

Training of Drivers for Safe Transport of Dangerous Goods

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Abstract: The safety of transporting dangerous goods is conditioned by a number of factors, many of which are significantly influenced by drivers. Drivers, as the central component of human resources, are expected to react appropriately at all times during the performance of their professional activity, in order to prevent the occurrence of a traffic accident or reduce its consequences, thus contributing to the safe transport of dangerous goods. He is expected to assess the situation and make a valid decision in accordance with the set tasks. Due to irregularities and omissions in the work when making an independent decision on how to act in certain moments, the driver directly influenced the occurrence of a large number of accidents. In order to minimize the driver's failures in the transport process, appropriate attention must be paid to their training.

Keywords: dangerous cargo, safe transport, training of drivers.

INTRODUCTION

Modern technological development has led to an increased of dangerous goods in the transport system. For the safe conduct of the transport process, it is necessary that all participants are professionally trained in accordance with their obligations and tasks. Training must be understood and realized as a unique process of acquiring knowledge, skills, habits and developing psycho-physical and intellectual abilities necessary for efficient and safe performance of functional duties of individuals in the entire transport process.

In order to provide the appropriate level of knowledge of drivers for safe transport of dangerous goods, the scope and content of the training program is defined, starting from the initial basic training course to specialist training courses defined depending on the mode of transport or type of dangerous goods. The constant need to increase the level of safety during the transport of dangerous goods and to adapt to changes in transport require that these drivers complete periodic refresher courses. In order to achieve the minimum level of knowledge of drivers required for the safe transport of dangerous goods, unique common rules have been defined for several countries that have made agreements on this. Many countries have additionally regulated by national regulations the conditions for the transport or handling

of dangerous goods, which is accompanied by additional training programs depending on the needs and policies of each country.

SAFETY OF DANGEROUS GOODS TRANSPORT

Transport and handling of dangerous goods differs significantly from procedures with other types of cargo. The terms "dangerous substance" or "dangerous goods" are often found in the literature. A distinction needs to be made so as not to create the confusion and misunderstandings that have already taken place. In particular, the term "dangerous substance" may be confusing if it is not known whether it is a dangerous substance in use as a "chemical" or a dangerous substance in transport, when it is a dangerous cargo or dangerous goods. The identification of the terms "cargo" and "goods" is wrong.

"Dangerous goods" is a product of industry, agriculture, crafts or other activities when it is intended for sale or is already on the market. The basic characteristic of a product that makes it a commodity is the intention of the manufacturer to sell it on the market, and not to satisfy his own needs with it [1].

Cargo is a thing that is manipulated in the traffic-transport sense [2].

Non-goods cargo can also appear in transport, and according to the established criteria for classification by modes of transport, made on the basis of UN transport recommendations, it is a danger, so for these reasons the term "cargo" is more appropriate, in this case "dangerous cargo".

Transport of dangerous goods is a process with increased risk that carries with it a number of potential dangers to people, property and the environment. The dangers are especially in the case of a traffic accident or an extraordinary event during transport. Transport relies on a number of complex and interdependent technical, technological and organizational components that can affect the safety of the process.

The existence of a high risk, ie consequences that may occur in the event of an accident with dangerous goods requires from all participants in the transport process maximum responsibility, knowledge and implementation of established rules for all participants, as well as compliance with all rules for specific transport, which are listed in ADR.

Accidents with hazardous substances during transport, handling or during the production process or storage are always possible. Accidents in India, Bhopal, 1984, are often cited as an example of the scale of the effects of a chemical on the environment. where more than 2,800 were killed and more than 50,000 were injured[3]. In the transport of dangerous goods, the consequences are usually not of that magnitude, but they are by no means negligible. An example is the accident in Spain in 1978 in Los Alfaques, where a tanker with 43 m³ of liquid propylene exploded [4]. 217 people were killed and an area of nearly 400 m in diameter was completely destroyed, indicating that the consequences could be incalculable. The latest example is the explosion in the port of Beirut of more than 2,700 tons of stored ammonium nitrate, on 04.08.2020, which has a wide used in agriculture, confirms the seriousness of the consequences that can occur depending on the characteristics of the cargo. The blast killed more than 200 people, injured more than 6,000 and left more than 300,000 homeless, according to newspaper reports.

According to the Organization for Economic Cooperation and Development (OECD), depending on the severity of the consequences, accidents are divided into technological disasters, major accidents, significant accidents [3].

This classification is based on the number of dead, the number of injured, the number of evacuees, the amount of material damage (outside of the plant).

An example for estimating the severity of the consequences of an accident based on the number of dead is:

- technological disasters - accidents with 25 or more dead;
- major accidents - accidents with 5 or more dead;
- significant accidents - accidents with 3 or more dead.

