ChemLog-T&T – Tracking and Tracing solutions for improvement of intermodal transport of dangerous goods in CEE

Analysis compiled for the Ústínad Labem Region in the Czech Republic

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0. Content

1. Introduction

Chemical industry belongs tokey industries in the Czech Republic (CR). The number of people employed in the chemical industry in 2007 was 10.1 % according to the Czech Statistical Office. It takes third place within the industries of the CR, right after the engineering (38 %) and metallurgical industry (14.3 %).

An important part of the chemical industry in the CR is represented by refineries for crude oil processing. It regards the companiesČeskárafinérská in Litvínov and in KralupynadVltavou, and Paramo in Pardubice and Kolín. Other significant companies in the Czech chemical industry includeSpolanaNeratovice, Synthesia in Pardubice, Synthos (formerly Kaučuk) in KralupynadVltavou, Spolchemie in Ústínad Labem, DEZA in ValašskéMeziříčí, Momentive Specialty Chemicals in Sokolov, BorsodChem MCHZin Ostrava,Lovochemiein Lovosice,LučebnízávodyDraslovkainKolín,Fosfa inBřeclav,Precheza inPřerov, etc.(2).

Products of the chemical industry are used in other industry sectors. For that to happen, they often have to go through a long transport connected with strict legislative requirements. Logistics is therefore of crucial importance to the operation of the market and that is why relatively close attention is paid to it at present.

The Ústínad Labem Region is crossed by an important arterial road which is the main connecting road with Germany.The Ústí Region, as the only region in the CR, makes use of the navigability of the riverElbe which connects the country with the North Sea. Railway transport is also represented here – the main line from Prague to Dresden runs through the region.

The importance of the Ústí Region resides mainly in heavy manufacturing. In the Lower Ore Mountains, there are important coal power plants (Tušimice, Prunéřov, Ledvice).Chemical industry (Litvínov, Ústínad Labem, Lovosice) contributes significantly to the region´s economy, along with other “non-chemical” industries, such as paper, glass, food or engineering industry. In an area of such economic importance, safety of transport is thereforein the foreground, also because the national park of Bohemian Switzerland and nature reservesČeskéStředohoří(Central Bohemian Uplands) and Labsképískovce (the Elbe Sandstone Mountains) are located here.

The landscape character of ČeskéStředohoří belongs to the most beautiful mountain ranges in the CR. The area is crossed by the Elbe which, on its way through the Uplands, forms a valley called BránaČech (the Gate to Bohemia). The sandstone landscape, extensive forests, cultural monuments and vernacular architecture are of great importance to the nature reserveof the Elbe Sandstone Mountains. Another place of interest, and a national park at the same time, is ČeskéŠvýcarsko (Bohemian Switzerland), the youngest national park in the Czech Republic. With regard to transport of chemicals, these monuments must be taken into consideration because standard routes of railway, road and river transport often pass right through these landscape units, or in their immediate environs.

Transport of chemicals is associated with international regulations known as ADR (road transport), RID (railway transport), ADN (river transport), IMDG-Code (sea transport), and ICAO-TI (air transport). All these regulations use the deep-rooted term designating chemical products, i.e. “dangerous goods”. The following text will therefore use this term as well.Certain harmonization of these regulations is in place because combined transport system is also expected to be used for the transport of dangerous goods.

Transport terms are clearly definedpursuant to these regulations. Let us mention e.g. labelling of chemicals packaging, labelling of transport units, filling out transport documents, or training of the individual participantsrequired by law.

The results of the ChemLog T&T project should mainly contribute to increased awareness and interest in intermodal transport and its use, and to the development of intermodal transport terminals. In the Ústí Region, the results could significantly promote the importance and use of the inland waterway transport and its full incorporation in the Trans-European Inland Waterway network. Objectives of all the project participants, at national, as well as at Central-European level, are identical and they are mainly aimed at improving transport infrastructure, improving logistics of chemicals, improving organization of multimodal transport, harmonizing regulations, improving safety and reliability of transport of chemicals, or implementing solutions for emergencies and crisis systems.

According to statistical indicators, the number of accidents in the CR in relation to dangerous goods occupies an important place. The aim of this project will thereforebe to try to propose a system which would be able to eliminate traffic accidents and leakages of substances, make work of rescue units easier and make information about dangerous goods available to them in good time, before theirresponse.

Several entities in the Czech Republic have been involved in designing projects and system solutions regarding improvement of transport by monitoring freight and vehicles. Some of the projects were purely theoretical, other, on the contrary, were successfully tested in normal operation. Out of the explored options, the most workable solution appeared to be the project which would make use of the European navigation system Galileo. ČVUT, together with ÚSTAV SILNIČNÍ A MĚSTSKÉ DOPRAVY a.s., participated in this project. The purpose of this project was to utilize the satellite system Galileo for supporting transport of dangerous goods which are subject to ADR using the GNSS system (global navigation satellite system in the CR). The project objective, and the task of the entire system, consisted in driving and tracking a vehicle transporting dangerous goods from the place of loading to its destination station. The main prerequisite was to suggest a suitable transport route for safe transport of dangerous goods so as to reduce the emergency hazard as much as possible, or to ensure a timely action of the Integrated Rescue System in order to minimize leakage of the substance into the environs. The system was meant to provide continuous updates about the entire transport process from its very beginning up to its definite end.

A certain shift for the transport of dangerous goods, and not only of them, would be to draw up map data showing the major key points (transhipment centres, ports, airports, …) which could be used in the future for computer simulations of transport, software and maps of transport routes, GPS, etc. Many shipping companies would appreciate an overview of transport restrictions within the area where their drivers operate. A big problem in the CR is with the placement of traffic signs B18 and B19. These signs are spread “non-uniformly” throughout the country and therefore it would be suitable to draw up an overview of their locations, or to suggest alternative (diversion) routes. It is not only thesesigns what poses trouble for shipping companies. Restricting for them are also prohibition signs regarding the tonnage of transport units, height and load capacity of bridges, tunnel entrances, etc. Mapping would be appropriate for the whole country.

The analysis is dedicated to the current state of transport of dangerous goods in the CR, with the focus on the Ústínad Labem Region.

2. Legislation

This section covers the main sources of legislation which provide for transport of dangerous goods. Because there are five different types of transport (i.e. road, railway, inland waterway, sea and air transport), this section will briefly cover international regulations associated with them, as well as Czech acts through which these international regulations are implemented into domestic law.

2.1 International legislation regarding the transport of dangerous goods

One of the most important objectives of the ChemLog T&T project was to direct attention to multimodal transport of dangerous goods. Therefore to start with, it is important to mention international conventions which must be followed by the participants involved in the transport.

The data about the volume of the transported dangerous goods issynoptically processed by the statistical office of the European Union, Eurostat. The transport of dangerous goods in the EU-27 remained relatively stablefrom 2009 to 2011. In 2011, more than 78 billion ton-kilometres of dangerous goods were transported (3).

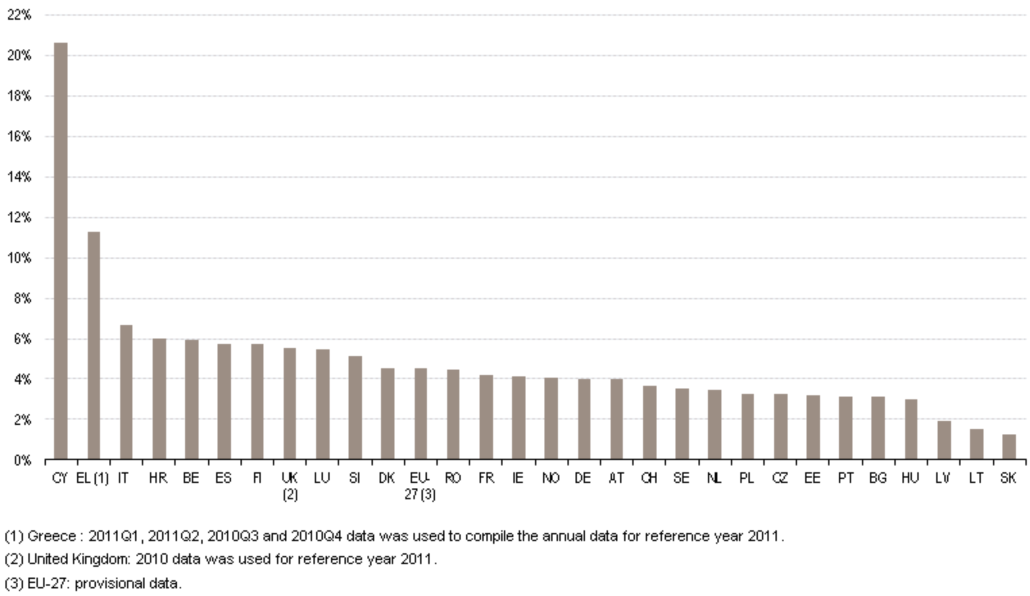
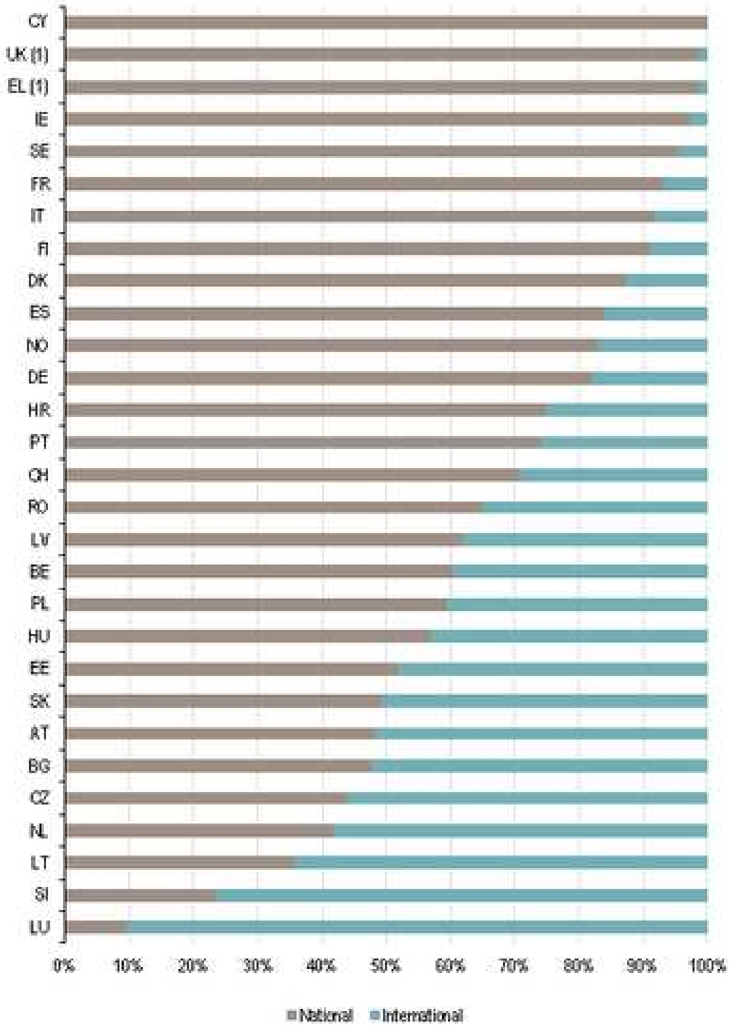


Fig.No. 1:*Share of transport of dangerous goods in total transport of all commodities by individual countries in 2011***(3)***.*

Fig. 1 shows the share of dangerous goods in the total transport of all commodities of each country in 2011. More up-to-date data has not been released. The respective countries are indicated according to the distinguishing signs of the country´s registration of motor vehicles. According to this chart, the share of dangerous goods transport hovered around 4 % in most countries.Some countries had a substantially greater proportion, i.e. Cyprus recorded almost 21 %,Greece 11 %, and Italy about 7 %. At the other extreme were Slovakia, Latvia, and Lithuania, between 1 – 2 % (3).

Fig. 2 shows the repartition of the transport of dangerous goods between national and international transport in the individual countries in 2011. The respective countries are indicated here according to the distinguishing signs of the country´s registration of motor vehicles. Grey colour in the chart represents domestic transport, and blue colour represents international transport.



(1) Greece and the United Kingdom: 2010 data was used for reference year 2011.

Fig. No.2: *The share of international and domestic transport of dangerous goods in the individual countries in 2011* **(3)**.

For most of the countries, more than half of their transport of dangerous goods is performed on their national territory. An exception is e.g. Luxemburg, where most (90 %) of its transport is international transport. The Czech Republic has a balanced share of the national and international transport – i.e. about 55 % of all transport is carried out abroad, and the rest within the country (3).

The type of dangerous goods involved in such transport in the EU in 2011 is shown in Fig. 3. As can be seen, the largest specific group was flammable liquids, with 59 %. This result could have been expected due to the fact that propellants belong to flammable liquids, and they are the most commonly transported goods at present. Two other large groups aregases (13 %) and corrosives (10 %) (3).

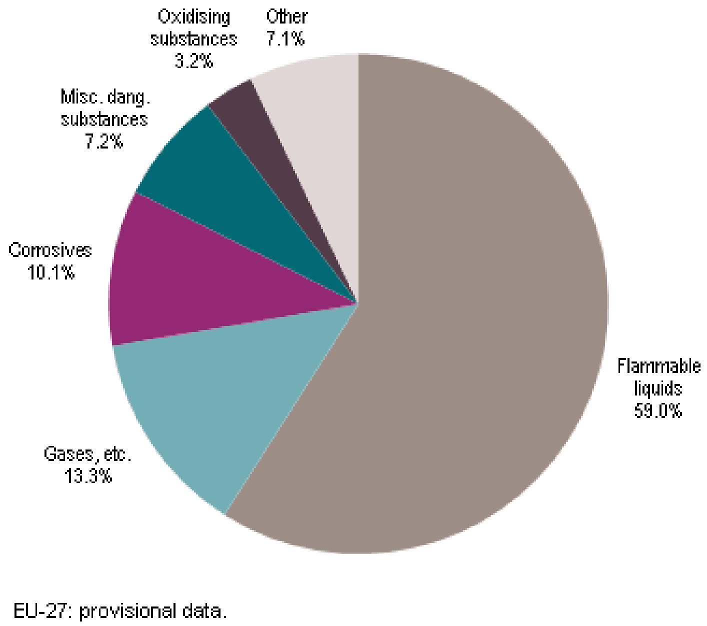


Fig. No.3:*EU transport of dangerous goods by type of dangerous goods in 2011***(3)**.

2.1.1 International legislation regarding the road transport of dangerous goods

Road transport of dangerous goods is provided for by the ADR Agreement, i.e. European Agreement Concerning the International Carriage of Dangerous Goods by Road. ADR was concluded in Geneva on 30 September 1957 under the aegis of the United Nations Economic Commission for Europe. Czechoslovakia acceded to ADR in 1987. After the dissolution of Czechoslovakia in 1993, the ADR Agreement was confirmed by both the Czech Republic and Slovakia.

The ADR prohibits carriage of a dangerous substance, or allows carriage under conditions stipulated therein – it sets conditions e.g. for the individual participants involved in the transport, ordains respective classification and use of instructions regarding packaging of each substance, stipulates correct labelling of packaging and transport units, requires preparation of transport documents, trained employees, etc. More detailed information will be provided in section 3 of this analysis.

The ADR is valid for two years and it is modified every odd year (i.e. it was issued e.g. in 2009, then in 2011, and the last one in 2013). Because changes must be implemented and must undergo the legislative process of each country, a transitional period of half a year has been established, during which it is possible to abide by the regulations of both the ADR which is coming to a close, as well as by the new current ADR. The current 2013 ADR has been published for the CR in the Collection of International Treaties, section 5, report 8/2013.

