

# ASSESSING RISK IN RAIL TRANSPORT AND ADMINISTRATION OF NON-INTEROPERABLE RAILWAY INFRASTRUCTURES WITHIN S.C. GRUP TRANSPORT FERROVIAR S.A

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**ABSTRACT:** *The railway safety and workers safety management system must be documented in all relevant parts and it describes, in particular, the distribution of responsibilities in the Organization Administrator for rail infrastructure. It indicates how management is provided at certain levels, the way in which staff and its representatives are involved at all levels and how is provided the continuous improvement of the safety management system. This paper summarizes the results of a study aimed at evaluating the risk factors influencing the reliability, availability, maintainability and workers safety at S.C. Group Transport Feroviar S.A. through the application of risk assessment guide in rail transport operations/administration of non-interoperable railway infrastructures. The study was done for both the maneuver of railway vehicles, and the traffic of trains. There have been assessed and ranked the risk factors identified, establishing their risk level, as well as the priorities in terms of risk prevention measures.*

**KEYWORDS:** *risk assessment, rail transportation, safety management, severity, prevention measures.*

## INTRODUCTION

Guidance on how to most effectively introduce the risk assessment process to an organization, and how to conduct them thereafter can be extracted from different sources, but the most valuable information source remains the practical experience gained by effectively performing the risk management. Practical guidance should be provided for Romanian companies in order to get started and make progress in the risk assessment process. Topics addressed include: a) the time to complete an assessment, b) forming a team, c) what to expect, d) when to stop a risk assessment, e) what to do in cross industry situations, f) when to revise an existing risk assessment, g) making changes to the protocol and h) results of risk assessment [2, 3].

The railway safety management system and workers safety, must be documented in all relevant parts to describe in particular, the distribution of responsibilities within the manager's organization of infrastructure or rail transport operators. Romanian Railway Safety Authority - RRSA is an independent body that operates within the Romanian Railway Authority - RRA, being organized and functioning according to the provisions of the Law nr.55/16.03.2006 regarding the railway safety and Government Decision no. 626/1998 on the organization and functioning of the Romanian Railway Authority - RRA, amended and supplemented by the Government Decision of Romania no.1561/01.11.2006 [6]. The Romanian Railway Safety Authority became operational on 01.03.2007 when it was approved the organizational structure of the Romanian Railway

Authority - RRA by the Minister of Transport order no. 373/01.03.2007.

- S.C. Grup Feroviar Român S.A is a fully privately owned company, whose main activity is the provision of freight railway transport services and services related as follows:
- freight transport on public and private railway infrastructure;
- servicing and routine maintenance of locomotives and freight wagons;
- current maintenance and periodical repairs to the railway lines and railway logistics;
- specialized support in the rail transport area;
- rental of locomotives and freight wagons
- perform technical maneuvers of rolling stock, as: composing and decomposing of maneuver trains and convoys introduction and removal of wagons from the loading/unloading fronts; separating wagons according to the categories given by the type of goods, type of wagons, condition of the wagons , sender customers or recipients , etc.

The fleet of locomotives, through its unique technological features in Romania (inclusively with a GPS Tracking System) is one of the most modern in Europe and it encloses over 260 locomotives (Electric Locomotives: LE-5100 kW, 4130 kW, 3400 kW; Diesel electric locomotives: LDE-2100 hp, 1300 hp, 1250 hp; Diesel Hydraulic locomotives: LDH - 1250 hp, 700 hp, 450 hp).

In order to sustain a wide range of services at a high level of quality, the company has license for rail, safety

certificate to operate on about 90% of railway stations from Romania, certificate no. 20 116 8200 2886 TUV Austria for the management system according to OHSAS 18001:2007 for the applicability domain for rail freight transport and certificate SMC series no. 188 issued by AFER on implementation and maintenance of a quality management system according to the requests of SR EN ISO 9001:2008, for transport activities and maneuver. The analysis conducted in the documentary phase of the research revealed a significant number of normative acts and regulations in force as well as applicable guides of good practice [7, 8, 9, 10,11, 12]

**RESEARCH METHODOLOGY**

In Romania, since 2006, when the new Occupational Health and Safety Act have stated that the risk assessment is compulsory, several approaches were in use but only one method is extended in application [1, 4, 5]. The method used to identify factors that influence reliability, availability, maintainability and safety in the railway field respects the particularities of the activity that are not restricted and that must be adapted to the domain and objective specific to the activity:

- a) System’s functioning:
  - Tasks that the system must meet and the conditions in which the tasks have to be fulfilled;
  - The existence of a wide variety of human groups (travelers, operating staff, staff responsible for the system implementation, users at the level of crossings etc), of the merchandise and systems in an operational context.
- b) Physical environment and the integration level of railway systems in the environment.
- c) Conditions of application concerning the new system requirements imposed by the existing infrastructure and other systems.
- d) Operating conditions on the integration of existing systems and new systems, when put in operating and running conditions.
- e) Categories of defects
- f) Human factor.

