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RAILWAY SAFETY: RISK ASSESSMENT TECHNIQUES

Transmitted by the Governments of Belarus, Czech Republic, Denmark, Germany, Hungary, Latvia, Lithuania, the Netherlands, Slovakia, Slovenia, Sweden, The former Yugoslav Republic of Macedonia, Turkey, United Kingdom

Note: During its fifty-third session (6-8 October 1999), the Working Party on Rail Transport invited Governments to transmit to the secretariat information on the application of risk assessment techniques to railway safety (TRANS/SC.2/192, para.23), particularly on the following items:

- (a) Railway accidents (based on definitions used in UIC statistics);
- (b) Methodologies used to establish investment priorities in the field of railway safety;
- (c) Traffic of dangerous goods on the network of the European Agreement on Main International Railway Lines (AGC);
- (d) Marshalling yards used more by dangerous goods transport.

The information submitted by Governments is reproduced below.

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BELARUS

Belarusian Railways are pursuing efforts to prioritize the safety of railway workers which is a central element in State policy with regard to health and safety at work.

The implementation of laws and regulations concerning occupational safety and various organizational and technical measures to prevent industrial injury led in 2000 to an overall decrease in the number of accidents at work, including fatalities and cases of serious disablement.

Special corridors have currently been designated for the carriage of dangerous goods by Belarusian Railways on the lines included in the European Agreement on Main International Railway Lines (AGC), maximum permissible concentrations of dangerous goods at nodes and marshalling yards have been specified, and hazard levels have been defined for populated areas where dangerous goods are handled.

CZECH REPUBLIC

(a) Railway accidents (based on definitions used in UIC statistics):

In Czech Railways, the definition of railway accident events, their classification and investigation methods are set out by the provisions of Regulation No. ÈD D 17 that is based on principles stipulated by superior law of the Czech Republic (in particular Act No. 266/94 Coll. and Regulation No. 173/95 Coll. as amended later). Definitions and classification are different to those of the UIC statistics, however, a system of definition and category transformations from the ÈD D 17 to the UIC norms has already been provided. Based on this system results, data on accidents are being sent through the General Directorate of Czech Railways to the UIC statistics every year.

(b) Methodologies used to establish investment priorities in the field of railway safety:

In order to determine investment priorities in the field of railway transport safety, Czech Railways take a well-considered approach using the following methods and procedures:

- Czech Railways continuously raise claims as to the application of the EC recommendations for the structure of capital expenditures in the transport infrastructure in the Czech Governmental Budgets starting the year 2000. About 2% of the Czech GNP goes to the transport infrastructure where the railway infrastructure accounts at least for 45%.
- Methods of investment priority assessments are further based on monitoring, analyses and regular evaluations of technical and operating conditions of infrastructure equipment, accident events and accident rate reasons, incl. assessment of potential risks in the railway operations and transport.
- On the basis of accident rate and event analyses as registered by Czech Railways the investment priorities are directed into:
 - development of TRS radio networks at auxiliary lines (GSM-R systems at corridor-type lines in future);
 - train interlocking system enhancements at driving vehicles;

- introduction of new technologies and/or modifications of interlocking installations in railway stations;
 - modernization of railway crossing systems, substructures and superstructures, bridge structures and tunnels.
- The investment priorities are also implemented not only to achieve high operating and transport safety standards but also to accomplish high track capacities and punctual observation of timetables.
- (c) Traffic of dangerous goods on the network of the European Agreement on Main International Railway Lines (AGC):

For the Czech domestic and international transport of hazardous goods the 'Code of International Transport of Hazardous Goods (RID)' is applied.

The domestic transport is governed by this Code through Resolution No. 1/2000 Coll. of the Czech Government. The transport of hazardous goods is made to from/to railway stations authorised for complete wagonloads or, if applicable, express freight, as well as through the transit passing the Czech territory.

For instances of extraordinary events during the hazardous goods transports, the Station Codes stipulate instructions for the employees of Czech Railways how to proceed to eliminate potential impacts and losses (the Information of the HZS ÈD, etc.).

Czech Railways actively co-operate with the Czech Ministry of Transport and Communications on amendments or updates of the existing provisions of the RID.

- (d) Marshalling yards used more by dangerous goods transport:

For the hazardous goods transports in the Czech Republic all available marshalling yards are used; no limitations from the point of view of hazardous goods are declared by the relevant authorities.

Safety is guaranteed by strict following of the RID requirements – i.e. all consignments must be marked, attached with stickers and specified in the relevant freight documents according to the RID provisions. No exceptions to the RID rules are granted for Czech Railways.