Contracting states to the ADR Agreement as of 1 January 2013 (48 countries in total) and the year of accession of each state are listed in Chart No. 1.

STATE	SINCE	STATE	SINCE	STATE	SINCE
ALBANIA	2005	ANDORRA	2009	AZERBAIJAN	2000
BELGIUM	1960	BELARUS	1993	BOSNIA AND HERZEGOVINA	1993
BULGARIA	1995	CZECH REPUBLIC	1993	MONTENEGRO	2006
DENMARK	1981	ESTONIA	1996	FINLAND	1979
FRANE	1960	CROATIA	1992	IRELAND	2006
ISLAND	2011	ITALY	1963	KAZAKHSTAN	2001
CYPRUS	2004	LIECHTENSTEIN	1994	LITHUANIA	1996
LATVIA	1995	LUXEMBOURG	1970	HUNGARY	1979
MALTA	2007	MACEDONIA	1997	MOROCCO	2001
MOLDAVIA	1998	GERMANY	1969	NETHERLANDS	1963
NORWAY	1976	POLAND	1975	PORTUGAL	1967
AUSTRIA	1973	ROMANIA	1994	RUSSIA	1994
GREECE	1988	SLOVAKIA	1993	SLOVENIA	1992
GREAT BRITAIN	1968	SERBIA	2001	SPAIN	1972
SWEDEN	1974	SWITZERLAND	1972	TAJIKISTAN	2011
TUNISIA	2008	TURKEY	2010	UKRAINE	2000

Chart No.1:*Contracting states to the ADR Agreement as of 1 January 2013***(4)***.*

2.1.2 International legislation regarding the railway transport of dangerous goods

Terms of the railway transport of dangerous goods are based on RID (Regulations Concerning the International Transport of Dangerous Goods by Rail), published in the Convention concerning International Carriage by Rail (COTIF), attachment C.

Unabridged RID, will all modifications and addenda, valid as of 1 January 2013, was published in the CR in the Collection of International Treaties, part 13, as a notification of the Ministry of Foreign Affairs no. 23/2013 Coll. of Int. Treaties.

As of 30 June 2012, the contracting states are as follows: Albania, Algeria, Belgium, Bosnia and Herzegovina, Bulgaria, Montenegro, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Croatia, Iraq, Iran, Ireland, Italy, Lebanon, Lichtenstein, Lithuania, Latvia, Luxembourg, Hungary, Macedonia, Morocco, Monaco, Germany, Netherlands, Norway, Poland, Portugal, Austria, Romania, Greece, Slovakia, Slovenia, United Kingdom, Serbia, Syria, Spain, Sweden, Switzerland, Tunisia, Turkey and Ukraine (5).

2.1.3 International legislation regarding the transport of dangerous goods by inland waterways

The European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways ADN concluded in Geneva on 26 May 2000 under the aegis of the United Nations Economic Commission for Europe (UNECE) and the Central Commission for Navigation on the Rhine (CCNR) came into force on 28 February 2008.

The agreement is regularly modified and amended at two-year intervals. Just as with the ADR and RID, a six-month transition period is applicable between the ADN coming to a close and the new one. The ADN 2013 has been in force since 1 January 2013.At the time of the preparation of this analysis, the ADN 2013 was not embedded in the Collection of International Treaties of the Czech Republic, we therefore reference at least the ADN 2011 which is currentlyin force (until 30 June 2013): part 53, notification 102/2011 of the Collection of International Treaties.

During the preparation of the ADN 2013, there were seventeen contracting states to the agreement: Austria, Bulgaria, Croatia, Czech Republic, France, Germany, Hungary, Luxembourg, Netherlands, Poland, Moldavia, Romania, Russian Federation, Serbia, Slovakia, Switzerland and Ukraine(6).

2.1.4International legislation regarding the air transport of dangerous goods

The instructions for the air transport are provided for by the Chicago Convention on International Civil Aviation, published by the International Civil Aviation Organization (ICAO) in 1944. In relation to air transport of dangerous goods, ICAO technical instructions must be taken into account (annexe 18 to the Chicago convention).

Unlike with the above mentioned ADR, RID and ADN agreements, no transition period is applicable with ICAO-TI. The 53rd edition was valid until 31 December 2012 and the 54th edition came into forceon 1 January 2013(7).

2.1.5 International legislation regarding the sea transport of dangerous goods

The sea transport of dangerous goods is included in the International Convention for the Safety of Life at Sea (SOLAS) issued by the International Maritime Organization (IMO). The regulations for the transport of dangerous goods are called IMDG-Code.

It was possible to use the 2010 IMDG-Code edition (amendment 35-10) from 1 January 2011, it strictly had to be used from 1 January 2012, and it can be used until 31 December 2013. IMDGCode 2012 (amendment 36-12) will come into force on 1 January 2014, but it can be used as of 1 January 2013, and it will be possible to use it until 31 December 2015. For clarity see Fig. 4, showing the dates of transition provisions of the IMDG-Code. Yellow fields mark the periods, during which it is possible to use both versions of the IMDG-Code (a year-long transition period), green fields mark the periods, during which only one valid version of IMDG-Code can be used (8).

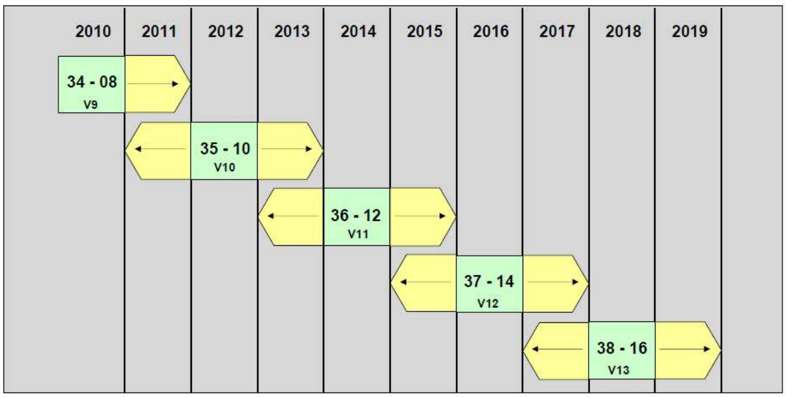


Fig. No.4: *Transition periods for the IMDG-Code***(9)**.

2.2 National legislation regarding the transport of dangerous goods

Road transport has the largest share in the transport in the CR. A detailed analysis was conducted by the Ministry of Transport of the CR and it is available on its website. The below mentioned data applies for 2011. The values are giveninths. tons. The 2012 data is not available, but we expect similar figures.

Chart No. 2 shows transport streams of goods in thenational transport according to the individual modes of transport in 2011. It should be pointed out that the data is not related to the transport of dangerous goods, but to the transport of other commodities (cereals, fruit, vegetables, etc.). Transport streams for the Ústínad Labem Region are also included there. A detailed itemization of transport streams among the individual regions in the CR will be discussed further in section 4 and presented in Annexe no. 2 to this analysis.

Type of transport	Total in the CR [ths. tons]	The Ústí Region [ths. tons]
railway	40 198.30	16 230.70
road	288 581.50	25 893.90
inland waterways	509.9	293.1
air	0	0

Chart No.2:*Transport streams of goods in the CR and in theÚstí Region in 2011***(10)**.

The following text will put great emphasis on the carriage of dangerous goods by road and its specifics, but it will not neglect railway and river transport either, because they are also typical of the Ústí Region, as shown in Chart No. 2.

Air transport of dangerous goods, as the newest type of transport, and its regulations will also be commented on here, as well as sea transport which is in the CR used within the multimodal type of transport (sea or air transport must be preceded by road or railway transport).

2.2.1 National legislation regardingthe road transport of dangerous goods

Act no. 111/1994 Coll., on Road Transport, as amended, is in force in the Czech Republic. The ADR Agreement was implemented in this act within sec. 22, art. (2):
„Only goods specified in the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) are allowed to be transported by road, under the terms therein".

The Act further specifies the basic obligations of the consignor, carrier and consignee of dangerous goods and possible sanctions for their breach.

2.2.2National legislation regarding the railway transport of dangerous goods

RID rules were implemented into the domestic legislation of the Czech Republic through Act no. 266/1994 Coll., as amended, the so called railway act, sec. 63, art. (2). Section 52 further specifies administrative offences and penalties which could be imposed on the transport participants for a breach.

RID reference can be also found in government regulation no. 1/2000 Coll., on transport rules for public railway freight transport.

2.2.3 National legislation regarding the transport of dangerous goodsby inland waterways

Transport of dangerous goods by inland waterways in the CR is embedded in Act no. 114/1995 Coll., on Inland Navigation, sec. 36. Permission needs to be sought for the transport of dangerous goods by waterway from the navigation office, which in turn needs to inform the relevant district council whose territories will be navigated during said transport.Penalty up to the value of 1,000,000 CZK may be imposed for a breach of the terms stipulated by this act concerning dangerous goods.

2.2.4 National legislation regarding the air transport of dangerous goods

On 16 July 2008, regulation (EC) No. 1899/2006 of the European Parliament and of the Council, of 12 December 2006, amending Council Regulation (EEC) No. 3922/91 on the harmonization of technical requirements and administrative procedures in the field of civil aviation, came into force. This regulation amendment contains Annexe No. III, defining requirements for the regulation of commercial air transport by aircraft. Annexe No. III to this regulation is commonly referred to as the so called EU-OPS and upon its effective date, it becomes a part of the legal systems of the EC member states. The EU-OPS fully replaces the requirements of the Czech national aviation regulation JAR-OPS 1, as well as of other relevant regulatory and legal provisions(11).Commission regulation (EU) No. 965/2012, laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No. 216/2008 of the European Parliament and of the Council, was adopted on 5 October 2012.

2.2.5 National legislation regarding the sea transport of dangerous goods

Owing to the fact that the Czech Republic is a landlocked country, the IMDG-Code is implementedhere through a notification of the Ministry of Foreign Affairs no. 105/1996 Coll., or 52/1995 Coll.

3. General issues concerning the transport of dangerous goods

Section 3 briefly characterizes the basic prerequisites for the transport of dangerous goods. Considering the fact that international agreements referred to in section 2.1 utilize similar principles (e.g. labelling with safety signs), it would be appropriate to describe here at least the basic identification data of a dangerous substance. This information is important especially because it is essential for security forces during rescue operations.

It should be mentioned here that certain fundamental differences can be found when comparing international regulations regarding the transport of dangerous goods. These nuances will be shown on a specific example in Chart No. 3.

Just to explain, I take the liberty of using the data from the ADR Agreement, namely the UN number, substance name, class, classification code, packing group, safety signs, orange labels and written instructions.

3.1 UN number

UN number is an identification number of a substance or article. It is a four-digit number, prefixed by the letters UN (e.g. UN 1203). If we know the UN number of a dangerous substance, it is possible to determine all the other particulars of the transport – labelling, means of packing, special requirements for transport, special provisions, etc.

3.2Name and description

This information contains the name of the dangerous goods or article, or an additional description. During transport, we usually go by the official name for the transport, which is filled out in the transport document, i.e. the name written in capital letters in table A, column (2) of the ADR Agreement.

_Example:_FUEL FOR COMBUSTION ENGINES, with flash point below 60 ℃.
Only FUEL FOR COMBUSTION ENGINES is considered to be the official name for the transport.

In case of international transport, the official name in the official language of the consignor country must be provided, and in case thatthis language is not English, French or German, then English, French or German translation must be added.

3.3 Class

Each dangerous article is classified into a relevant class. This class number is assigned according to the procedures and criteria provided for in section 2 of the ADR Agreement. The ADR Agreement distinguishes the following 13 classes:

Class 1	Explosive substances and articles
Class 2	Gasses
Class 3	Flammable liquids
Class 4.1	Flammable solids, self-reactive substances and solid desensitized explosives
Class 4.2	Substances liable to spontaneous combustion
Class 4.3	Substances which, in contact with water, emit flammable gases
Class 5.1	Oxidizing substances
Class 5.2	Organic peroxides

Class 6.1	Toxic substances
Class 6.2	Infectious substances
Class 7	Radioactive material
Class 8	Corrosive substances
Class 9	Other dangerous substances and articles

3.4 Classification code

Classification codes of dangerous goods or articles provide information about the character and nature of hazard. Classification codes consist of numbers and letters, where the letters represent the hazard type. The meanings of the letters used in the classification codes (applicable to all classes, except for class 1 and 7), are explained below:

A	-	asphyxiants
F	-	flammable
D	-	explosive substances, desensitized
SR	-	self-reactive substances
S	-	substances liable to spontaneous combustion
W	-	substances which, in contact with water, emit flammable gases
O	-	oxidizing substances
P	-	organic peroxides
T	-	toxic
I	-	infectious
C	-	corrosive
M	-	substances which can present another risk during transport (which does not fall within classes 1 – 8)

Example:A substance with the classification code FTC has three types of risk, i.e. flammability, toxicity and corrosive effect.

3.5 Packing group

Dangerous goods, expect for classes 1, 2, 5.2, 6.2 and 7, and except for self-reactive substances of class 4.1, are classified into packing groups based on the degree of their danger:

Packing group I:	great danger
Packing group II:	medium danger
Packing group III:	least danger

Thepacking group numbers are assigned according to the procedures and criteria provided for in section 2 of the ADR Agreement.

3.6 Safety labels

The colour and pictogram of a safety label indicate the respective type of hazard. For example, orange colour indicates explosion hazard, red indicates fire hazard, yellow indicates an oxidising agent, white – health and life hazard, etc. These safety labels are affixed to the units, containers, tank containers, transferrable containers, MEGC and vehicles. The model number of a safety label is also referred to in the transport documentation. Models of the safety labels are presented in Annexe No. 1.

3.7 Orange plates

Orange plates are affixed to transport and carriage units in order to alert to the presence of dangerous goods or to provide the UN number and dangerous properties. There are two types of orange plates – blank orange plates without numbers and numbered plates (see Fig. 5).

The blank plate without any number alerts to the presence of a dangerous substance and it is usually affixed to vehicles carrying articles. A numbered orange plate informs about the transported substance and its danger. It is divided into halves. The number at the top is the hazard identification number (Kemler number), the bottom number is the identification number of the substance (UN number). The numbered orange plate is usually affixed to tanks and units carrying goods in bulk. For example, plate in Fig. 5 alerts to the fact that the vehicle carries petrol (UN 1203) which is considered to be a highly flammable substance (number 33).

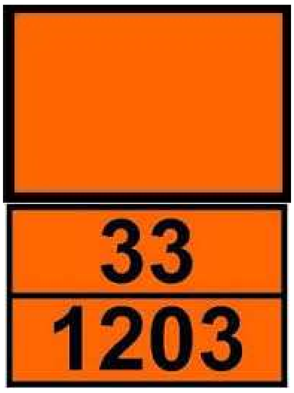


Fig.No. 5:*A blank and a numbered orange plate.*

3.8 Written instructions

Written instructions provide information to vehicle occupants about how to react in case of an accident or emergency. Since 2009, unified written instructions have been applicable to all types of dangerous substances transported by road, which is their main disadvantage. Written instructions must be provided in a language the driver understands, and must be provided in the cab and be easily available.

3.9 Comparison

For the purpose of preparation and implementation of any transport, the above mentioned identification criteria are the most important indicators of the hazard of the transported goods and are used for a quick orientation about how to act in case of an accident or emergency. It is therefore necessary to show how these criteria differ in relation to the chosen mode of transport, which can be derived from Chart No. 3. The chart compares the differences in classification, labelling and presence of written instructions in the unit for a specific UN number UN 1072 – oxygen.