Categories of defects that may affect reliability, availability, maintainability and safety in the rail area are defined according to the methodology applied in Table 1:

**Table 1. Categories of defects that may affect reliability, availability, maintainability and safety in the railway field**

Categories of defects	Definition
<i>Critical (failure which results with the interruption of service)</i>	A failure that prevents the movement of the train or trains a delay of the service greater than the specified one and / or causes a higher cost to the specified level
<i>Important (failure that results with disturbances in service)</i>	A failure that must be rectified for the system to meet the specified performances and it should not lead to a delay or superior costs, exceeding the minimum limit specified for a serious failure
<i>Minor</i>	A failure which prevents the system to meet the specified performances and does not meet the applicable criteria for critical or important defects

According to the methodology for risk assessment, the following steps were passed through:

- a) identification of risk factors from the analyzed system;
- b) establishment of the consequences of their actions, respectively their gravity;
- c) establishment of the probability of action of the risk factors on the performer;
- d) assigning risk levels depending on the severity and probability of the consequences of risk factors, in particular, based on scales specific to the method [13].

**CASE STUDY: RISK ASSESSMENT FROM THE BRANCH "MOVEMENT", "MANEUVER OF RAILWAY VEHICLES" ACTIVITY**

The purpose of the analyzed activity consists in carrying out necessary operations for the maneuver of the railway vehicles in safety conditions of traffic and transport safety, without danger for the personnel engaged in transport operations, entrusted assets for transport, rail vehicles, rail infrastructure and environme.

- i. description of technological processes**
  - checking the operation status of the switches and crossings;
  - checking the operation state of the main installations;
  - verification of lines;
  - verification of the positions of railroad siding and lifting gate;
  - organization, management and execution of the maneuver;
  - maneuver with the locomotive;
  - use of the hand brakes and hand block at maneuver;
  - withdrawal and stopping the maneuver;
  - rail vehicles ran;
  - maneuvering of railway vehicles carrying dangerous goods.
- ii. specifying the work task that falls on the performer: performs maneuvering operations of railway vehicles, in compliance with the applicable regulations, orders in full terms of traffic**

safety, security and occupational health and emergency situations.

**iii. description of the existing environmental conditions**

- temperature: high in summer / low during winter;
- relative variable humidity;

- lighting: natural and artificial;
- ventilation: natural.

The results of the evaluation are shown synthetically in the tables 2, 3, 4, 5 și 6.

**Table 2. Identification of risk factors from the system**

No crt	Activity	Risk factor
1.	a) checking the operation status of switches and crossings	<p>Failure to check the operating status of switches and crossings</p> <p>Disconnecting the connections between the points rail and bar/operating bar-connection-traction</p> <p>Failure to bond the tip of the counterattack siding to form between them a space greater than 4 mm in the right of the axis bar / operating bar-connection-traction</p> <p>Visible cracks or break of the siding and / or stock rail on the running surface</p> <p>Failure to observe the break at the tip of the heart or junction at its wings</p> <p>Rupture or absence of two or more screws from the runway rail or side rail</p> <p>Break of the rail joint bar from the heel of the switch</p> <p>Not laying out the mobile red discs in case of revealing one of the defects listed above</p> <p>Wrong use of the protection means by the worker</p> <p>The delay of the worker to perform the check of the switches and crossings</p> <p>Wrong execution of the checking operation of switches and crossings</p> <p>Temperature / humidity high/ low of the environment</p> <p>Inadequate lighting conditions</p> <p>Unsuitable weather conditions (lightning, rain, hail, blizzards, wind ...)</p>
2	a) checking the operation state of facilities SCB, TC, IFTE	<p>Checking the operation state of installations SCB, TC, IFTE</p> <p>Switches levers, derailment blocks, signals and various elements of malfunctioning installations</p> <p>Failure in handling the facility in order to check their functionality</p> <p>Lack of control seals for facility</p> <p>Failure to check the integrity and existence of operating bars-connection-traction</p> <p>Presence of foreign bodies between the siding and stock rail, rails and guard rail or between the point of frog and its wings</p> <p>Failure to remedy the defects found in facilities SCB, TC, IFTE</p> <p>The existence of disturbances or other hazards</p> <p>Wrong use of the protection means by the worker</p> <p>The delay of the worker to perform the check of the facilities</p> <p>Wrong execution of the checking facilities</p> <p>Temperature / humidity high/ low of the environment</p>
3	b) Verification of lines	<p>Failure to check the lines</p> <p>The safety marks of the lines on which are no maneuvers are not free</p> <p>Railway vehicles are not insured against running, depending on the slope of the line</p> <p>Failure to check the situation of the hand blocks if it complies or not with the one on the rack</p>