DENMARK

- (a) Railway accidents (based on definitions used in UIC statistics):

Accidents on the state owned railway infrastructure and the infrastructure of the Danish Private Railways, 1990-1999, according to the analysis by The Danish National Railway Agency mentioned under point D.

Train crash	51
Derailment	73
Shunting	3815
Accidents at level crossings	179
Fire	88
Total	4206

(b) Methodologies used to establish investment priorities in the field of railway safety:

For the establishment of investment priorities concerning railway safety, Banestyrelsen (the Danish National Railway Agency) carries out cost-benefit analyses and risk assessments.

(c) Traffic of dangerous goods on the network of the European Agreement on Main International Railway Lines (AGC):

Dangerous goods are being transported on the Danish State rail network, the Oeresund Link and the Great Belt Link, where the Danish National Railway Agency is responsible for safety standards.

The Danish National Railway Agency has access to databases containing information on whether dangerous goods are being transported on the Danish State rail network or the two links mentioned.

Data on the nature and volume of dangerous goods transported have traditionally been collected by DSB Gods (the Freight Division of the Danish State Railways).

(d) Marshalling yards used more by dangerous goods transport:

Marshalling yards used to a larger extent for dangerous goods transports are situated in Copenhagen, Fredericia, Kolding, Århus and Padborg.

GERMANY

(a) Railway accidents (based on definitions used in UIC statistics):

At present, the only accident data available are those supplied by Deutsche Bahn AG. In accordance with the Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on rail transport statistics, other infrastructure managers and railway undertakings are to be included in the statistics in the future.

The accident statistics supplied by Deutsche Bahn AG for 1999 and 2000 are as follows:

	1999	2000
Number of accidents		
Collisions and derailments	361	337
Other accidents	494	436
Number of persons killed		
Collisions and derailments	3	12
Other accidents	227	213
Number of persons injured		
Collisions and derailments	35	192
Other accidents	236	200

Source: DB AG statistics

The accident data supplied by Deutsche Bahn AG illustrate the high level of safety on the railways. Given the low absolute accident figures, the comparison between 1999 and 2000 has to be seen in the light of the customary statistical dispersion.

(b) Methodologies used to establish investment priorities in the field of railway safety:

Under Section 4 (1) of the General Railways Act, railway companies are responsible for ensuring that their infrastructure and rolling stock are in a proper condition and that their operations are conducted in a safe manner. In this context, they also establish investment priorities, although they have to observe the requirements laid down by laws and regulations. In addition, they are required to comply with sound engineering practice (e.g. ISO, EN and DIN standards), and may only deviate from this if they prove that at least the same level of safety is ensured as if they had applied sound engineering practice. When weighing up the priorities of investment to improve operational safety, the guide entitled "Risk-Oriented Safety Records in Railway Operations" is applied (see answer to question E. b) in the 1998 questionnaire).

In the field of technical safety (e.g. track guidance, control and signalling technology, safety and rescue systems), a high level has been reached, and this level is taken into account and evolved when making investments, in accordance with the state of the art.

Most accidents, however, are caused by human error. For this reason, more money is being invested in systems that rule this out.

In the field of control and signalling technology, far-reaching protective mechanisms have already been installed.

(d) Marshalling yards used more by dangerous goods transport:**Transport of dangerous goods by rail:**

		1996	1997
All dangerous goods	million tonnes	42.7	42.7
– Dangerous goods' share of total traffic	%	13.9	13.5
Dangerous goods in inland transport	million tonnes	34.5	33.9
– Share of total traffic	%	15.4	15.0

Source: Verkehr in Zahlen 2000

No data are available on the transport of dangerous goods on specific routes or via specific marshalling yards.

HUNGARY(a) Railway accidents (based on definitions used in UIC statistics):

Personal consequences of railway accidents

	1999	2000	index
Number of passenger fatalities	15	11	73
Number of passenger injuries	218	223	102
Number of railwaymen's fatalities	4	1	25
Number of railwaymen's injuries	22	23	140
Number of third persons' fatalities	108	105	97
Number of third persons' injuries	357	382	107

In 2000 main cause of the injuries were: getting / leaving moving trains 26%; crossing at forbidden spots 23%; falling down on platforms 20%; collisions at level crossings 18%.

(b) Methodologies used to establish investment priorities in the field of railway safety:

Investment priorities derive from rentability calculations which are brought about apart from business considerations, also the necessity to meet the requirements of safety. At the calculations the saving from the prevention of arising of detriments is a decisive factor to calculate the net revenues expected from the investment.