The UN number and the substance name remain unchanged for all the five modes of transport. There is a slight difference in terms of the classes. For ADR, RID and ADN, the categorization into the classes is identical. Classes in the IMDG-Code differ in the following:

Gases are divided into class 2.1 – flammable gases, 2.2 – non-flammable gases, non-toxic gases, and class 2.3 – toxic gases. The categorization of gases for the air transportis the same, but ICAO-TI refers to this categorization as to a division (i.e. sub-class). In terms of air transport, the same holds for the other classes 4, 5 and 6 (categorization into sub-classes 4.1, 4.2, 4.3, 5.1, 5.2, 6.1 and 6.2, whose names are identical with the names of the classes according to the ADR).

The classification code is the same again as with the ADR, RID and ADN, but it does not exist forthe sea and air transport. The subsidiary hazard for the sea transport is provided in a separate column in the IMDG-Code; the subsidiary hazard for the air transport in ICAO-TI is provided in the same column as the class. The packing group for gases does not exist and this information is the same for all the mentioned modes of transport. Information about the location of the safety labels is also identical. Written instructions work for ADR, RIN, and ADN.The sea and air transport deal with leakages in a different way.

Parameters /mode of transport	**UN number**	**Shipping name**	**Class**	**Classifica-tion code**	**Packing group**	**Safety labels**	**Written instructions**
road	UN 1072	OXYGEN, COMPRESSED	2	1O	-	no. 2.2 + 5.1	yes
railway	UN 1072	OXYGEN, COMPRESSED	2	1O	-	no. 2.2 + 5.1	yes
waterway	UN 1072	OXYGEN, COMPRESSED	2	1O	-	no. 2.2 + 5.1	yes
air	UN 1072	OXYGEN, COMPRESSED	2.2 (subsidiary risk 5.1)	non-existent	-	non-flammable gas, oxidizing	no*
sea	UN 1072	OXYGEN, COMPRESSED	2.2 (subsidiary risk 5.1)	non-existent	-	no. 2.2 + 5.1	no**

Chart No.3:*Comparison of basic identification criteria according to the international regulations for UN 1072.*

** The so called ERG Code (The Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods) is used instead of the written instructions. It is not an official part of the ICAO-TI and it must be looked up in the document 9481-AN/928 ICAO.*

*** Instead of the written instruction, the so called EMSs are used. They are additional emergency measures containing first aid, freight storage, marine pollutants, etc.*

4. State of the transport in the Czech Republic

On account of its location, our country is predestined to be a natural crossroads of European roads, which is also testified by the intensity of both national and transit transport. The Ministry of Transport of the CR compiled a clear statistics about the transport streams of certain goods in the past years in national transport, import and export. This statistics includes data about transport of cereals, fruit, vegetables, textiles, animals,items of plant and animal origin, products of agricultural origin, etc. Unfortunately, the Ministry has not compiled a separate statistics concerning the transport of dangerous goods, but I am quoting here this statics anyway, just to give you an idea of the quantities of the goods transported by road, railway, inland waterway and air in the CR. The full 2011 statistics is presented in Annexe No. 2 to this analysis (10).

329 289.7 ths.tons of goods in total were transported nationallywithin the individual regions of the Czech Republic. Road transport takes the largest share in this figure,with 87.6 %. Railway freight transport takes 12.2 % according to this statistics, and inland waterway transport mere 0.15 %. Although the Ministry of Transport of the CR has not published any statistics regarding dangerous goods, we expect the figures to be similar.

The share of the Ústínad Labem Region in the national road transport is about 9 %. As can be seen from the chart in Annexe No. 2, this mode of transport is mainly carried out on the territory of the Ústí Region (almost 76.5 %). The share of the railway transport in the total number of goods transported in the Ústí Region is over 40 %. Most goods transported by rail are within the Ústí Region again, followed by the Central Bohemian Region. Inland waterway transport is of great importance to the Ústí Region because it is almost the only region which takes advantage of navigability of the river Elbe. In 2011, 293.1 ths.tons of goods were transported this way, mainly to the Central Bohemian Region and to the capital city of Prague.

Relevant information about the international transit transport through the Ústí Region (European multimodal transport corridor no. 4 – the Elbe, railway, motorway) is not available and it was not possible to obtain this data when this analysis was being compiled. That is whythe data is not incorporated in the conclusion of this analysis, although their significance and impact on the entire matter of the transport of dangerous substances is evident.

4.1 Roadside checks in the CR

A part of the roadside checks in the CR was aimed at checking compliance with the ADR requirements during the transport of dangerous goods by road. The checks were mainly focused on the proper identification of the vehicle, compulsory vehicle equipment or accompanying transport documents. The number and outcomes of these checks carried out in 2010 and 2011 are presented in Fig. 6.

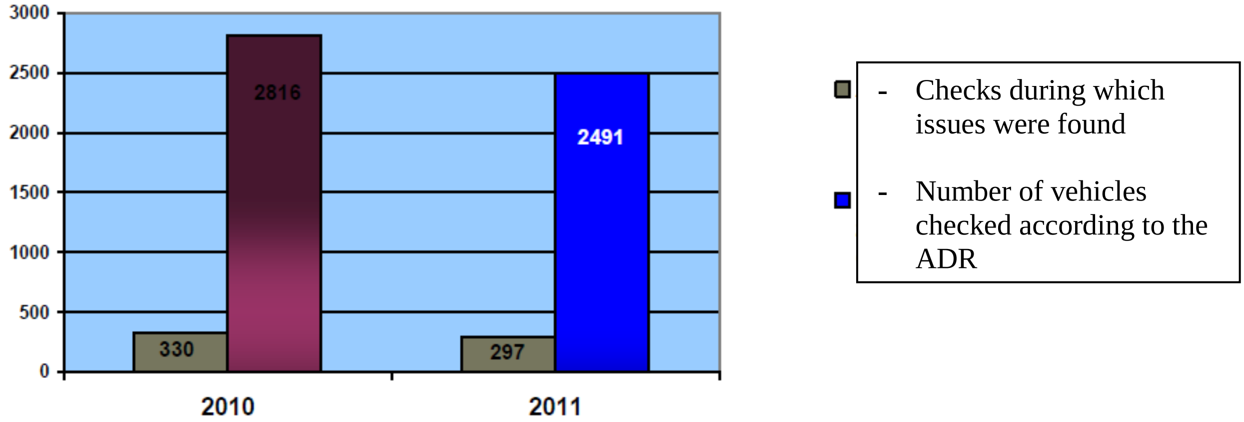


Fig. No.6:*The number of checks of the transport of dangerous goods according to the ADR Agreement between 2010 - 2011* (12)*.*

At least one breach of the ADR Agreement was uncovered in 330 out of 2,816 vehicles checked during roadside checks in 2010, i.e. a breach was uncovered in 11.7 % of checked vehicles. At least one breach of the ADR Agreement was uncovered in 297 out of the 2,491 vehicles checked during roadside checks in 2011, i.e. a breach was uncovered in 11.9 % of checked vehicles. In terms of the roadside checks performance, checks of the transport of dangerous goods according to the ADR Agreement in 2011 involved about 2.5 % of all vehicles (out of 99,260 vehicles) which were inspected during roadside checks.(12).

Chart No. 4 shows that carriers often force their drivers to break the law, even at the cost of putting the driver´s safety at risk and even though they might be given a penalty. Drivers are under pressure and are more likely to make a mistake which can lead to a traffic accident. Based on these numbers it is clear that a system for tracking and tracing of vehicles would be a fundamental step to improve road safety.

Type of the breach	2010	2011
Non-compliance with the set driving time (day-long, week-long or two-week-long limit)	4817	5200
Non-compliance with the safety breaks	6525	5970
Non-compliance with the set break time (day-long and week-long)	7675	9174
Malfunctioning of tachograph, its misuse or adjustment	1185	1326
Data sheets for the given period not presented during the roadside check	7663	12155
Data sheets were presented in the carrier´s business premises (carrier did not keep the records for the required period of one year)	3169	2608

Chart No.4:*The most common types of law violations uncovered during roadside checks in 2010 and 2011***(12)***.*

4.2 Railway controls

The state of railway controlsin relation to the transport of dangerous goods in the CR could not be traced, but statistical datawerefound from neighbouring Germanyfor the years 2010 and 2011. In 2011, the Federal Railway Authority carried out 14,389 checks in total, which was about 2 % more than in 2010. Tanker trucks (9 837), gas tanker trucks (2 287) and tank containers (837) were among the most frequently checked. Checks were carried out in dispatch stations and frontier stations, because that is where the checks are most efficient.Failures were uncoveredin924 checks, which is 6.9 % of the total number of checks (1085 failures were uncovered). The attached chart shows the most frequent failures. No major deficiencies were uncovered during checks oftanker trucksfilling by means of ultrasound.

Order no.	Type	2010	2011
1.	Shutters of bottom discharge tankers not properly closed (no leakage of the transported substance)	189	158
2.	Terms of proper identification by large safety labels not complied with	100	111
3.	Terms of identification by orange plates not complied with	115	102
4.	Tank label, or its data, missing/incorrect	133	87
5.	Shutters at the top of the tank not properly closed (no leakage of the transported substance)	70	75
6.	Data/labels on the tank or plate missing/incorrect	70	70
7.	General information in transport documentation missing/incorrect	63	69
8.	Tanker cisterns, attached equipment for operation not in an operable condition	49	44
9.	Terms for the use of the label identifying substances hazardous to the environment not complied with	6	41
10.	Old large safety labelsnot removed	43	37
11.	Leakage of a dangerous substance through bottom discharge equipment	36	36
12.	Gas tanker trucks, shutters not secured	40	34

Chart No.5:*The most common deficiencies during the railway transport of dangerous goods in Germany between 2010 and 2011* **(13)***.*

4.3Traffic accidents in the CR and the Ústínad Labem Region

Accidents do not avoid drivers transporting dangerous goods too. On the website of the Police of the CR, it was possible to find statistics regarding the number of accidents related to dangerous goods in the Czech Republic between 2002 and 2009. One of them is presented in Chart No. 6. Most accidents were caused directly by the drivers themselves. As can be seen, the trend in the number of accidents has been decreasing over the years. With regard to the state of the transported substances, accidents were more frequent during the transport of liquids. This is not surprising because it is related both to the number of drivers who have the ADR driver's training certificate for class 3 in tankers, and to the fact that liquids (mainly fuel) account for the largest volume of road transport of dangerous substances. Accidents are most commonly connected with instability of the tank container on the road due to the movement of liquid inside the tank.

By comparing the number of accidents which resulted in a leakage of substances, we can see that liquid products are to blame for most leakages, which is connected with the above explained reason. The extreme change between the years 2002 and 2003 is definitely worth mentioning. In 2002, there were 89 accidents which resulted in a substance leakage, whereas in 2003 this number dropped dramatically to mere 10 accidents(14). The reason behind such a dramatic drop was the fact that right up till 2002, statistics registered also accidents which were not directly connected only with a leakage of the transported goods – accidents during which there was a mere leakage of fuel from the damaged tanks were also included. Since 2003, accidents with a leakage of the transported substances have been recorded separately.

Year	Number of traffic accidents during the transport of dangerous goods				There was a leakage of dangerous substances during the accident			
	solid	liquid	gaseous	**total**	solid	liquid	gaseous	**total**
2002	91	139	25	**255**	1	82	6	**89**
2003	84	118	16	**218**	3	7	0	**10**
2004	13	146	17	**176**	1	10	0	**11**
2005	31	163	15	**209**	3	15	2	**20**
2006	12	149	25	**186**	0	5	0	**5**
2007	17	131	24	**172**	1	9	0	**10**
2008	25	124	17	**166**	0	5	1	**6**
2009	5	72	14	**91**	1	5	1	**7**

Chart No.6:*The number of traffic accidents with dangerous substances in the CR between 2002 - 2009***(14)***.*

A useful source of information about the number of accidents is available from the portal of the Ministry of Transport of the Czech Republic – information system DOK.The system can generate the number of traffic accidents during the road, railway, inland waterway and air transport of dangerous goods in different regions of the Czech Republic. The statistics shows different figures than the above quoted statistics of the Police of the CR. For comparison, the accident rate in the CR, and specifically in the Ústí Region, between the years 2006 and 2010, is presented in Chart No. 7. The first figure shows the number of accidents in the entire CR, the other value shows the situation directly in the Ústí Region.

It can be seen that numbers provided on the website of the Ministry of Transport and the Police differ in hundreds of accidents a year. The difference is caused by the fact that the statistics of the Ministry of Transport includes also minor fuel and operating fluid leakages from passenger cars. This was reflected in most records out of the total number of accidents with a leakage of dangerous substances.

There were several accidents with a minor leakage of dangerous substances (mostly less than 10 l) during the road transport of dangerous goods in the Ústí Region in 2010. About 30 larger leakages were recorded. It regarded mainly leakages of diesel oil, petrol, motor oil and petroleum distillates in the volume of more than 20 l. The largest leakage was recorded on 14 May 2010 in Děčín, when up to 150 l of oil products UN 1268 leaked into the environment.

	2006	2007	2008	2009	2010
road	data not found	3860/408	925/106	3593/420	2016/243
railway	174/60	99/11	84/21	33/2	39/5
waterway	0/0	0/0	0/0	0/0	0/0
air	0/0	0/0	0/0	0/0	0/0

Chart No.7:*Number of traffic accidents with dangerous substances in the CR and in the Ústí Region between the years 2006 and 2010* **(15)***.*

There were five cases of a dangerous substance leakage during railway transport. All the cases were minor leakages, which were dealt with immediately on the spot. The value of the damagewas hundreds of Czech crown at the most. None of the casesput human livesat risk or caused casualties. With regard to inland waterway and air transport of dangerous goods, there has been no serious accident.

An advantage of the DOK system is the good arrangement of items being looked up. Information can be searched by the UN number, shipping name, class according to the ADR, date of the accident or the mode of transport, both for the entire CR, or separately for the individual regions, districts or cities. The outcomes can be summed up into a chart or a map (15).

4.4Number of casualties and the amount of damage on Czech roads

According to the information by the Directorate of Traffic Police of the Police Headquarters, there were 1,425 traffic accidents involving a vehicle transporting dangerous goods between 2003 and 2011 and 39 people died in them. The trend was more positive between 2009 and 2011 and only one out of nine casualties was caused by a driver transporting dangerous goods.

The total material damage reached the value of 65,342,900 CZK, and ADR drivers were accountable for more than a half of this figure, almost 39 million CZK(16).

5. Transport tracking

Transport of dangerous goods is a hazardous activity. Incorrect handling or neglect of obligations may lead to accidents and leakages of substances into the environment. As a result, it is not only the driver who could be affected, but also people in the vicinity. A joint effort of all theChemLog T&T project partners is to ensure that the transport of dangerous goods is as safe as possible, mainly in terms of minimizing occurrence of such emergencies.

Nowadays it is no news that carriers use monitoring units to track their drivers and vehicles. There are a number of reasons for that. If the carrier wants to check on his driver (whether he really takes the scheduled routes, or whether he does not steal fuel from the tank - today's systems are capable of measuring this quantity), he can save the operating costs connected with the driver´s inefficiency.

It is clear from the data provided in sections 2 and 4 of this analysis that a large part of transport in the Czech Republic is concentrated on roads. This is then associated with a large percentage of road accidents in comparison to other modes of transport. The objective of the ChemLog T&T project, as previously mentioned, is to shift the logistics of dangerous goods transport towards the intermodal transport. The basic unit of the combined transport is a container (be it container for transport of units or a tank container). The container owner, or the relevant carrier, may not see the container for several months or even years. It is in his own interest to know what is happening with the container during the transport, or what its location is.

However, tracking of containers is no easy task. The more so, if reloading from the road to railway transport, or from inland waterway to sea transport, is expected.