Cases of explosions of tanks on loading or unloading, spills of liquid on loading or unloading, overturning of vehicles and spills of liquids occur. Recurrence of accidents with the same consequences indicates that, among other things, no detailed analysis of these accidents is performed, omissions and responsibilities are not determined and appropriate preventive and punitive measures are not taken. Every accident during the transport of dangerous goods requires a detailed analysis of the causes, occurrence and possible consequences. Each case can serve as an example in reviewing omissions and defining the procedure for such cases. Only in this way can a long-term reduction in the number of accidents as well as the consequences of such an event during the transport of dangerous goods (cargo) be ensured.

ROLE AND TASKS OF DRIVER IN THE DANGEROUS GOODS TRANSPORTATION PROCESS

Based on the obligations he has in the process of transporting dangerous goods, from the sender to the recipient, the role of the driver is especially important. He is often required to make important decisions quickly and independently, which are related to taking appropriate actions according to traffic conditions as well as in cases of endangering transport safety. In that way, it directly affects the possibility of an accident and the magnitude of the consequences, ie the safety of transporting dangerous goods.

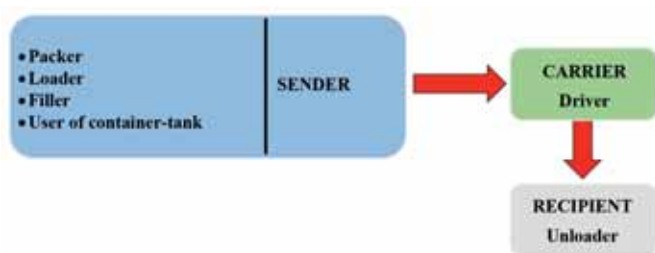
The potential danger posed by the transport of dangerous goods and the possible impact on the territory of several countries have contributed to the creation of unique, common rules according to which this process will be performed. In 1957, the European Agreement concerning the International Carriage of Dangerous Goods by Road - ADR [6] was concluded, which entered into force in 1968 when the agreement was ratified by five states. According to ADR 2019, the contracting parties to the agreement are 51 states.

Numerous subjects or persons participate in the process of transporting dangerous goods. They can be divided into main and other participants, Chapter 1.4 ADR. Their roles and obligations are conditioned and connected. The beginning of the transport is with the sender and therefore the biggest responsibility. When the driver picks up the load, he must check that the conditions are met and only then can he perform the transport. In order to make the right decision, it is necessary for him to be qualified for that. The transport ends at the consignee of the cargo, where the unloader appears as a participant in the transport, who sees the fulfillment of the conditions for transport that were the obligation of all previous participants. In that case, the knowledge gained could be used to establish a safer transport system.

According to the tasks they perform in the transport process, the main participants are:

- - sender;
- - carrier (driver) and
- - recipient.
- Other participants in the transport process are:
- - packer;
- - loader;
- - filler;
- - unloader and
- - user of container-tank / portable tank.

Transport takes place in three phases: preparation of dangerous goods for transport at the sender, transport of dangerous goods and unloading of dangerous goods at the recipient or reception. The packer, loader, ie filler and user of the tank / portable tank participate in the preparation of the dangerous cargo for transport at the sender, at the carrier it is the driver, and at the consignee it is the unloader, Figure 1).



Picture 1. Participants in the transport process

By acting within the framework of its obligations and responsibilities, the sender can have the greatest impact on creating an environment for safe transport. Several persons participate in the shipment of cargo at the sender, who influence the course of the process, picture no. 1. In addition, the sender shall be responsible for the delivery of dangerous goods and shall verify that the conditions of the carrier are met.

The role of other participants in the transport process is also important, but with less complexity and conditioning by the environment.

Safe transport of dangerous goods, in order to reduce the risk of an emergency, imposes a large number of restrictions on all participants in the transport process, ie established rules and conditional procedures. The carrier must adapt to the conditions imposed by such transport, in order to protect and preserve human lives and the environment.

Drivers who drive vehicles during the transport of dangerous goods are a central component of human resources. They are independent, often without the possibility of assistance at a given time and as such represent the most important resource for the success of the transport process. Drivers, as well as other persons who may

be in the zone of potential impact of dangerous cargo during its transport, are exposed to possible occurrences of undesirable consequences, which are mainly directly affected by the driver. The importance of the role of the driver can be seen from his obligations, subsection 1.4.2.2 ADR.