(c) Traffic of dangerous goods on the network of the European Agreement on Main International Railway Lines (AGC):

Dangerous goods, 9 million tons in 2000 give 20% of total freight volume by rail and run 200 km in average. Approximately 80% are moved on the main lines included in AGC network. From the 12 stations with largest volumes of dangerous goods 4 are not along an AGC line, but 20-30 km far along sidelines. Volume of dangerous goods are not registered in the electronic real time wagon tracing system by different lines.

(d) Marshalling yards used more by dangerous goods transport:

4 marshalling yards are used mostly in dangerous goods' traffic of which 1 is included in the List of Marshalling Yards in the AGC Network.

LATVIA

(a) Railway accidents (based on definitions used in UIC statistics):

	1998	1999	2000
People suffered in railway accidents	106	69	82

(b) Methodologies used to establish investment priorities in the field of railway safety:

LDz investment priorities are stated basing on the following criteria: Railway lines' division in categories (strategic meaning infrastructure and regional meaning infrastructure); constraints of capacity in railway sections and stations; traffic volume forecasts; promotion of railway network to EU technical standards.

(c) Traffic of dangerous goods on the network of the European Agreement on Main International Railway Lines (AGC):

Latvia has not yet joined the European Agreement on the Main International Railway Lines (AGC).

(d) Marshalling yards used more by dangerous goods transport:

Marshalling yards used more by dangerous goods transport are Ģīrotava, Daugavpils, Rēzekne, Ventspils

LITHUANIA

(a) Railway accidents (based on definitions used in UIC statistics):

Total number of accidents in railway transport sector in 2000:

- 1 accident;
- 110 breaks by fault of the Lithuanian Railways;
- 15 breaks by fault of the railways of other states;
- 3 breaks on approaching roads;
- 3 breaks, i.e. locomotive burning;
- 2 breaks by fault of other companies.

(b) Methodologies used to establish investment priorities in the field of railway safety:

1. Improvement of infrastructure (roads, automation and communications and other);
2. Modernization of rolling-stocks and development of repair basis;
3. Training of staff;
4. Procurement of technique and devices for the liquidation of accident consequences.

(c) Traffic of dangerous goods on the network of the European Agreement on Main International Railway Lines (AGC):

Approximately 200 thousand tones of freight are transported, through Šeštokai and Mockava railway stations including 5 thousand tones of dangerous goods of ten various sorts (classes 1, 2, 4, 8 and 9).

(d) Marshalling yards used more by dangerous goods transport:

Wagons carrying dangerous goods are allocated at railway stations of Vaidotai, Radviliškis, Khipėda, Bugeniai, "Draugystė" and Kaunas.

NETHERLANDS

(a) Railway accidents (based on definitions used in UIC statistics):

Railway accidents

passengers	1994	1995	1996	1997
injured	160	11	116	141
killed	0	0	1	6

SLOVAKIA

(a) Railway accidents (based on definitions used in UIC statistics):

From the point of view of a long-term development of rate of accidents in comparison to the previous 5 years, the condition is as follows:

Accident events for 1995 to 1999

Total/ŽSR					
Category	1996	1997	1998	1999	2000
A	23/6	24/10	20/4	14/2	11/1
B	9/1	12/3	13/5	15/7	10/1
C	106/38	102/36	100/36	92/37	73/35
D	1,060/818	949/736	836/625	915/685	888/655
In total	1,198/863	1,085/785	969/670	1,038/729	982/692

It is obvious from the above-mentioned chart that the condition of the rate of accidents is varying. Despite an increase in 2000, the accidents events had a tendency to decrease. The human factor has continually a high share in casual relation of occurrence of accident events.

Level crossings remain to be an issue. In 2000, a number of collisions of rail and road vehicles occurred, while the number of casualties increased. This trend is related to decline in discipline of drivers of road vehicles. To eliminate this phenomenon, the ŽSR, in economically justified cases, particularly on upgraded and renewed tracks of Pan-European corridors commences to build fly-over crossings whose implementation is very demanding in terms of finance anyway.

(b) Methodologies used to establish investment priorities in the field of railway safety:

Economic assessment of social benefits of the project is an integral part of any investment project on the network of the ŽSR. Within these benefits, an increase in security of railway transport constitutes a significant component. Benefit of the project is expressed by an assumed decrease in costs to remove consequences of accidents related to railway transport.

Thanks to a high degree of security in the railway transport and compliance with national and international standards, the ŽSR has no distinct priorities in the area of security of railway transport.