5.1 The issue of telematic systems

Development of a telematics system, which would be able todetect the current position of the container, entails a number of problems which need to be dealt with. Below is their short description. The following text uses the term OBU unit (= On Board Unit). It is a device affixed to the container which makes it possible to track the container and report its current status.

5.1.1 Independence from energy supply

Nowadays it is no problem to track road vehicles (passenger or goods vehicles), because majority of commonly available units are based on constant supply of electricity from the vehicle source. This type of power supply cannot be considered in relation to containers. The OBU unit should be affixed to the container (in a stable way, outside or inside) and therefore it is necessary to ensure that the energy source of this unit is independent from the on-board voltage and remains in operation for a number of months, even years.

5.1.2 Container material and location of the OBU unit on the container

The container material also plays a major part in the functioning of the OBU unit. The biggest problem is to ensure a quality, continuous signal transmission. Most of the tracking devices operate on the principle of signal transmission by GPS (Global Positioning System). It works on the principle of satellites situated above the Earth's surface, orbiting the Earth. So that a satellite could determine the exact location, it must be fitted with a receiver, transmitter and atomic clockwith an accuracy of billionths of a second. The satellite orbit is adjusted by the receiver; the transmitter then transmits data to the users of the navigation or tracking system. The telematics system receivers´ view of the satellites must not be blocked, otherwise they would not obtain the required data. Any material or object blocking the receiver´s view impairs the signal quality. If the OBU unit, which is based on detecting position by GPS, were situated inside the container, there would be a loss of the signal (17).

A solutionto this issue would be in adjusting the container, e.g. drill it through and lead the GPS aerial outside. Here we run into another problem which is connected with handling the container. We expect that stacking of containers in transhipment centres and aboard shipswould block out the signal transmission. There is the possibility of the OBU unit to be located on the container. But then the container would need to be adjusted and a protection cage would need to be provided for the OBU unit. Magnetic attachment in this case is out of the question.

Another possibility for detecting the position is based on the GSM signal. To utilize this method, the OBU unit must know the exact location of the mobile network or Wi-Fi transmitters. When the OBU unit wants to verify its position, it detects the networks which are currently available. This enables at least an approximate orientation. However, this primary orientation is highly imprecise. For example, GMS transmitters have a reach of up to 35 km in all directions, so the unit can be located in a circle with a diameter of 70 km. The unit then detects which other transmitters it can currently see within the circle. If it finds at least three transmitters, it can try to find the intersection point of the three circles and thus limit its possible position by something like a triangle. Of course, the more transmitters, or the smaller the reach, the better the positioning (18).The principle of GSM positioning can be seen in Fig. 7.

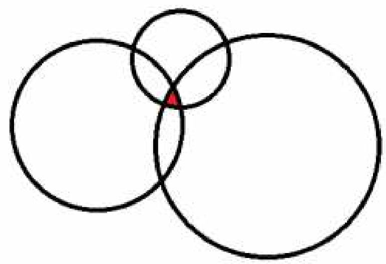


Fig. No.7: *Principle of GSM transmission to locate the OBU* **(18)**.

5.1.3 The OBU unit for the combination of road – railway – sea transport in terms of "shock" sensor and its sensitivity

A certain prerequisite for the operation of the entire system is that the OBU unit must be able, in case of an accident or emergency, to ensure the arrival of rescue services. "Shock" sensors, sensitivity sensors, motion sensors, derailment sensors etc. must be affixed to the container for that purpose. From the below mentioned it is clear that the stress level of the unit is different for each mode of transport(19). With multimodal transport, it is necessary to take into account a combination of all these stresses. This is of course connected with the right setting of the sensitivity of the "shock" sensor, which would be able to detect an emergency. To give you an idea, below is an overview of forces acting on the given mode of transport and their combination and related requirements for securing freight in the transport unit.

During transport, the transported goods (regardless of the used means of transport) are subject to the following kinds of mechanical stress:

- Individual impacts – occur mainly in railway transport. They are caused mainly during shifting (impact of two rail cars), when using emergency brakes or disconnecting trains. Intensities of inertia forces depend mainly on impact speed, and also on deceleration (slowing down, reducing speed), freight weight and vehicle design.
- Repeated impacts – occur mainly in road transport. They are caused mainly when the vehicle is slowing down, when it is going through a bend or when overtaking and during shocks when travelling on bumpy surfaces.
- Vibrations (repeated, short-term stress) – they are caused due to shocks and shaking of vehicles as a result of movement or imbalance of their propulsive and transmission mechanisms or due to shocks in relation to properties of the transport route (road unevenness, rail junctions, etc.).
- Pressure forces – are caused when stacking cargo units (gravity impact of higher levels of transport units on lower levels). Stacking pressure depends on the weight of the transport unit, on the total height of the stack, the height of the individual transport units and on the area of the contact surface of the bottom of the lowest placed transport unit. Pressure forces are of crucial importance for railway and sea transport, and they are important in road and air transport.
- Dragging.

Chart No. 8 shows the individual types of mechanical stress for road, railway, inland waterway, sea and air transport of goods.

Stage of goods circulation			Types of mechanical stress				
			impacts	**repeated imacts**	**vibrations**	**pressure forces**	**dragging**
Transport	land	**road**	X	XXX	XXX	XX	X
		railway	XXX	XX	XXX	XXX	X
	water	**river**	X		XX	XXX	
		sea	X		X	XXX	X
	air	**plane**			XXX	XX	

Chart No.8: *Types of mechanical stress for ground, water and air transport* **(19)**.

NOTE:
X – stress during the given type of transport exists, but it is insignificant for determining the risk of mechanical stress
XX – stress is significant for determining the risk
XXX – stress is of crucial significance for determining the risk

The following forces act on the freight and vehicle during transport:

- Gravitational force (F_H) – the force that pushes the freight towards the cargo surface of the vehicle. It is caused by Earth´s gravity and it is calculated as the product of freight weight (m) and Earth´s acceleration (g). During transport it can add or ease the load.

- Inertia force (F_S) – the force that causes movement (shifting) of the freight (cargo unit) on the cargo surface of vehicle. Inertia force depends on the value (massiveness) of speedup (acceleration) or slowdown (deceleration) and on the weight of the freight that is affected by the slowdown and, besides that, also on the structure and weight of the vehicle and absorption capacity of equipment causing the speed change (e.g. a device for regulation of brake force of a road vehicle – ABS system, etc.).
- Friction force (F_T) – the force that acts in the opposite direction to the freight (cargo unit) movement. It is created between the contact surface of the freight (cargo unit) and cargo surface of the vehicle. It depends on the surface structure of the contact surface of the freight and cargo surface of the vehicle where the freight is placed, and on gravitational force. With regard to the needs of transport loading, friction is divided into dynamic friction (sliding) and static friction. Dynamic friction is lower than the static one. Static friction acts when the freight is positioned on the cargo surface of the vehicle. Dynamic friction acts in cases when there is a movement of the freight on the cargo surface of the vehicle.
- Residual (fixation) force (F_X) – the force that must be captured by securing devices or equipment so that the freight in a vehicle (in a shipping container) is properly secured (and cannot move). This force is calculated as the difference between the inertia force acting on the transported freight and the friction force acting between the freight and the cargo surface of the vehicle. This force is calculated as the difference between the inertia force acting on the transported freight and the friction force acting between the freight and the loading area of the vehicle.

In railway transport, the goods are subject to the highest mechanical stress, which is created during shifting and train ride. During shifting, the created forces act in the horizontal, transverse and vertical direction. In the horizontal direction, the force can achieve the value of Fx = 4 mg, with acceleration factor fx = 4. In the transverse direction, the force can achieve the value of Fy = 0.5 mg, with acceleration factor fx = 0.5 and in the vertical direction, the force can achieve the value of Fz = 0.3 mg, with acceleration factor fx = 0.3. During train ride, the acceleration factor values are lower for the force acting in the horizontal direction, where the acceleration factor is fx = 1. Other factors (for the transverse and vertical force) are the same as during shifting. The below picture shows acceleration factors for railway transport.

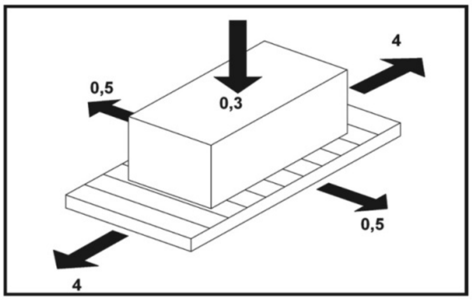


Fig.No. 8:*Acceleration factors for rail transport***(19)**.

In road transport, the freight is affected during travel by inertia forces in three basic directions:

- Horizontal, in the forward direction (when the vehicle is slowing down) - the so called accelerating force, the value of Fxz = 0.8 mg can be achieved, with acceleration factor fz = 0.8; and in the backward direction (when setting the vehicle in motion) - the so called decelerating force, the value of Fxzp = 0.5 mg can be achieved, with the acceleration factor fz = 0.5;

- Perpendicular to the direction of travel (in case that it is not a rectilinear motion, we speak about centrifugal force), the value of Fy = 0.5 mg can be achieved, with acceleration factor fz = 0.5; for unstable freight with a risk of a fall (overturning), it is necessary to take into account the so called rocking factor. The resulting value of the acceleration factor is thus increased by 0.2 to 0.7 (0.5 + 0.2 = 0.7).
- Vertical to the direction of travel, the so called gravitational force.

The below picture shows acceleration factors for road transport.

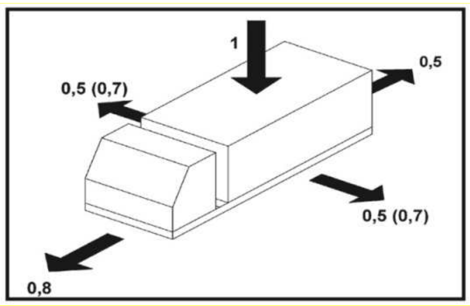


Fig.No. 9: *Acceleration factors for road transport***(19)**.

In sea transport, mechanical stress of freight differs significantly from road or railway transport. Based on completely different weather conditions, the freight is affected by different forces in different directions at the same time. These forces are created when the ship is rocking or sliding on waves, or when surfacing or submerging. And there can be several such movements at the same time. The values of these forces differ from each other according to the type of the sea. In the horizontal direction, the force can achieve the value of Fx = 0.4 mg, with acceleration factor fx = 0.4. In the transverse direction, the force can achieve the value of Fy = 0.8 mg, with acceleration factor fy = 0.8 and in the vertical direction, the force can achieve the value of Fz = 2.2 mg, with acceleration factor fx = 2.2. The below picture shows acceleration factors for sea transport.

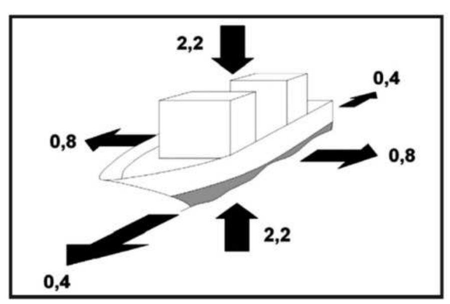


Fig.No. 10: *Acceleration factors for sea transport***(19)**.

In combined transport systems, the value of inertia forces acting on the freight placed in a transport unit depends on the given type of transport. If, for example, a container is transported by railway, road and sea transport, maximum values of the acceleration factor must be considered for the calculation of inertia forces. The below picture shows maximum values of acceleration factor for combined transport road – railway – sea.

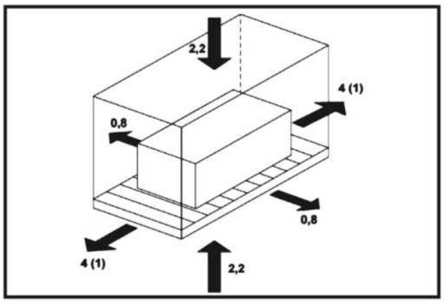


Fig. No.11: *Acceleration factors for combined transport***(19)***.*

From the above it is obvious that the "shock" sensor must be set in such a way so as to be able to detect if it is moving on road, railway or water. A solution would be to switch this mode remotely if a certain frontier on the map were crossed. For example, national transport in the map would always be set as ground transport (road or railway) and from the port frontier, the sensor would be programmed to water transport (inland waterway or sea).

5.2 Availability of telematics systems on the CR market

The current market is oversupplied with various types of navigation, tracking or tracing systems with various parameters. A number of companies in the CR are engaged in the production of such units. Let umention e.g. the company LEVEL s.r.o from Náchod which is engaged in the development and production of electronics. It has been operating on the Czech market since 1990. Over the years it has become the leading manufacturer of telecommunication, security and lighting technology operating all over Europe. Exports are mainly aimed at Eastern and Western Europe. The company LEVEL is involved in European scientific-research projects regarding the use of GSM and GPS technologies. One of the products on offer is e.g. the train communicator GC 071 123. It is designed for installation on wagons with no power supply. It collects data regarding the position and routes taken by the wagon by means of GPS coordinates and sends them to the integrator server through the GSM network. It comes in a stainless case for outside installation, or in a plastic case for installation inside the wagon. The unit can be supplied by oneto three batteries, which can last from eight months up to two and a half years, depending of the period of operation. The customer can track the train movement in the RailMap+ by the company Jerid, which incorporates also other functions (e.g. editing the data about the vehicle, information about the sent SMS messages, serial number, SIM card number, etc.). The unit is able to distinguish whether the train is moving or whether it is at a standstill (20).

Another well-known Czech development company is Telematixs.r.o. It is engaged in various systems supporting the transport of dangerous freight. The effort to prevent misfortunate events gave rise to the design of an information system which would be able to track the position and state of vehicles and send information to the nearest emergency call centrein case of an accident which would in turninform the relevant rescue system units to ensure necessary action (eCall). The units may also serve as the so called black boxes(21).

Since 2002, the company ATLAS Europe s.r.o. has been involved in the development of dispatching system ATLAS Europe for vehicle tracking. OBU units provide a wide range of services (e.g. history logbook, map-based dispatching applications, data sharing with customers´ information systems, interconnection of orders from the logistics program with particular vehicles, registration of drivers, and many others). The system enables communication between vehicles and the dispatching centres, utilizing the mobile GSM network. The dispatching system ATLAS Europe has a program interface which makes it possible to share data received from vehicles with the customer´s information system. This way it is possible to easily and effectively interconnect independent program products with the aim to combine information about the position e.g. with orders or other information flows connected with the transport of goods and operation of vehicles (22).

There are not many similar manufacturers in the Czech Republic. But they have one thing in common. They are able to prepare a custom-made OBU unit for the customer, according to the given requirements. Within the ChemLog T&T project, basic requirements for the OBU unit have already been specified. In the first place, it was necessary to determine, which data will be transmitted by the OBU unit. Logically, the OBU unit must be maintenance-free so as to minimize the influence of human error. Also in terms of sensitivity and data misuse, the OBU unit must transmit only essential data, which include the container position and identification (e.g. number, designation, or container code). The only other necessary piece of information is the “shock” sensor output, which specifies a possible accident (place, time, and extent). Any other data will be available from a data server separated from the OBU unit. Access to the server would be given only to people involved, and possibly to the integrated rescue system units.

The financial demands for the development and testing of such “custom-made” adjusted unit are beyond the ChemLog T&T possibilities and therefore the use of an existing OBU unit will be tested in the following stages.

6. The Ústínad Labem Region

Ústínad Labem Region is situated in northwest Bohemia. It neighbours on the Liberec Region in the east, andon the Central Bohemian Region in the southeast; there is a short stretch of common border with the Plzeň Region in the south, and it borders on the Karlovy Vary Region in the southwest. The longest stretch of common border is with the German federal state of Saxony in the northwest(23). The Ústí Region is divided into seven districts: Děčín, Chomutov, Litoměřice, Louny, Most, Teplice andÚstínad Labem. The location of the Ústí Region in the CR is depicted in Fig. 12.