**Table 3. Risk assessment from the analyzed system**

No. crt.	Risk Factor	The frequency category	Description
1	Failure to check the operating status of switches and crossings	Rare	Susceptible to occur sometime in the life cycle of the system. The danger is reasonably expected
2	Failure to observe the disconnection of the links between the points rail and bar/operating bar-connection-traction	Rare	Susceptible to occur sometime in the life cycle of the system. The danger is reasonably expected
3	Failure to observe the gluing of the tip of the stock rail siding with the formation of a free space greater than 4 mm in the right of the axis bar / operating bar-connection-	Improbable	A little susceptible to occur, but possible. It may be admitted that the danger is possible in an exceptional way

	traction		
4	Failure to observe visible cracks or break of the siding and / or stock rail on the running surface	Improbable	A little susceptible to occur, but possible. It may be admitted that the danger is possible in an exceptional way
5	Failure to observe the break at the tip of the heart or junction at its wings	Improbable	A little susceptible to occur, but possible
6	Rupture or absence of two or more screws from the runway rail or side rail	Occasional	Susceptible to occur many times. The danger is expected several times.
7	Break of the rail joint bar from the heel of the switch	Improbable	A little susceptible to occur, but possible. It may be admitted that the danger is possible in an exceptional way

**Table 4. Determining the level of severity**

No. crt.	Risk Factor	Level of severity	Consequences on people or environment	Consequences on service
1	Failure to check the operating status of switches and crossings	Marginal	Minor injuries and / or significant environmental threats	Serious losses of one or more systems
2	Failure to observe the disconnection of the links between the points rail and bar/operating bar-connection-traction	Critical	A dead man and / or seriously injured person and / or significant environmental damage	The loss of an important system
3	Failure to observe the gluing of the tip of the stock rail siding with the formation of a free space greater than 4 mm in the right of the axis bar / operating bar-connection-traction	Critical	A dead man and / or seriously injured person and / or significant environmental damage	The loss of an important system
4	Failure to observe visible cracks or break of the siding and / or stock rail on the running surface	Marginal	Minor injuries and / or significant environmental threats	Serious losses of one or more systems
5	Failure to observe the break at the tip of the heart or junction at its wings	Critical	A dead man and / or seriously injured person and / or significant environmental damage	The loss of an important system
6	Rupture or absence of two or more screws from the runway rail or side rail	Critical	A dead man and / or seriously injured person and / or significant environmental damage	The loss of an important system

**Table 5. Risk ranking and setting priorities of prevention**

No. crt.	Risk Factor	The frequency of risk occurrence	Risk levels	
1	Failure to check the operating status of switches and crossings	Rare	Tolerable	
2	Failure to observe the disconnection of the links between the points rail and bar/operating bar-connection-traction	Rare		Unwanted
3	Failure to observe the gluing of the tip of the stock rail siding with the formation of a free space greater than 4 mm in the right of the axis bar / operating bar-connection-traction	Improbable		Tolerable
4	Failure to observe visible cracks or break of the siding and / or stock rail on the running surface	Improbable	Negligible	

5	Failure to observe the break at the tip of the heart or junction at its wings	Improbable		Tolerable
6	Rupture or absence of two or more screws from the runway rail or side rail	Occasional		Unwanted
7	Failure to observe the break of the rail joint bar from the heel of the switch	Improbable	Negligible	

**Table 6. Establish preventive measures . Card of prevention measures**

No crt	Working place / risk factor	Risk level			
			Nomination of measure	Competencies / responsibilities	Term
1	Failure to check the operating status of switches and crossings	Tolerable	The functioning of switches and crossings will be checked	Workplace coordinator / IDM	Permanent
2	Failure to observe the disconnection of the links between the points rail and bar/operating bar-connection-traction	Negligible	It will be interdicted the movement over the switches and crossings, it will be covered with red mobile discs	Workplace coordinator / IDM	Permanent
3	Gluing of the tip of the stock rail siding with the formation of a free space greater than 4 mm in the right of the axis bar / operating bar-connection-traction	Tolerable	It will be interdicted the movement over the switches and crossings, it will be covered with red mobile discs and the defect will be approved for remedial	Workplace coordinator / IDM	Permanent
4	Visible cracks or break of the siding and / or stock rail on the running surface	Negligible	It will be interdicted the movement over the switches and crossings, it will be covered with red mobile discs and the defect will be approved for remedial	Workplace coordinator / IDM	Permanent
5	Breaks at the tip of the heart or junction at its wings	Tolerable	It will be interdicted the movement over the switches and crossings, it will be covered with red mobile discs and the defect will be approved for remedial	Workplace coordinator / IDM	Permanent
6	Absence of two or more screws from the runway rail or side rail	Negligible	The switches and crossings will be covered with mobile red discs, and the defect will be approved for remedial	Workplace coordinator / IDM	Permanent
7	Maneuver of the railway vehicles carrying dangerous - incendiary goods	Negligible	The wagons with dangerous goods must be protected from contact with ignition sources	Workplace coordinator / maneuver leader	Permanent