(c) Traffic of dangerous goods on the network of the European Agreement on Main International Railway Lines (AGC):

Traffic of dangerous goods in the entire network of the ŽSR is regulated by the Rules for International Railway Transport of Dangerous Goods (RID). The ŽSR has formed structures, organizational units and material and technical basis as well as it prepared procedures to secure transports of dangerous goods and to address potential risky and emergency situations.

The issue of traffic dangerous goods and the measures to prevent emergency situations is an integral part of internal corporate education and training of workers of the ŽSR.

(d) Marshalling yards used more by dangerous goods transport:

Marshalling yards are used in transporting dangerous goods in accordance with applicable national as well as international legal and technical standards.

SLOVENIA

(a) Railway accidents (based on definitions used in UIC statistics):

YEAR	<i>Number of accidents</i>					<i>Number of passenger fatalities</i>		
	Collisions	Deraillments	Other (not including accidents in cols. 5 and 6)	At level crossing	of persons caused by rolling stock in motion	Collisions and deraillments	Other accidents (in cols.4,5 and 6)	per 1000000000 PKm
1996	2	5	6	29	35	-	-	-
1997	3	9	1	27	36	-	1	1.6
1998	1	1	5	20	34	-	-	-
1999	6	3	4	16	40	-	-	-
2000	4	2	3	15	32	-	-	-

YEAR	<i>Number of passenger injuries</i>		
	Collisions and deraillments	Other accidents (in cols.4,5 and 6)	per 1000000000 PKm
1996	-	6	9.8
1997	1	11	19.5
1998	-	7	10.9
1999	-	12	19.3
2000	-	7	9.9

(b) Methodologies used to establish investment priorities in the field of railway safety:

The investment priorities in the field of railway safety are defined in accordance with the unified methodology for preparing the programmes on public procurements which was prescribed by the Government of the Republic of Slovenia. The procedure includes the following basic steps:

- the evaluation and assessment of the investment
- the type and obligatory contents of the investment documentation
- the procedures and participants for preparing the documentation
- the measures for establishing the investment efficiency.

(c) Traffic of dangerous goods on the network of the European Agreement on Main International Railway Lines (AGC):

Year	Tonnes
1996	851,906
1997	1,207,556
1998	814,368
1999	800,489
2000	950,455

(d) Marshalling yards used more by dangerous goods transport:

Ljubljana - Zalog and Maribor - Tezno.

SWEDEN

Applied definitions in Swedish official statistics differ some from UIC standard. See page 60 in attached railways 1997.pdf.

(a) Railway accidents (based on definitions used in UIC statistics):

Accidents

Derailments of trains in motion:	12
Collisions of trains in Motion:	3
Collisions at level crossings:	20
Other accidents:	72
Sum	107

Fatalities

Passengers:	0
Railway employees:	1
Other persons:	21
Sum	22
– moreover suicides:	58

Casualties

Passengers:	1
Railway employees:	1
Other persons:	14
Sum	16

– moreover attempts at suicide: Unknown

Specification of collisions at level crossings

Collisions with:

- cars, trucks and buses:	17
- other motor vehicles:	0
- non motor vehicles and persons crossing the line by foot:	3
Sum	20
- of which fatalities:	15
- of which casualties:	10

Source: Swedish Railway Inspectorate

(b) Methodologies used to establish investment priorities in the field of railway safety:

Most decisions on safety standards are taken after discussions between experienced persons. The reason is that that accidents generally are so few, that it is hard to develop statistical models to forecast future accidents. One exception exists; cost-benefit calculations of safety improvements at level crossings road-rail. The accident-forecasting model is based on the parameters daily flow of trains and cars, train speed and type of protection. The model is described in Swedish in the publication, Banverket BVH706.00 chapter 2.14.

Source: National Rail Administration

(c) Traffic of dangerous goods on the network of the European Agreement on Main International Railway Lines (AGC):

Traffic of dangerous goods on the AGC network is not accessible. Reported below are the total transports of dangerous goods in Sweden aggregated on four-digit NHM level.