Fig.No. 12:*Location of the Ústínad Labem Region in the CR***(24)**.

6.1 Economically important areas in the Ústí Region

The region´s economy is area-specific as several distinct landscape types can be defined within the region. From lowland areas with thriving agriculture (Litoměřice, Louny areas), to industrial areas (basin area), to mountainous areas (Ore mountains, Českéstředohoří, Doupovskémountains). In general, the Ústí Region is distinguished by its strong focus on heavy manufacturing. In the basis of the Lower Ore Mountains there are large deposits of brown coal (Chomutov-Most brown coal basin). Its supplies constitute, and in the next few decates probably will remain to constitute, the most important source of energy in the Czech Republic (and in the future also the most important source of raw materials). In this context, there has been a great development in mining and in chemical and energy processing of coal in this region. In the proximity of the surface coal mines there are the largest Czech coal power plants (Prunéřov,Tušimice, LedviceandPočerady) (23)**.**

Chemical industry is very significant in the region. In Litvínov, there is the largest Czech oil refinery, whose products are further used in the chemical manufacturing industry.Chemical industry based on the production and processing of synthetic resin and food chemistry is significant for the regional city of Ústínad Labem. Production of artificial fertilizers and viscose fibres is significant in Lovosice(23).

6.1.1 Unipetrol RPA, s.r.o.

Unipetrolis the leading group in the area of oil processing and petrochemical industry in the Czech Republic (this is also reflected in the abbreviation RPA = refinery, petrochemistry, and agrochemistry) and it is one of the main players in Central and Eastern Europe. Since 2005, it has beena part of PKN Orlen, the largest refining and petrochemical group in Central Europe(25).

The company offers a rich portfolio of products. Refinery products include asphalt, lubricating oils, lubricating greases, motor fuels and other light and heavy fractions from oil processing – liquefied petroleum gases, heavy fuel oil, oil hydrogenation products or sulphur (25).

Petrochemical products include monomers, aromatics, other petrochemical products and polyolefins. Monomers are used for the manufacture of polyethylene, polypropylene, oxo-alcohols, acrylic acid and acrylates for further chemical synthesis. Aromatics are used for the production of benzene and chemical syntheses. Other petrochemical products are used as petrol additives, low-sulphur fuel or for the production of motor fuels. Polylefins are thermoplastic materials used for the production of injection moulded articles (25).

Agrochemicalsinclude ammonia and ammonia water. These agrochemicals are mainly used as fertilizers. Ammonia is used for the production of nitric acid and as a medium in cooling machines. In agriculture it can be used for direct fertilizing. Ammonia water is used for various industrial purposes. Unipetrol is also engaged in the production of energetic products (fly ash) and soot (25).

The premises of Unipetrol in Litvínovoccupy an area of 8.23 km^2. The company is involved in the TRINS system which, via its centres, provides continuous help in emergencies connected with the transport or storage of dangerous goods in the Czech Republic. (25).

The premises also house the seat of the company Českárafinérská, a.s., which is a joint venture of UNIPETROL and of the companies ENI and SHELL. It is the largest oil producer and oil product manufacturer in the Czech Republic. It operates refineries in Záluží and KralupynadVltavou.

6.1.2 Lovochemie, a.s.

Lovochemie, a.s. is the largest producer of fertilizers in the Czech Republic, and its product portfolio has significantly contributed to the development of Czech agriculture. Lovochemie, a.s. currently focuses on the production and sale of nitrogenous and multi-compound fertilizers in a solid and liquid state: foliar fertilizers, potassium fertilizers, nitrogen fertilizers, phosphatic fertilizers, magnesium fertilizers, foliar fertilizers, sulphur fertilizers, special fertilizers, lawn fertilizers, calcium fertilizers etc. The company mainly operates in the Czech Republic, Italy, Germany, Austria and Slovakia. Lovochemia is also a TRINS member(26).

6.1.3 Spolek pro chemickou a hutnívýrobu, a.s.

Spolek pro chemickou a hutnívýrobuis one of the leading synthetic resinsmanufacturers in Europe. Its main product range includes epoxy resins and alkyd resins, as well as hardeners and dissolving agents. Besides synthetic resins, Spolek also manufactures other chemicals. The company is based in Ústínad Labem on an area of ca. 0.52 km^2. Spolekdelivers its products to 4 continents and to more than 40 countries (27).

The company comprises three business units: resin specialities, resin commodities and inorganics. Resin commodities and specialities develop, produce and sell a wide range of innovative synthetic resins, custom-made as per customer needs. The product portfolio includes liquid resins, solid resins, solutions and other epoxy derivates, epoxy hardeners, solvents and high solid resins, water-soluble alkyde resins and epoxy final systems for moulding. The products can be used in a wide range of applications in various industrial sectors from powder coating compositions, to anticorrosive protection, composites, electrical engineering and adhesives, to wind power plants and construction (27).

The core of inorganics production is electrolytic chlorine production and sodium and potassium hydroxides of high purity in both liquid and solid state. Chlorine production is closely related to allylchloride and epichlorohydrin production. The efficient and modern technology used inepichlorohydrin production is licensed to worldwide chemical companies. Other products include hydrochloric acid, sodium hypochlorite, perchloroethylene, Molantin, organic specialities, and potassium permanganate. (27).

6.1.4 Mondi Štětí, a.s.

Mondi is an important international packaging and paper manufacturer with a strong focus on Western Europe, growing markets in Central Europe, Russia and the Republic of South Africa. Key products of the Mondi group include fine, unglazed paper, as well as packaging materials and products. In addition to that, the company also provides specialized solutions, such as surface coating, removable protective foils and flexible packaging. Mondi is a fully integrated business organization in all aspects of paper and packaging production – from forestry to cellulose and paper production (including recyclable materials), to processing of wrapping paper for packaging from corrugated cardboard and industrial bags, as well as processing of extruded or siliconized materials and production of flexible foil or laminate packaging (28).

Four Mondi divisions are situated in the Czech Republic, three of which are located in the Ústí Region and the fourth one is in ČeskéBudějovice. Mondi Štětí is the world leading manufacturer of paper materials, paper and wood pulp. Mondi Coating Štětí is engaged in the production and development of materials with barrier properties for the use in industrial and consumer packaging, in the area of construction insulations or for components used in the car industry. The company Mondi Bags Štětí manufactures paper bags and paper carrier bags, mainly for cement and plaster mixtures, charcoal, etc. (28).

6.1.5Other chemical companies in the Ústí Region

Enaspol a. s. is a chemical company with years of tradition in research and production of surfactants, construction chemicals (mainly concrete plasticizers and superplasticizers), textile auxiliaries, other construction chemicals (preparations for the removal of boarding and moulds, concrete retarders), as well as other chemical specialities (dye dispersants, softeners and disinfectants, fluccolants, products for the rubber industry, etc.). It is based in Velvěty, near Teplice (29).

The manufacturing facility of the company Flexfills.r.o. was completed in 2006 in the Lovosice industrial zone in the premises of a former sugar factory. It is a part of an international corporation operatingin over 55 countries which has a leading position in the area of production and application of chemical products used for maintenance and repair jobs, with a focus on industrial and commercial users and institutions. The company Flexfill based in Lovosice specializes mainly in water-based products, organic solvents, acids and enzymes. Flexfill products are mostly applied in industry, e.g. in surface protection, maintenance and cleaning, water treatment, lubrication, cooling and disinfection; in car repair shops, power plants or service facilities for agricultural equipment. Special disinfection chemicals are used in the food industry, in meat-packing plants, bakeries, dairies etc. (30).

The company ASTIN Catalysts and Chemicals, s.r.o. is currently located within the industrial premises of UNIPETROL RPA, s.r.o., in Litvínov-Záluží. Its line of business is mainly the development and production of catalysts (catalysts for chemical production, catalysts for product cleaning, catalysts for air purification and other specialized catalysts) (31).

CHEMOTEX Děčín a. s.manufactures surfactants and detergents, chemicals for mechanical engineering, construction, textile, and paper industries, as well as speciality products. A part of the production includes consumer chemistry represented by a number of cosmetic, washing and cleaning products.

PREOL, a.s. is the largest Czech rapeseed processor and the largest manufacturer of products based on this traditional domestic plant. Integrated production unit for rapeseed processing and rapeseed oil methyl ester production can be divided into two parts. The first part is vegetable oil production for food purposes. The other part is oleochemical production of rapeseed oil methyl ester and glycerine. The entire plant is situated in the industrial chemistry site in Lovosice and operates state-of-the-art production technology of the giant Belgian-Italian enterprise DeSmetBallestra. The modern plant processes 450 thousand tons of rapeseed a year, from which it produces 120 thousand tons of rapeseed oil methyl ester, more than 270 thousand tons of rapeseed meal and 10 thousand tons of pharmaceutical quality glycerine. Rapeseed meal is used as feed in farming production. PREOL, a.s. also participates in promotion and development of biofuels in the Czech Republic and European Union (32).

Glanzstoff Bohemias.r.oin Lovosice manufactures ca. 10,500 tons of viscose fibre a year. Viscord fibre by Glanzstoff Bohemia is used by all renowned tyre manufacturers. A valuable by-product of this technological process is sodium sulphate of high purity which is also available for purchase(33).

SIAD Czech spol.sr.o. supplies a full range of technical, medicinal and specialized gases in compressed or liquefied form. It is also engaged in construction of reduction stations and installation of cryogenic tanks for storage of liquid gases. Distribution of gas, both compressed and liquefied, is ensured all over the Czech Republic. In the Ústí Region, dispensing points are situated in Brňany u Mostu, Děčín, Duchcov, Chomutov, Litoměřice, Louny, Most, Postoloprty, Roudnicenad Labem and Teplice (34).

Air Products spol. s r.o., based in Děčín, is also a supplier of technical and medicinal gases. The company Orica Mining Services, based in Teplice, is the world leading supplier of industrial explosives. A number of other small and medium-sized enterprises operate in the region in the area of chemical and plastics industry, recycling of plastics and rubber products.

The joint-stock company ČEPRO, a.s. is mainly engaged in transport, storage and sale of petroleum products. In relation to this area, it provides transport, storage and specialized services to other parties. Its mission also includes protection of state material reserves. It also operates a network of its own filling stations under the trade name EuroOil(35).Large capacity fuel storage is situated in Hněvice, near Roudnicenad Labem.

The transport map of the Ústí Region (Fig. 13) shows the location of the four largest above described enterprises (Unipetrol RPA, Lovochemie, Spolek pro chemickou a hutnívýrobu, and Enaspol). The map is available from the crisis portal of the Ústí Region. It is possible to incorporate any other possible hazards into the map, such as floods or soil and rock slides. The map can be viewed at any scale. Further information about the crisis portal will be described in section 7 of this analysis (36).

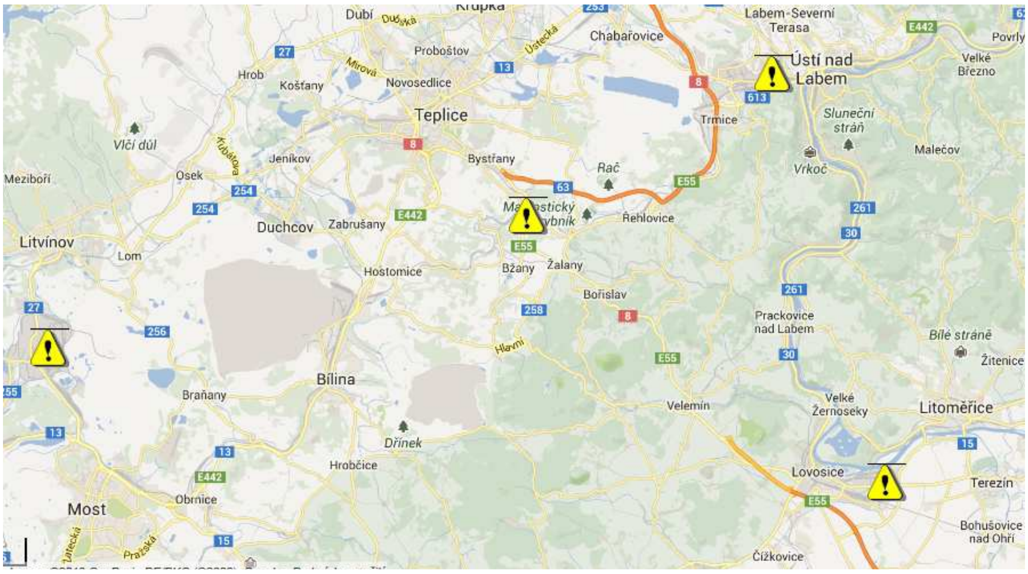


Fig.No. 13: *A section of the Ústí Region map with the four largest enterprises***(36)**.

6.2 Natural monuments in the Ústínad Labem Region

In the Ústí Region there are several natural monuments which need to be taken into account during transport of dangerous goods. The locations of the nature reserves and national parks are depicted in Fig. 14 (37).

In the Děčín area (between the municipalities of Hřensko, Chřibská and Brtníky), you can find the youngest national park in the Czech Republic – National Park Bohemian Switzerland. It is situated along the state border with Germany, which separates it from the national park Saxon Switzerland situated in the Free State of Saxony (Germany). The park occupies an area of 79.23 km². The south and west part of the park is surrounded by the nature reserveElbe Sandstone Mountains, in the east it borders on the nature reservethe Lusatianmountains. It was declared a nature reserve in 2000 and the main subject of protection is the unique sandstone structures and their biotope. Massive rock towers, gates, walls, ravines, formations and mazes were formed as a result of erosion of Cretaceous marine sediments which had been lifted to the surface during the Quaternary as a result of the Alpine orogeny. The most famous rock structure is Pravčickábrána (gate) which has become the park symbol. It bears the status of a national natural monument and it is the oldest rock gate in Europe. Up to 97 % of the national park area is covered by forests (37).

The landscape character of theElbe Sandstone Mountainsresembles the Bohemian Switzerland national park. The area ofthe Elbe Sandstone Mountainsused to be connected with the national park, but they were split in 2000. Today, the Elbe Sandstone Mountainsoccupy an area of 250 km^2.

The area of the Lusatian Mountains was declared a nature reserve in 1976. Currently, it occupies an area of 267 km² and its purpose is to protect the diverse landscape of the sandstone rock formations and phonolite, trachyte and basalt cones. From the German side, the LusatianMountains are adjoined by the Zittau Mountains of a similar nature, as well as of the same natural and cultural development, the only difference being the name and the state border (38).

Fig.No. 14: *Location of the nature reserves and national parks in the Ústí Region***(37)**.

The nature reserve of Českéstředohoří (Central Bohemian Uplands) is located between Louny and ČeskáLípa. Its area is 1063.17 km^2, which makes it the second largest nature reserve in Bohemia. It is naturally divided by the Elbe River. The area was declared a nature reserve in 1976. It partially covers areas of seven districts (ČeskáLípa,Děčín, Litoměřice, Louny, Most, Teplice and Ústínad Labem). The highest peak is Milešovka, whereas the lowest point is the level of theElbe in Děčín. The main reasons for declaring the area a nature reserve were the Central European uniqueness of the landscape relief of the Early Tertiary volcanic mountain range, diversity of the geological structure, species richness of vegetation and corresponding enlivening of the landscape by typical fauna (39).