## CONCLUSIONS

Risk assessment is an explicit requirement of the Romanian Health and Safety at Work Act and is also explicitly required by other general and industry-specific regulations. A suitable and sufficient risk

assessment, with effective use made of the findings, is seen as an integral part of successful health and safety management. The purpose of carrying out a risk assessment is to determine whether the level of risk arising from workplace activities is acceptable, or whether more needs to be done to control or reduce the

risk. Risk assessment involves both an estimation of the magnitude of the risk (i.e. how big is it?) and an evaluation of the significance of the risk (i.e. is it acceptable?).

The railway safety management system and workers safety, must be documented in all relevant parts to describe in particular, the distribution of responsibilities within the manager's organization of infrastructure or rail transport operators. It indicates the way the management is provided at certain levels, the way staff and their representatives are involved at all levels and the way it is ensured continuous improvement of the safety management system.

If for the activity "maneuver of railway vehicles" we have identified and analyzed 69 risk factors for the activity "train movements". We identified and assessed 63 risk factors, proceeding in a similar manner.

The analysis of the existing safety conditions at the analyzed workplaces showed that staff is equipped with personal protective equipment, it is mandatory trained for the carrying, keeping and storage of the equipment; in areas where the activity develops, safety signs are assured; workplaces are equipped with medical first aid kits; there were established employees' responsibilities and obligations on the security line and occupational health and emergency situations; people who give the first aid in case of injury have been nominated, evacuation in case of emergency situations; there are developed instructions for the development of the activity under the occupational safety; Staff is trained when hired and periodically from the health and safety at work field and from the emergency situations field. Risk management within any system must be subordinated to the objectives that form an integrated, coherent system and converging to the overall objectives, so that levels of activity to be mutually supportive. Risk control is a risk treatment technique, which includes all actions aimed at preventing undesirable events occurrence, regardless of their nature and actions of protection, to limit the effects.

Technical, economic, human, social, organizational and even communicational risks can affect even complex socio-technical systems or their environment. Therefore, organizations try to arm themselves with a rational and continuous approach of risk identification and management.

## REFERENCES

- [1] Băbuț, G., Moraru, R., *Risk assessment- Transposition of the requirements of Directive 89/391/EEC on legislations of the Member States of the European Union, Universitas Publishing, Petroșani, 2009, ISBN: 978-973-741-127-3*
- [2] Moraru, R., *Occupational Health and Safety: University Handbook (in Romanian), Universitas Publishing House, Petroșani, 2013*
- [3] Moraru, R.I., Băbuț, G.B. - *Participative risk assessment and management: a practical guide (in Romanian), ISBN 978-973-677-206-1, Focus Publishing House, Petroșani, 2010, Romania.*
- [4] *The Parliament of Romania, Occupational Safety and Health Law no.319/2006, Official Gazette of Romania, Part I, no. 646/26.07 2006.*
- [5] *Romanian Government (2006), Government Decision no. 1425 for approval of Methodological Norms for applying Occupational Safety and Health Law no. 319/2006 (in Romanian), Official Journal of Romania, part I, no. 882/30.10.2006, Bucharest, Romania.*
- [6] \* \* \*, *Law nr.55/16.03.2006 regarding the railway safety and the Government Decision no. 626/1998 on the organization and functioning of the Romanian Railway Authority-RRA*
- [7] \* \* \*, *The Romanian Government Ordinance no. 12/1998 on the Romanian railway transport;*
- [8] \* \* \*, *The Romanian Government no. 581/1998 on setting-up the National Railway Company "CFR" SA; \**
- [9] \* \* \*, *The Romanian Government Ordinance no. 89/2003 for capacity allocation of railway infrastructure, rail infrastructure charging and safety certification, approved by Law no. 8 18/02/2004*
- [10] \* \* \*, *Romanian Government Decision no. 1696/2006 for approving the Regulation for the allocation of railway infrastructure capacity;*
- [11] \* \* \*, *Romanian Government Decision no. 1409/2007 regarding the approval of Conditions rental by National Railway Company "CFR" - SA of some parts of the non-interoperable railway infrastructure and their management;*
- [12] \* \* \*, *The Minister of Transport no. 101 of 29.01.2008 concerning the granting of authorizations for safety to the administrator / railway infrastructure managers in Romania (dated 09.03.2008).*
- [13] \* \* \*, *Guidance on risk assessment at work, European Commission, Luxembourg, Office for Official Publications of the European Communities, 1996.*