Year	million tonnes	million tonne-kilometres
1996	1.8	895
1997	1.9	932
1998	1.9	922
1999	1.9	951

Source: Green Cargo AB

(d) Marshalling yards used more by dangerous goods transport:

- Malmö
- Hallsberg
- Göteborg – Sävenäs
- Sundsvall

Source: Green Cargo AB

THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA

(a) Railway accidents (based on definitions used in UIC statistics):

		1999	2000	Index
1.	Severe accidents during the rail traffic performance	10	1	10
2.	Accidents during the rail traffic performance	48	73	152
3.	Severe accidents on road passages and out of them	26	19	73
4.	Accidents on road passages and out of them	4	9	225
Total		88	102	116

		1999	2000	Index
1.	Personal defaults during the rail traffic performance	23	30	130
2.	Technical reasons	26	32	123
3.	Force majeure	2	4	200
4.	Negligence by passengers and third persons	37	36	97
Total		88	102	116

TURKEY

(a) Railway accidents (based on definitions used in UIC statistics):

	1998	1999	2000
OPERATING ACCIDENTS			*
1- Number of Accidents			
- Collisions	27	36	
- Derailments	113	89	
- Collisions at Level Crossing	311	307	
+ Casualties Caused by Rolling Stock Motion			
- Falling from a train	133	91	
- Train hit a person	230	247	
- Other Accidents	21	29	
- Total Number of Accidents	835	799	
2- Number of Fatalities			
- Passengers	22	12	

-	Railway Employees	3	5
-	Other Persons (Train hit a person)	133	152
-	At Level Crossing	69	64
-	Total Number of Fatalities	227	233

2- Number of Casualties

-	Passengers	92	156
-	Railway Employees	3	34
-	Other Persons (Train hit a person)	74	97
-	At Level Crossing	107	211
-	Total Number of Casualties	276	498

* Data on 2000 hasn't been completed yet.

(b) Methodologies used to establish investment priorities in the field of railway safety:

Basic factors threatened the railway safety are collisions, derailments, accidents in level crossing, falling from train, along with run away of train and wagon etc. Investments given priority and provided safety on planning of the railway investments are as :

- (i) It is targeted to prevent derailments through the rehabilitation of the railway infrastructure and for this purpose the existing rail infrastructure is renewed periodically. In addition, pose of reinforcement, renewal of switch and rail welding is made according to the damage occurred on the rail and rail equipment.
- (ii) In order to prevent the train collisions, the signalling projects are carried out along with minimizing staff mistakes on this issue and using of the technological development, and at the framework of a programme gradually signalling all of TCDD network.
- (iii) In order to prevent collisions on level crossing, the projects of the mechanic and electronic safety installations in existing network are carried out.
- (iv) In order to prevent falling from train, run away of wagon and train, the projects of modernization of the trains and wagons and especially modernization of the suburban train projects are carried out.

UNITED KINGDOM(a) Railway accidents (based on definitions used in UIC statistics):

HM Chief Inspector of Railways' Annual Report 1999-00, published in December 2000, revealed that overall rail safety continues to improve gradually year on year. For the period 1 April 1999 to 31 March 2000, collisions were down by 27, from 121 to 94 – the lowest on record. Derailments at 90 represented an all time low. Significant incidents were down by seven from 104 to 97 – the second lowest annual total ever. Passengers fatally injured falling from moving slam door trains were down from five the previous year to two – equalling an all time low. The train crash at Ladbroke Grove in October 1999, in which 31 people died, was the only train accident during that year in which passengers were killed. Vandalism was still to blame for over half of all train incidents.

(b) Methodologies used to establish investment priorities in the field of railway safety:

Specific guidance for taking safety decisions on the Railtrack-controlled infrastructure is set out by Railtrack in its Railway Safety Case, which is accepted by Her Majesty's Railway Inspectorate (HMRI). In summary, where risks lie in the "as low as reasonably practicable" (ALARP) region, decisions on whether to implement further safety measures are guided by balancing safety benefits (i.e. reductions in risk) against the cost of undertaking those measures.

Safety benefits are measured in terms of fatalities and injuries avoided, which are converted to an index of equivalent fatalities (with 10 major injuries equivalent to one fatality, and 200 minor injuries equivalent to one fatality). The number of equivalent fatalities avoided is valued by applying an appropriate value of preventing a fatality (VPF). In 2000/01 these values, which are calculated by using the Department of the Environment, Transport and the Regions (DETR) formula for road safety expenditure, are £ 1.15m per equivalent fatality avoided for single fatalities, and £ 3.22m for multiple fatalities or where risks are close to intolerable.

In May 1999 the Health and Safety Executive (HSE) published a discussion document, *Reducing Risks, Protecting People*, which provided further guidance on taking safety decisions.

(c) Traffic of dangerous goods on the network of the European Agreement on Main International Railway Lines (AGC):

Not Applicable – The United Kingdom is not a signatory to the AGC

(d) Marshalling yards used more by dangerous goods transport:

This information will be provided at a later date in the near future.