A stretch of the Elbe River between Děčín and the state border crosses the Elbe SandstoneMountainsand right before the border with Germany it also runsalong the border of the national park Bohemian Switzerland. The Elbe canyon („PortaBohemica“) divides the nature reserve Českéstředohoří into two parts. Practically the same area is crossed by the main railway line Dresden – Děčín – Prague. The cities of Děčín, Ústínad Labem, Lovosice and Litoměřice are also situated within these nature reserves.Through the middle of the nature reserve Českéstředohoříruns the D 8 motorway, which is connected with the German A17motorway at the border crossing Krásný les in the Ore Mountains. It therefore presents the most important arterial road for road haulage in the region.

The above implies that preventive measures aimed at minimizing the risk of emergencies are very important in the Ústí Region. Moreover, the region, and mainly its basin part between the cities of Ústínad Labem and Chomutov on one side, and The Elbe valley between the cities of Děčín and Litoměřice on the other, belong to the most densely populated areas in the CR (more than 220 inhabitants per km^2).Emergency prevention during transport of dangerous substances is therefore important for nature protection, as well for the protection of society.

6.3 Transport in the Ústínad Labem Region

The Ústí Region is nearly the only Czech region which besides the road and railway transport uses also the inland waterway transport. Road transport, of course, prevails. Due to the location of the Ústí Region, increased demand for the railway and waterway transport, or their combination, can be expected, if the Elbe River is made navigable and the water corridor Danube – Odra – Elbeis built. Inland waterway and railway transport is much cheaper than road transport, and it also puts less strain on the environment. In comparison to the road transport, inland waterway and railway transport is safer. The main road, railway and river routes will be described in the following paragraphs.

6.3.1Road transport

Due to its geographic position, the region has been of great importance in terms of transport since the Middle Ages till present. This importance has nowbeen even multiplied by the link between the national economy and the European Union. At present, road transport is the most significant, as well as the most problematic, mode of transport. The volume of traffic in the Elbe Sandstone Mountainsnature reserveis biggest in the Elbe canyon between Děčín and the state border. The road between Děčín and Schmilka was completed on the right bank of the river Elbe in 1942. The area is crossed by the I/62 A-road with traffic load in the axisDěčín – Hřensko(40).Very important in terms of safety of the transfer of dangerous substances and minimization of its impact on the environment is the concourse of the road transport and the inland waterway transport on the Elbe and the international railway line Děčín – Dresden running on the left river bank. It is a double track without the possibility of further extension or increase in capacity. Its freight and passenger traffic load is 85 % at present (on the German side, the load is more than 90 % due to a high volume of passenger transport).

The I/13 A-road constitutes the entire south border of the Lusatian Mountainsnature reserve, with the total length of 40 km. Another A-road crossing the area of theLusatian Mountains is the I/9 road. It is mainly used for international lorry transport. At present, the NovýBor bypass can be taken(41).

Several A-roads and a stretch of the D8 motorway run through Českéstředohoří. The I/30road connectsLovosice, Ústínad Labem and Chlumec with the D8 motorway and A-roads I/62 and I/13. They run through a large part of Českéstředohoří and skirt the railway line KralupynadVltavou – Děčín.

The I/15 road connects the Most and Litoměřice areas with the ČeskáLípa area in the Liberec Region. This communication presents the main regional transport axis between west – east, mainly for the Litoměřice district.It starts in Most, runs along the southern foothills of Českéstředohoří (it is the I/15 road which presents the south border of the nature reserve along a large part of its route), through Třebenice, Lovosice, Litoměřice and Úštěk, and ends near Zahrádky in the ČeskáLípa district. Its total length is 74.360 km.

The I/28 road is an important section of the shortest transport link between the cities ofLouny and Most.The I/27 road running through Most and Žatec to Plzeň is an important transport tangent linking the D8 and D5 motorways outside the Prague transport hub. The I/13 road is the most important communication in Lower Ore Mountainswhich, besides other things, facilitates connection of chemical facilities in Ústínad Labem, near Teplice and Most (Záluží) with chemical factories in the Karlovy Vary Region (Sokolov), and with Germany, through the border crossing Pomezí near Cheb.

The D8 motorway runs in the north-northwest direction to Prague, through Lovosice and Ústínad Labem to the state border Czech Republic/Germany (Krásný Les/Breitenau), where it joins the German A17motorway. The D8 motorway has not been completed so far. A stretch between Lovosice and Řehlovice, 16.4 km long, is missing. When completed, the total length will be 92.208 km. It will be the only Czech motorway running through a nature reserve (Českéstředohoří). The construction of the remaining stretch was officially commenced on 6 November 2007, but its completion and putting into operation is not expected until 2015 due to ongoing legal disputes between the Directorate of Roads and Highways and environmental organizations. The required documentation of the assessment of environmental impacts was approved in 1996. However, in order to run a motorway through a nature reserve, statutory exemption from Act No. 114/92 Coll., granted by the Ministry of Environment of the CR, was required.Due to ministerial changes, the Ministry had changed its mind several times. However, the statutory exemption was eventually granted by Minister MilošKužvart. This exemption wasapproved on 14 February 2001.Alternate routes are being excessively strained as they had not been intended for such a big volume of traffic. Moreover, the deathtoll there is high. The completed motorway would improve the continuity of the traffic flow and increase safety (42).

The map section of the Ústí Region (Fig. 15) shows the road and motorway network. Pink colour marks expressways and A-roads, orange colour marks motorways. The map also depicts the stretch of the D8 motorway which has not been completed so far (yellow).

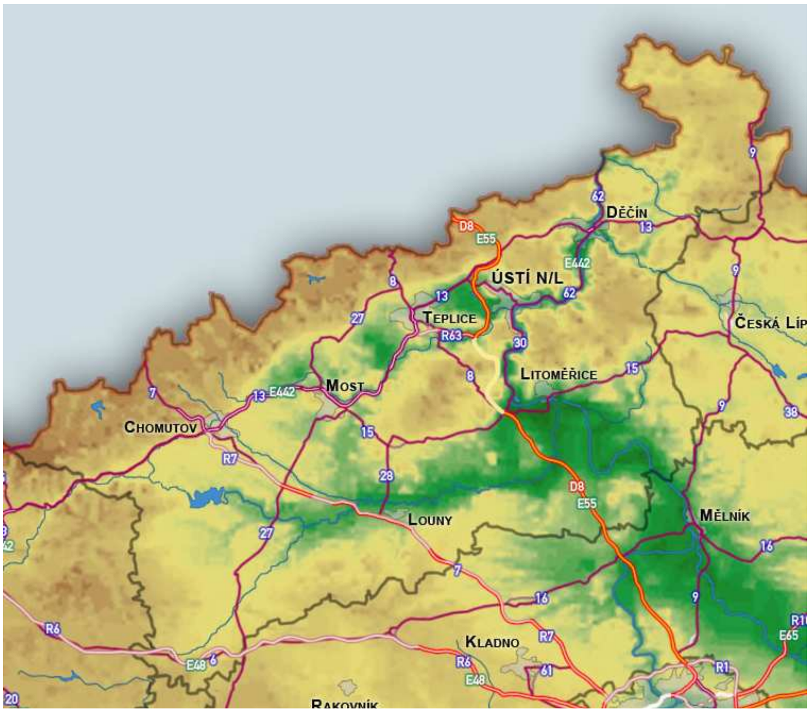


Fig.No. 15: *The road and motorway network in the Ústí Region***(43)***.*

6.3.2Railway transport

The railway network in the Ústí Region belongs to the densest networks in the CR. There is no doubt that the reason behind the construction of a number of local tracks was mining or other industrial activity at the end of the 19th century and in the first half of the 20th century. The tracks were used for freight transport. The region is now interspersed with a railway network with the total length of 1023 km. The main railway lines include the I. and II. railway corridor. This mode of transport has a very negative impact on the environment. The map in Fig. 16 shows the routes of both corridors through the Ústí Region.

Besides being an important domestic connection, the I. railway corridor alsopresents the transit connection of Berlin and Dresden with Bratislava, or Vienna. It is the main long-distance railway line between Dresden and Břeclav. The total length of the corridor route is 458 km. The corridor runs through the following tracks:

- *(Schöna DB -) DolníŽleb - Děčín (track 098 in the passenger train timetable)*
- *Děčín - Ústínad Labem - KralupynadVltavou - Praha-Holešovice(tracks 090 and 091)*
- *Praha-Holešovice - Kolín - Pardubice - ČeskáTřebová (tracks 010 and 011)*
- *ČeskáTřebová - Svitavy - Brno (track 260)*
- *Brno - Břeclav - Lanžhot(- Kúty ŽSR) (track section250)*(44)

The IV.transit railway corridor is the name for the main long-distance railway line between Děčín and HorníDvořiště. It represents the transit connection of Berlin and Dresden with Linz. The total length of the corridor route is 365 km. The first 145 km run in concourse with the I. corridor. The corridor runs through the following tracks:

- *(SchönaDB –) DolníŽleb – Děčín (track 098 in the passenger train timetable)*
- *Děčín – Ústínad Labem – KralupynadVltavou – Prahahlavnínádraží (tracks 090 and 091)*
- *Prahahl.n. – Tábor– ČeskéBudějovice (tracks 220 and 221)*
- *ČeskéBudějovice – HorníDvořiště (– SummerauÖBB) (track 196)*(45)

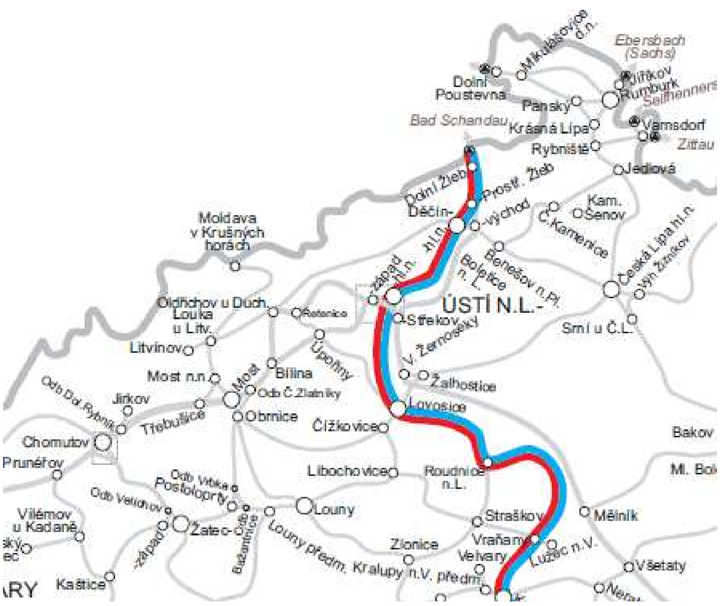


Fig.No. 16: *The route of the I. and IV. railway corridorin the Ústí region***(46)***.*

6.3.3Inland waterway transport

Inland waterway transport in the CR is limited mainly by the total length of navigable river stretches (waterways), which amounts to 355 km. In comparison with the length of the road network, which is approx. 50 ths.km, or the CR railway network (ca. 10 ths. km), this is the reason for the marginal position of the inland waterway transport in the transport system of the CR.

The advantage of the waterway transport is the fact that the inland waterway transport is almost always connected with the sea, and thus with sea transport. In case of the CR, this is implemented through the Elbe River, which empties into the North Sea. The inland waterway transport in the CR on the Elbe and Vltava Rivers is used mainly for long-distance transport of loose building materials, coal, petroleum and petroleum products, and for container transport of goods. Unfortunately, water shortages play an important part againstthe inland waterway transport. If there is a long spell of dry weather, there is a lack of water in the rivers and navigation must be suspended.

Waterways do not need to be expensively built. Their maintenance is also much easier than the maintenance of other transport communications. Sometimes, however, construction adjustments (deepening of the river bed, lock chamber) can be in conflict with environmental interests and may disturb the river ecosystem. The river navigability is also limited due to hydraulic structures used for energetic and water management needs of the state. In the 50s, navigability of the Vltava River was definitely terminated due to the construction of the Vltava Cascade (47). The map of the inland waterways ispresented in Fig. 17. It includes the existing, as well as the planned routes.

The most important port in the CR is situated in Děčín and it is owned by Česko-sasképřístavys.r.o. Apart from the Děčín port, this company also owns the ports in Lovosice in the CR and in Dresden, Risea, Torgau and Rosslau in Saxony. The Děčín port offers trimodal combined transport – it has a very good connection with the railway and road network. It is immediately connected to the state road (62, 13), and to the main network of the federal track. The Elbe makes transport possible along the entire European waterway network: Germany, Holland, Belgium, France, Switzerland, Austria, Poland, Slovakia, and Hungary.

Another CR port is located directly in Ústínad Labem (T-Port spol. s r.o.) and it is owned by Česképřístavy, a.s. The company also owns the following ports: Mělník,PrahaHolešovice,PrahaRadotín,PrahaSmíchovorKolín(48).

Unlike trends in Europe, waterway transport in the Czech Republic is oppressed and it needs to invest all its energy devoted to its development in the fight with pseudo-environmental organizations. This creates immense costs and delays which are reflected in non-functionality of freight transport and in the increased number of lorries, mainly in the transit corridor Děčín – Hamburg. The inland waterway transport, distinguished by relatively small negative environmental impacts and high level of operational safety when compared to other modes of transport, has a very small share in the transport performance of the CR. Moreover, the impossibility to plan the transport regardless of the weather forces carriers to shift to other modes of transport. This is then incorrectly interpreted as a lack of interest in waterway transport. Interest would be enhanced if this mode of transport became more stable and systematic.

The objective of the transport policy of the CRis to increase the transport performance of the inland waterway transport. One of the means to achieve this is through construction and modernization of the inland waterways infrastructure which would ensure a quality transport network. The basis for the development and reliability of the inland waterway transport in the CR is the implementation of the “Děčín Weir” project, i.e. construction of a weir near the town of Děčín which is a necessary step for ensuring a draught of 140 cm for 345 days per year (20 days is allowed for freezing over and flooding) in the critical 40 km long section Ústínad Labem – state border CR/Germany. It is a compromise solution for achieving navigability of the Elbe. Navigation-technical studies have proven that improvements of the navigation conditions on the Lower Elbe can only be achieved through the construction of weirs. Weirs have been designed for MaléBřezno and ProstředníŽleb. Dissenting opinions of environmental authorities and environmental activists have led to a changed solution for one of the weirs – the Děčín Weir. Its technical solution complies with the parameters of waterways in Germany (upon completion of the planned modifications in 2010, navigability of the Elbe should be ensured along its entire watercourse in Germany based on an obligation of the German Ministry of Transport, i.e. to ensure a minimum navigation depth of 160 cm for 345 days per year). Theoretical capacity of the Elbe with the Děčín weir is more than 8 mil. tons per year, whereas without the weir it is only 5 mil. tons per year. However, this capacity is not fully utilized because carries do not have the certainty that ships will be able to navigate (due to drought). The 2009 reality was only 535 ths. tons, and the number is falling further(49).

The Elbe waterway is currently used for inland waterway freight transport only as far as toChvaletice, mainly for transport of watercraft from the dockyard in Chvaletice. This waterway has not been completed and it lacks an appropriate public port and necessary subsequent centre for connection with other modes of transport. The projects lookinto stretching the waterway from Chvaletice to Pardubice, or as far as to Kunětice. This prolongation to Pardubice, with a prospective multimodal logistics centre for the Pardubice and Hradec Králové Regions, will make it possible to transport all bulk substrates to and from these regions. With respect to other plans, it will make transport of oversized freight and containers possible.(50).

Ideas to connect the three important European rivers, the Danube – Odra – Elberivers, for navigation purposes are hundreds of years old. However, a 300 km long channel that would interconnect the three rivers is still missing. This water corridor could be incorporated in the trans-European network TEN-T. The channel would help to resolve the issue of the missing stable interconnection of the CR with the sea. In addition to freight and passenger transport, it would ensure water management and flood control function (50).

