if the proposal is compliant with all the legal environmental requirements of the EIA Directive and Water Framework Directive and the Water Act (WA).

The EIA has defined a large number of measures for achieving the preventive action principle, especially during the period of operation. **Public consultations** were held in the municipalities affected by the project and the results of the discussions have been taken into consideration by the Ministry of Environment and Water in the final decision making process.

EIA's conclusions identified as the most environmental-friendly alternatives that included in **Scenario C1** for the railway section **Sofia-Peturch** and that included in **Scenario A** (a combination between Scenarios C and D) for section **Peturch-Dragoman**, including the construction of a new railway station in Slivnitsa and a new direct double track railway connection to sectional post.

A favourable EIA Decision was issued by the Ministry of Environment on 05/05/2016, based on the grounds and conclusions of the EIA Report and considering the impact of the investment proposal on the environment, especially on the protected Natura 2000 sites, surface and ground water bodies and the results of the public consultations.

A favourable opinion of the competent authority ascertained that the special areas of conservation BG0000322 "Dragoman BG0002001 Rajanovtzi" will not be adversely affected by the investment proposal because the railway line does not pass through the sites of the special areas, remaining beyond their boundaries.

During the EIA procedure, the **Basin Directorate** has given a positive opinion for the approval of the investment proposal, according to which the investment proposal is acceptable in terms of achieving environmental objectives and measures for attaining good status of water and its security zones, set out in the River Basin Management Plan (i.e., RBMP) of the Danube region.

The most important and common principles of environmental sustainability addressed by the project implementation can be summarised as follows:

- transparent and systemic management of the risk, uncertainty and irreversibility;

- provision of appropriate environmental assessment and restoration of natural sites where necessary;
- integration of environmental, social, human and economic goals;
- environmental integrity.

Safety levels

The signalling equipment of the stations is currently out to date and for that reason the project includes the construction of computer interlockings in the stations in Slivnica and Kostinbrod; the construction of a Dispatching Centre for Centralised Traffic Control and ERTMS ETCS level 1; GSM-R and SCADA.

NRIC will establish a **system for monitoring and controlling parameters of the rolling stock**. This system will be constructed as a radial structure, which contains local control information points. The information will be submitted to the sectional and common centre, whose main functions are to take operational decisions, to collect and archive data and to elaborate statistical reports.

It is envisaged the construction of 27 control points situated along the whole railway network in Bulgaria. Depending on the necessity of the separate control hot points, different parameters shall be monitored such as the identification of the vehicle, wheel loading and wheel flats, hot axle box, hot points and overheated brakes.

The construction of such points within the scope of the current project is envisaged for the station of Dragoman. By the installation of this system, the conditions for continuous objective monitoring of train operation and rolling stock will be created. As a result, it will be ensured safety transportation and accidents and incidents will be more effectively prevented.

There is no specific information on safety issues and black spots, before and after project implementation.