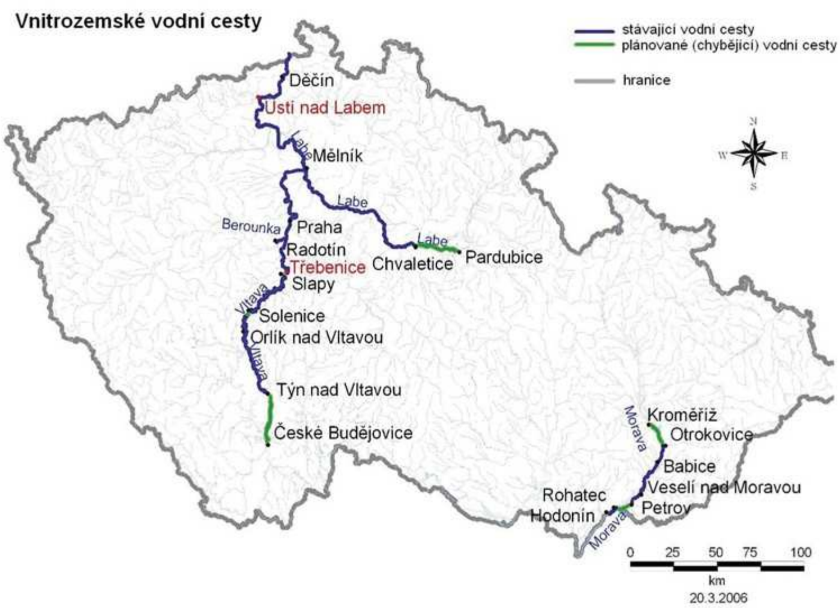


Fig.No. 17: *Inland waterways in the CR* **(50)**.

6.4 Critical points in the Ústí Region

In terms of transport, the premises of the above described chemical facilities are considered critical points. This regards mainly the premises of Unipetrol RPA in Záluží near Litvínov, where the road no. 27 runs right through the middle of the company premises which are located on both sides of this communication. The hazardous area is 17.29 km^2. An excellent source of information for the public about the risks connected with the relevant hazardous companies is available from the crisis portal of the Ústí Region. E.g. In relation to Unipetrol RPA, the following information is provided: Sources of risk of serious emergency situations,with impacts on the surroundings,within the premises of UNIPETROL RPA, s.r.o. are presented by the equipment of the individual operators containing dangerous substances and by the way operators handle dangerous substances. Hazardous are mainly non-standard conditions of this equipment and production processes (shutdowns – regular and emergency, re-commissioning) and multiple dangerous substance handling (filling, bottling). In case of a leakage from the equipment (production, storage or transport) with possible consequences beyond the borders of the premises, mainly the following substances are considered dangerous substances: ammonia, hydrogen sulphide, hydrocarbon, flammable liquids (petroleum, petrol, paraffin, diesel oil …). A document intended for the public with information about emergency planning zones is also attached there. The document synoptically and coherently informs about the object on its own(36).

Lovochemie premises are situated on the exit from the Lovosice centrein the industrial zone in Terezínskástreet. It is wedged between the railway station and the Elbe. The most hazardous substances used within the premises of Lovochemie include ammonia and carbon disulphide. Based on the risk analysis and assessment, ammonia tank emergency and ammonia cistern emergency were chosen as the most hazardous scenarios. The size of the contaminated area would be up to 2.5 km^2. In the worst case emergency scenario, parts of reservoirs and the entire width of the Elbe towards Žalhostice could be affected(36).

The premises of Spolek pro chemickou a hutnívýrobu are considered the critical point for the railway and inland waterway transport. The company is situated right in the city centre (the premises borders are located 400 m from the main square). It is surrounded by residential areas from three sides and the southern side adjoins the Ústí west railway station. Its premises occupy an area of 22 ha. The most hazardous substances used within the Spolek premises include e.g. chlorine and propylene. Dangerous substances management when pumping railway tanks was identified as the most hazardous scenario. Potential emergency consequences in the vicinity of the premises could be expected in case of a leakage of a certain amount of chlorine and in case of a propylene explosion. The size of the affected area could be 14.65 km^2. The railway station is an important connection point for railway transport, as well as for road and inland waterway transport. Track 090 (section of the I. and IV. corridor: Děčín – Ústínad Labem – Prague) and track 130 (Ústínad Labem – Teplice – Most – Chomutov) run from the reservoirs. Near the railway station there is also the D8 motorway (Dresden – Ústínad Labem – Prague) and the Elbe waterway (Chvaletice – Hamburg, port of Ústínad Labem) (36).

Enaspol is located in the industrial zone Velvěty near Teplice. The most hazardous substances include liquefied hydrocarbons based on propane-butane and formaldehyde. Pumping and storage of liquefied hydrocarbons and formaldehyde tank emergency have been identified as the most hazardous scenarios.The affected area could be 0.06 km^2. In the worst case scenario, one of the most important connection lines with the D8 motorway, i.e. the R 63 motorway, could be contaminated(36).

Just as the road or railway transport, the inland waterway transport has its limits as well. Let us mention the situation in 2002 or 2013. The 2002 flooding in Bohemia was one of the most important events of its kind in the history of the Czech Republic. In August 2002, Bohemia was hit by a five-hundred or a thousand-year flood. The worst hit area was the Vltava River with its basin, and later the Lower Elbe, and marginally also areas in the Ohře and Dyje basins. There were 17 casualties, 7 regions declared a state of emergency, 753 municipalities were affected and the damage reached 73.3 bil. CZK. There was a chlorine leakage from the premises of Spolana in Neratovice. As a result of this flooding, a law on the state of emergency and a law on the integrated rescue system were passed and flood control plans were drawn up, based on which flood control measures in many places of the country were implemented (51).

The town ofZálezlice at the confluence of the Elbe and Vltava rivers was one of the worst damaged municipalities during the flooding. Out of the 120 houses there, water damaged 90 of them, out of which 40 had to be pulled down. The flooding damaged the local wastewater treatment plant and the church. The water also damaged the electricity distribution system, street lighting, roads, sewage system, water pipelines, and the football stadium. The town was cut off from the rest of the world during the disaster, and it was surrounded by a "lake" with an area of 400 ha. Flood control earthen wall was supposed to protect people against another flooding. Its construction was commenced last autumn. However, the wall had not been completed before it was burst by another flooding in 2013 (52). In between, the Ústí and Liberec Regions were put at risk by flash floods in 2010.

During the flooding in 2002 and 2013, a part of the Lovochemie premises in Lovosice was flooded and the Spolchemie premises in Ústínad Labem were also under immediate threat. In both cases, the premises were secured in such a way so as to prevent significant damage to the environment. Moreover, in the interim, protection walls and other flood control measures were built between 2002 and 2013 which minimized the impact of flooding on the safety situation. Nonetheless, the danger of flooding continues to be an important factor which also influences the safety of dangerous substances transport, not only during their storage, loading and unloading within the premises in question, but also during the road, railway and inland waterway transport, because the main road and railway routes in the Ústí Region run along the banks of the river Elbe.

7. The crisis portal of the Ústínad Labem Region

On the websites of the Ústí Region you can find the crisis management portal. Its objective is to create a functioning information platform which would be able to provide information about crisis situations in the regionto the public. The last time it proved itself useful was during the floods in June and July 2013. As of 2014, a cross-border “Portal for information support in decision making in crisis situations” will become a part of the crisis management portal. Below is a brief summary of what the portal should be used for.

Emergencies which the modern society needs to face in an effective way are not governed by the rules by which the life of the human community is organized. They uncompromisingly cross the borders of the individual states and bring similar consequences to both sides of the border. Response to such cross-border emergencies and crisis situations is naturally more demanding and problematic. They are dealt with in different legal and language environments, which might imply various specifics and possible problems connected with the organization of the response. In relation to the membership of the Czech Republic and its neighbouring countries in the European Union, the prerequisites and conditions for dealing with these issues are improving. It is not only a result of a higher level of economic and political integration, but also thanks to specific projects financed with the support of the European Union.

One of such projects is the program called “Cíl 3/Ziel 3” for the support of cross-border cooperation between the Czech Republic and the Free State of Saxony. This program also incorporates implementation of the project “Portal for information support in decision making in crisis situations”. The objective of this project is to put into operation a portal which would inform the professional and general public about crisis situations within the given region and about the status of the response to them. The project result would be a synoptic information portal in Czech and German language which would provide information about current emergencies and crisis situations on both sides of the state border. Information will also be provided about prevention measures and about how to behave in such situations and where to ask for necessary help. The portal will serve both to the general and to the professional public. The main contribution of the portal will be in facilitating cooperation of the rescue services on the Czech and Saxon side of the border, thanks to the detailed collection of all the necessary information in real time.

The professional objective of the project is to create a joint cross-border database containing structured information necessary for the information support of decision making in emergency and crisis situationsmanagement and response. The database will contain the full spectrum of information, including information about the territory infrastructure and its capacity, about resources necessary for the crisis management response,and about hazards on both sides of the state border. Flooding especially presents a hazard which is one of the most probable sources of a crisis situation in the given area. In order to predict the development of the situation and to efficiently assess the development of the flood, both within the regional territory, and within the territory of the project partner, it will be necessary to integratecurrent data about the water levelinto the crisis information system, especially data about the water level of the Elbe on the Czech and German side. This integration will help to obtain precise information about the state and development of the water level and the flow rate, and it will help to better coordinate the activities on both sides of the state border.

Majority of the collected data will contain a characteristic about its location in space, i.e. it will be an integrated database with spatial data and it will be possible to view and analyse the database also in terms of spatial relationships and linkages. A part of the integrated database development will also be the development of geodata sources. Mobile access to cross-border information support will provide information support for crisis situations response under limited or crisis conditions. The basic difference in comparison with the online platform will be the fact that it will be functioning also without the connection to the central infrastructure and that it will be independent of the surrounding services and systems. The mobile platform will also be functioning if there is a cut-off or unavailability of communication networks in the given area and it will be possible to operate the entire system on a standardized laptop. The common aspects of the offline and mobile platform are the data sources which will be used by both of these applications, as well as web services, which will be used by the offline platform when connection to the central server is available. The solution includes also conclusion of cooperation agreements on providing access and visual information between the regional council and the operators of the camera systems. Visual information available from the CCTV located in the territory of the administrative unit is one of the basic pillars of the support of decision making of the crisis teams in emergencies or crisis situations. Assessment and subsequent integration of the regional camera systems into the cross-border crisis information system will be conductedfor this purpose.

The target state will make it possible for the authorised users to obtain visual information about the events in a certain location in real time, based on the access to the existing camera systems, and to specify and adjust potential decisions. The integration will mainly be aimed at the existing camera systems of the police, city police, or private web cameras of entities and institutions situated in localities which are important for crisis management.

Other data sources for the cross-border crisis information system include also data from the transport system. These comprise visual information from traffic cameras situated at crossroads and on the main transport routes, information about the traffic density, updates about closures, traffic accidents and impassable areas. Up-to-date and exact information of this kind are essential for proper coordination of a crisis situation in the affected area by a central authority and for planning and selection of diversion, evacuation and supply routes. To illustrate the situation when responding to emergencies or crisis situations, there must be an exact and undistorted overview of disposable, or actively deployed,resources and means in the given area. The individual resources and means e.g. with the IRS are equipped with technical positioning equipment, or such equipment is currently being planned. The aim will be to integrate the data from the GPS positioning units in emergency vehicles, or IRS vehicles, into the monitoring systems implemented by online and offline platforms under the cross-border crisis management system.

The integration of the information system shall provide the necessary source of real time data about the position and use of material, or human resources. For dealing with cross-border crisis situations, the information system of the Emergency Medical Service of the Ústí Region will be technologically interconnected with health-care facilities providing hospital emergency care, as means of communication and interconnection with central hospital admissions will be ensured. This is, of course, only a brief outline of the integrated solution approach. The system will be used on both sides of the border and it will be common to both sides.

Mutual Czech-Saxon cooperation is a must for providing crisis situation response. Floods, forest fires, serious traffic accidents on heavy traffic roads, as well as emergencies in industrial enterprises, especially the chemical ones, all these are the risks that are common to the Ústí Region and to the border areas of Saxony. All this is a responsible and professional approach of the Ústí Region management when ensuring protection of people and protection of the critical infrastructure.

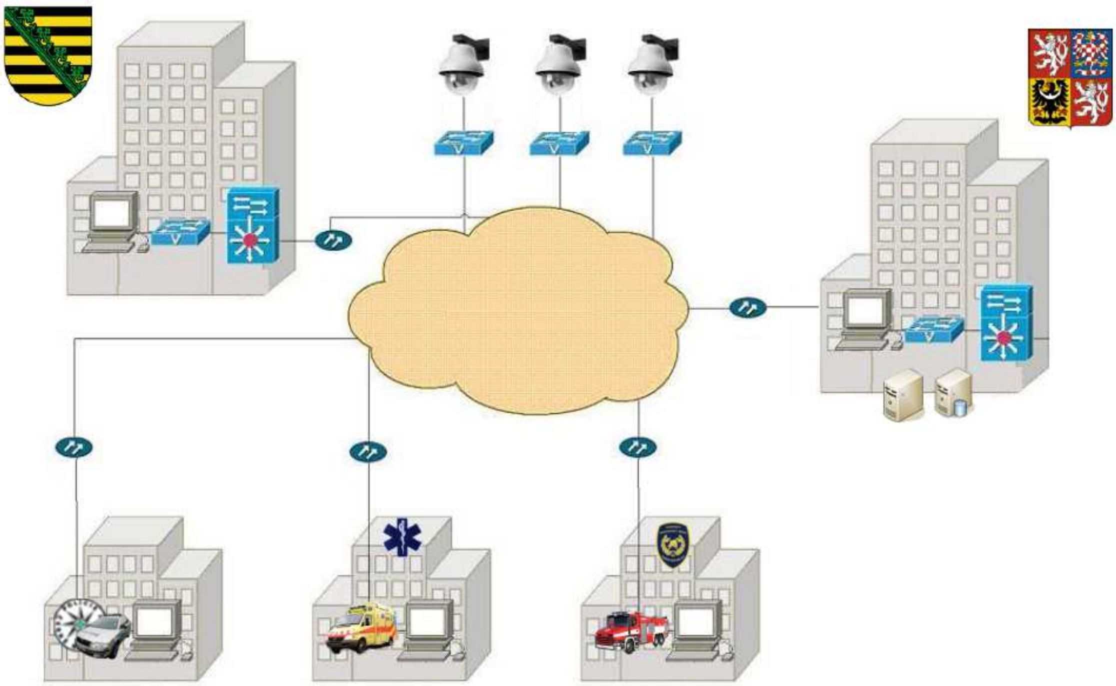


Fig.No. 18: *Diagram of the portal applicability on both sides of the border (the Ústí Region – the Free State of Saxony).*

In conclusion, it must be stated that the crisis management portal has been designed so as to include all necessary and synoptic information regarding any emergency situation which could hit the region. Cooperation, interconnectivity and functionality of the portal with the Saxon side in Germany are excellent. In terms of the ChemLog T&T project, the crisis portal is certainly a tool which could be used as a server capable of providing basic information to the emergency teams in case that a vehicle carrying a dangerous substance is in an accident.

8. Conclusion

Just as anywhere else, road transport is the most common means of transport in the Czech Republic as well. However, it poses greater risks than the railway or inland waterway transport. In today's hectic world, employers place unreasonable demands on drivers of goods vehicles, which is reflected in the safety of their driving. Drivers also overestimate their abilities more and more and thus get into unpleasant situations during which they put at risk their own lives, as well as the lives of other road users. There are only a few drivers nowadays who strictly follow the traffic rules. Ignoring speed limits or break times, making phone calls while driving, exhaustion, carelessness or poor condition of the vehicle are frequent causes of accidents. Other drivers must then wait in endless tailbacks before the accidents are investigated and removed. As a result, they try to make up for the delay and put others at risk by their reckless driving. Of course, the conditions of the Czech roads and motorways, and incomplete sections of some roads and motorways, are to blame here as well. Last but not least, freight transport contributes largely to the deterioration of the road infrastructure condition.

The main objective of the ChemLog T&T project in general is to increase awareness of multimodal transport. In the Czech Republic especially, there is a trend in focusing all transport on the roads, although the relatively good railway network or the Elbe waterway, which provides connection with the North Sea, could be utilized. The costs of road transport are much higher than the costs of railway or waterway transport, not mentioning the fact that in terms of ecology, road transport cannot compete with them. Also the volume of goods which can be transported in one load by railway or inland waterway transport cannot be compared with the volume of the goods carried by one lorry.

Another point of the project is a quick response in case of an accident. Over the past years there has been a big boom in the technology designed for tracking and tracing of vehicles. However, majority of such tracking devices are based on constant power supply from the vehicle. Therefore it is necessary to develop a system which could be satisfactorily affixed directly to the transport container. Problems are associated mainly with the power supply of the unit, with signal transmission, or with sensor sensitivity to different stimuli.

This analysis should refer to the current situationof transport of dangerous goods in the Czech Republic, with the focus on the Ústínad Labem Region. The analysis mentions the individual international and domestic conventions for the given modes of transport and the main identification data for identifying dangerous properties. The statistics of checks and traffic accidents during transport of dangerous substances is also included here. Last but not least, the analysis includes basic issues connected with container tracking and the current state of risks in the regions with reference to the crisis portal of the Ústí Region.

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10. List of figures

11. List of charts

Annexes

Annexe No. 1: Patterns of safety labels

CLASS 1 HAZARD
Explosive substances and articles

(**No. 1**)
Divisions 1.1, 1.2 and 1.3
Symbol (exploding bomb): black;
Background: orange; Figure “1” in bottom corner

(No. **1.4**) Division 1.4 | (No. **1.5**) Division 1.5 | (No. **1.6**) Division 1.6

Background: orange; Figures: black; Numerals shall be about 30 cm in height and be about 5 mm thick (for a label measuring 100 mm x 100 mm); Figure “1” in bottom corner

** *Place for division – to be left blank if explosive is the subsidiary risk*
* *Place for compatibility group – to be left blank if explosive is the subsidiary risk*

CLASS 2 HAZARD Gases

(No. **2.1**)
Flammable gases
Symbol (flame): black or white;
(except as provided for in 5.2.2.2.1.6(c))
Background: red; Figure “2“ in bottom corner

(No. **2.2**)
Non-flammable, non-toxic gases
Symbol (gas cylinder): black or white;
Background: green; Figure “2” in bottom corner

(No. **2.3**)
Toxic gases
Symbol (skull and crossbones): black;
Background: white; Figure “2” in bottom corner

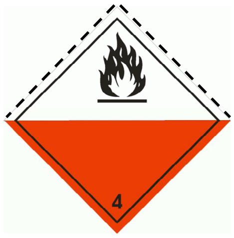
CLASS 3 HAZARD
Flammable liquids

(No. **3**)
Symbol (flame): black or white;
Background: red; Figure “3” in bottom corner

CLASS 4.1 HAZARD
Flammable solids, self-reactive substances and solid desensitized explosives

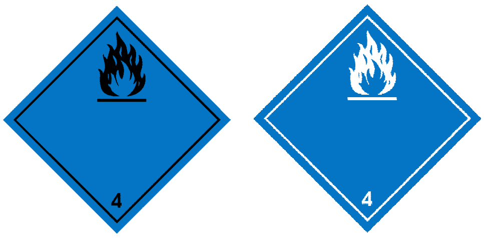
(No. **4.1**)
Symbol (flame): black;
Background: white with seven vertical red stripes;
Figure “4" in bottom corner

CLASS 4.2 HAZARD
Substances liable to spontaneous combustion



(No. **4.2**)
Symbol (flame): black;
Background: upper half white, lower half red;
Figure “4” in bottom corner

CLASS 4.3 HAZARD
Substances which, in contact with water, emit flammable gases

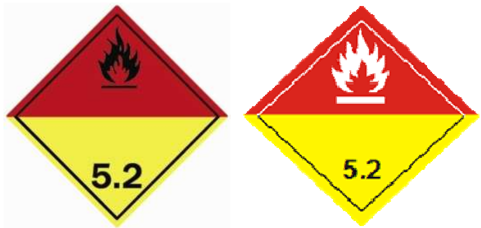


(No. **4.3**)
Symbol (flame): black or white;
Background: blue;
Figure “4” in bottom corner

CLASS 5.1 HAZARD
Oxidizing substances

(No. **5.1**)
Symbol (flame over circle): black;
Background: yellow
Figure “5.1” in bottom corner

CLASS 5.2 HAZARD
Organic peroxides

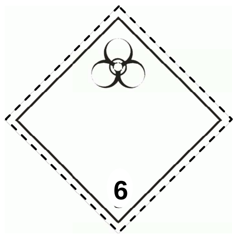


(No. **5.2**)
Symbol (flame): black or white;
Background: upper half red; lower half yellow;
Figure “5.2” in bottom corner

CLASS 6.1 HAZARD
Toxic substances

(No. **6.1**)
Symbol (skull and crossbones): black;
Background: white; Figure “6” in bottom corner

CLASS 6.2 HAZARD
Infectious substances

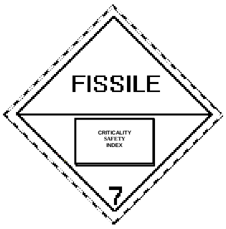


(No. **6.2**)
Symbol (three crescents superimposed on a circle) and inscriptions: black;
Background: white; Figure “6" in bottom corner

CLASS 7 HAZARD
Radioactive material

(No. **7A**)
Category I – WHITE
Radiation symbol (trefoil): black;
Background: white;
Text (mandatory): black in lower half of the label:
"RADIOACTIVE"
"CONTENTS ..."
"ACTIVITY ...";
One red bar shall follow the word "RADIOACTIVE";
Figure "7" in bottom corner

(No. **7B**) (No. **7C**)
Category II – YELLOW Kategorie III - ŽLUTÁ
Radiation symbol (trefoil): black;
Background: upper half yellow with white border, lower half white;
Text (mandatory): black in lower half of label:
"RADIOACTIVE"
"CONTENTS..."
"ACTIVITY ...";
In a black outlined box: "TRANSPORT INDEX"
Two red vertical bars shall Follow the word „RADIOACTIVE"
Three red vertical bars shall follow the word „RADIOACTIVE"
Figure "7" in bottom corner

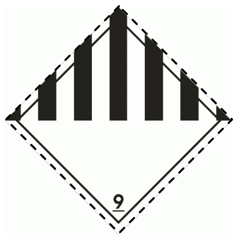


(No. 7E)
Class 7 fissile material
Background: white;
Text (mandatory): black in upper half of the label: "FISSILE";
In a black outlined box in the lower half of the label:
"CRITICALITY SAFETY INDEX";
Figure «7» in bottom corner

CLASS 8 HAZARD
Corrosive substances

(No. **8**)
Symbol (liquids, spilling from two glass vessels and attacking a hand and a metal): black;
Background: upper half: white; lower half: black with white border;
Figure "8" in bottom corner

CLASS 9 HAZARD
Miscellaneous dangerous substances and articles



(No. **9**)
Symbol (seven vertical stripes in upper half): black; Background: white;
Figure "9" underlined in bottom corner

Other labels:

Label for environmentally hazardous substances

Label for elevated temperature substances

Annexe No. 2: Transport streams in the CR

Transport streams between the regions in the CR, in ths. tons:

Railway transport of goods — **Year: 2011**

Region of loading	Region of unloading	CZ011	CZ021	CZ031	CZ032	CZ041	CZ042	CZ051	CZ052	CZ053	CZ063	CZ064	CZ071	CZ072	CZ081	Total
CZ011	Capital City of Prague	17.3	46.0	3.0	129.8	27.2	22.4	2.3	3.8	20.8	0.4	25.8	99.5	506.8	151.4	**1 056.4**
CZ021	Central Bohemian Region	103.5	1 336.9	23.7	108.0	172.7	1 474.2	58.6	18.0	59.6	50.1	62.0	62.2	34.8	198.3	**3 762.5**
CZ031	ČeskéBudějovice Region	0.5	23.7	35.8	43.2	15.0	43.2	0.7	2.2	0.6	21.8	4.3	2.1	3.5	7.7	**204.2**
CZ032	Plzeň Region	229.3	46.0	11.4	216.9	56.2	326.8	0.1	3.5	1.3	38.4	2.0	2.6	1.2	6.0	**941.4**
CZ041	Karlovy Vary Region	29.4	291.9	464.9	774.5	1 516.8	272.3	1.0	5.8	1.5	40.7	4.5	35.1	7.7	32.2	**3 478.5**
CZ042	Ústínad Labem Region	57.1	1 745.2	407.8	256.5	67.3	5 821.7	56.8	843.2	5 471.4	134.1	247.1	326.4	482.1	314.2	**16 230.7**
CZ051	Liberec Region	1.8	22.5	19.1	12.6	9.6	66.4	24.4	8.7	0.1	13.3	53.9	14.1	2.7	25.0	**274.2**
CZ052	Hradec Králové Region	22.6	6.0	1.1	12.2	61.0	246.5	12.2	51.2	124.1	35.0	4.4	1.0	0.8	74.3	**652.3**
CZ053	Pardubice Region	27.7	64.4	8.4	20.1	14.1	158.8	3.3	37.3	48.8	17.2	49.3	17.7	7.1	60.9	**535.0**
CZ063	Vysočina Region	0.9	11.7	2.8	5.6	8.4	231.8	0.8	4.0	2.7	38.5	2.7	1.0	0.7	124.5	**435.9**
CZ064	South Moravian Region	15.1	256.9	8.0	7.0	3.0	40.2	0.0	1.4	5.6	39.0	32.0	48.8	33.3	207.6	**697.8**
CZ071	Olomouc Region	93.6	92.9	16.3	9.1	7.9	59.6	0.1	8.7	18.8	45.3	39.3	223.5	16.2	546.6	**1 177.7**
CZ072	Zlín Region	306.2	18.9	9.6	22.2	0.6	28.3	0.2	1.5	1.5	37.5	6.4	4.9	19.1	150.6	**607.6**
CZ081	Moravian-Silesian Region	171.6	781.6	13.9	26.8	145.6	253.8	10.1	90.4	428.6	128.5	286.9	208.9	197.4	7 400.1	**10 144.1**
	Total	**1 076.6**	**4 744.3**	**1 025.7**	**1 644.5**	**2 105.3**	**9 045.8**	**170.7**	**1 079.7**	**6 185.3**	**639.6**	**820.4**	**1 047.6**	**1 313.4**	**9 299.4**	**40 198.3**

Road transport of goods

Region of loading	Region of unloading	CZ011	CZ021	CZ031	CZ032	CZ041	CZ042	CZ051	CZ052	CZ053	CZ063	CZ064	CZ071	CZ072	CZ081	Total
CZ011	Capital City of Prague	13 368.2	3 868.0	434.0	549.4	300.8	622.2	394.6	351.6	260.3	140.3	633.7	404.7	109.3	275.8	**21 712.7**
CZ021	Central Bohemian Region	4 416.4	31 749.9	1 115.8	930.3	336.3	1 742.6	757.9	1 331.5	833.6	911.4	841.5	478.3	201.0	282.2	**45 928.6**
CZ031	ČeskéBudějovice Region	388.9	1 044.5	15 233.2	516.7	35.6	254.3	78.7	122.5	120.6	362.3	278.7	130.9	37.3	64.3	**18 668.5**
CZ032	Plzeň Region	290.1	1 177.4	466.3	20 742.0	446.3	488.3	8.4	116.2	148.5	76.0	93.5	104.2	17.7	73.2	**24 248.1**
CZ041	Karlovy Vary Region	365.4	339.1	152.1	479.0	6 669.5	318.0	28.5	80.0	32.3	18.5	46.7	83.1	39.2	11.8	**8 663.2**
CZ042	Ústínad Labem Region	697.2	1 780.4	458.6	857.3	485.6	19 799.9	464.0	293.9	215.9	209.2	253.6	125.9	117.2	135.2	**25 893.9**
CZ051	Liberec Region	193.0	972.6	106.7	14.0	17.9	419.9	6 391.7	361.1	38.5	65.3	64.9	70.5	36.2	52.6	**8 804.8**
CZ052	Hradec Králové Region	372.9	985.5	106.0	120.7	36.0	342.7	439.2	13 795.7	593.3	184.4	216.2	168.8	43.1	131.5	**17 535.7**
CZ053	Pardubice Region	241.8	664.1	105.8	128.5	29.1	162.4	72.1	644.2	10 558.5	330.2	427.5	442.1	144.8	219.1	**14 170.1**
CZ063	Vysočina Region	240.3	674.5	487.2	124.5	12.8	95.2	41.1	311.9	276.5	9 818.7	759.0	235.2	56.8	162.2	**13 295.9**
CZ064	South Moravian Region	559.9	695.2	434.6	148.7	43.1	110.8	121.8	138.4	385.2	997.8	20 019.5	1 132.6	613.4	652.7	**26 053.6**
CZ071	Olomouc Region	342.0	476.8	91.7	103.4	30.9	101.8	57.5	170.3	938.6	185.2	1 196.2	13 700.7	1 185.0	2 581.8	**21 161.8**
CZ072	Zlín Region	132.7	176.1	38.4	10.2	12.7	19.1	30.1	83.7	54.5	59.3	626.6	711.5	8 278.4	726.5	**10 959.7**
CZ081	Moravian-Silesian Region	260.7	269.4	91.8	117.5	10.5	56.9	87.4	190.3	138.6	212.6	604.5	911.6	510.1	28 023.2	**31 484.9**
	Total	**21 869.3**	**44 873.5**	**19 322.0**	**24 842.1**	**8 466.9**	**24 534.0**	**8 973.0**	**17 991.1**	**14 594.8**	**13 571.1**	**26 062.1**	**18 700.0**	**11 389.5**	**33 392.1**	**288 581.5**

Inland waterway transport of goods

Region of loading	Region of unloading	CZ011	CZ021	CZ031	CZ032	CZ041	CZ042	CZ051	CZ052	CZ053	CZ063	CZ064	CZ071	CZ072	CZ081	Total
CZ011	Capital City of Prague	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**6.7**
CZ021	Central Bohemian Region	0.0	210.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**210.1**
CZ031	ČeskéBudějovice Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ032	Plzeň Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ041	Karlovy Vary Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ042	Ústínad Labem Region	143.3	115.5	0.0	0.0	0.0	34.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**293.1**
CZ051	Liberec Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ052	Hradec Králové Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ053	Pardubice Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ063	Vysočina Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ064	South Moravian Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ071	Olomouc Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ072	Zlín Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ081	Moravian-Silesian Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
	Total	**143.3**	**332.3**	**0.0**	**0.0**	**0.0**	**34.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**509.9**

National air transport of goods

Region of loading	Region of unloading		CZ021	CZ031	CZ032	CZ041	CZ042	CZ051	CZ052	CZ053	CZ063	CZ064	CZ071	CZ072	CZ081	Total
CZ011	Capital City of Prague	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ021	Central Bohemian Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ031	ČeskéBudějovice Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ032	Plzeň Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ041	Karlovy Vary Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ042	Ústínad Labem Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ051	Liberec Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ052	Hradec Králové Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ053	Pardubice Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ063	Vysočina Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ064	South Moravian Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ071	Olomouc Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ072	Zlín Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
CZ081	Moravian-Silesian Region	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
	Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**