Based on the transport and accompanying documentation, visual inspection of the vehicle or container, and where appropriate the cargo, the driver must ensure that:

- a) Cargo classified in accordance with ADR and that its transport is permitted;
- b) Has the appropriate documentation and information made available to him by the sender;
- c) Vehicle and cargo without visible defects, no leaks or cracks, no missing parts of vehicle equipment, etc.;
- d) The date of the next test of tank-vehicles, battery-vehicles, demountable tanks, portable tanks, tank-containers, and MEGC has not expired;
- e) That the vehicles are not overloaded;
- f) That the markings and markings on the packaging and the vehicle comply with the requirements of Chapter 5.3 of the ADR;
- g) To ensure that the equipment prescribed in the written instructions, section 5.4.3 ADR, for the transport unit, vehicle crew and certain classes, is in the vehicle

Based on the stated obligations of the driver, the complexity and responsibility of the work he performs is considered. If the driver finds that the ADR requirement has not been met, he will not start transport until the defect has been rectified. Facilitation is the ability for the driver to rely on information and data available to him from other participants, such as the sender in relation to the allegations under (a), (b) and (e).

A carrier is a company, other legal entity, entrepreneur or natural person, who, in accordance with the national legislation of the state in which its registered office or residence is located, is authorized to perform cargo transportation [2].

In accordance with the established requirements for driver jobs, the carrier as an organization must provide drivers who are competent for their work on the basis of education, training and qualifications. Checking and selecting a driver for the jobs he performs also requires checking his qualifications. In order for this to be done successfully, it is necessary to perform:

- competence checks before employment and during working life;
- training for acquiring and maintaining the necessary competencies;
- assessment of competencies;
- monitoring and periodic evaluation of the system for evaluation of driver competencies.

Records of measures taken and activities must be kept and the results obtained during the verification compared.

TRAINING AS A FACTOR OF DRIVER TRAINING FOR DANGEROUS GOODS TRANSPORTATION

The SRPS ISO 9001 standard pays significant attention to human resources, focusing on employees whose work affects the fulfillment of some of the requirements of the quality management system. As far as drivers are concerned, they are required to have education, training, knowledge and experience in the transport of dangerous goods, ie. to be trained for the work they perform.

The interrelationship of theory and practice in each individual case determines the content and character of the personification.

Training drivers for the *transport of dangerous goods* is a complex process composed of training, education and training, Picture 2, where education and training as educational processes are realized in educational institutions [7].



Picture 2. Training structure

The essence of the problem is in the optimal, not equal participation of education and training in training. When this relationship is broken, then improvements is equated only with training, or only with education. The conditionality of training with education, that is, that broader education enables training to be achieved through more intensive and shorter training, does not justify minimizing any component of training. The formal result of the training is a qualification, ie a "certificate" as an institute of social recognition of the right to perform certain tasks. The certificate is obtained in the process of verification and recognition of qualifications for a certain activity.

Training can be defined as the establishment of a system of behavior that consists of attitudes, knowledge and skills, which are required of participants in order to act adequately in order to achieve a particular task. The training has specific goals and strives to minimize individual differences.

Education of drivers for the transport of dangerous goods is an organized activity by which individuals are trained to perform dedicated tasks in the handling of dangerous goods. It is a unique process of acquiring knowledge, skills and habits and developing psycho-physical and intellectual abilities and other qualities that are necessary for efficient performance of functional duties of dangerous cargo drivers.

Successfully completed training for the result should have persons trained for the activity - jobs for which they were trained.

The quality of training can be said to be conditioned by a number of factors, such as:

- expected goal of the training (level of achieved abilities),
- qualitative preconditions of training (ability of persons in training to adopt habits and gather information, motivation of persons and training providers and training methods),
- environment-ambience of training (place and time of implementation, scope of content, price of training, etc.),
- the content of the training (durability of the acquired knowledge and the way of checking the achieved level of training),
- adequacy of the applied method of work in the training system,
- material support of training (literature, aids and other teaching aids) i
- evaluation of the achieved results by the contractor

In the training process, different training methods are applied, which depend on the ability of the training provider to solve its tasks. Using the training methods, the persons in training acquire the necessary knowledge in mastering the skills and habits necessary for performing the tasks of transporting dangerous goods.

The need for continuous training arose as a consequence of the amount of new knowledge that is increasing every day, while existing knowledge is becoming obsolete faster.

The development of a dangerous goods transport system largely depends on the ability of all participants to achieve the projected training objectives, which are determined by the needs in the transport of dangerous goods. At the same time, it is very important to connect general education with the essential study of new contents and forms that arise from newly introduced technologies.

Becoming an essential feature of the profession, training drivers to transport dangerous goods has become a task of modern education and upbringing of adults. The importance of this task grows proportionally with the speed of changes that occur in the transport process of dangerous goods.

The need for continuous training of employees in jobs in the transport of dangerous goods, and especially drivers, has become a development area of work of many institutions specializing in the training of adults through various types of training.

TRAINING OF DRIVERS FOR TRANSPORT OF DANGEROUS GOODS IN ACCORDANCE WITH ADR/

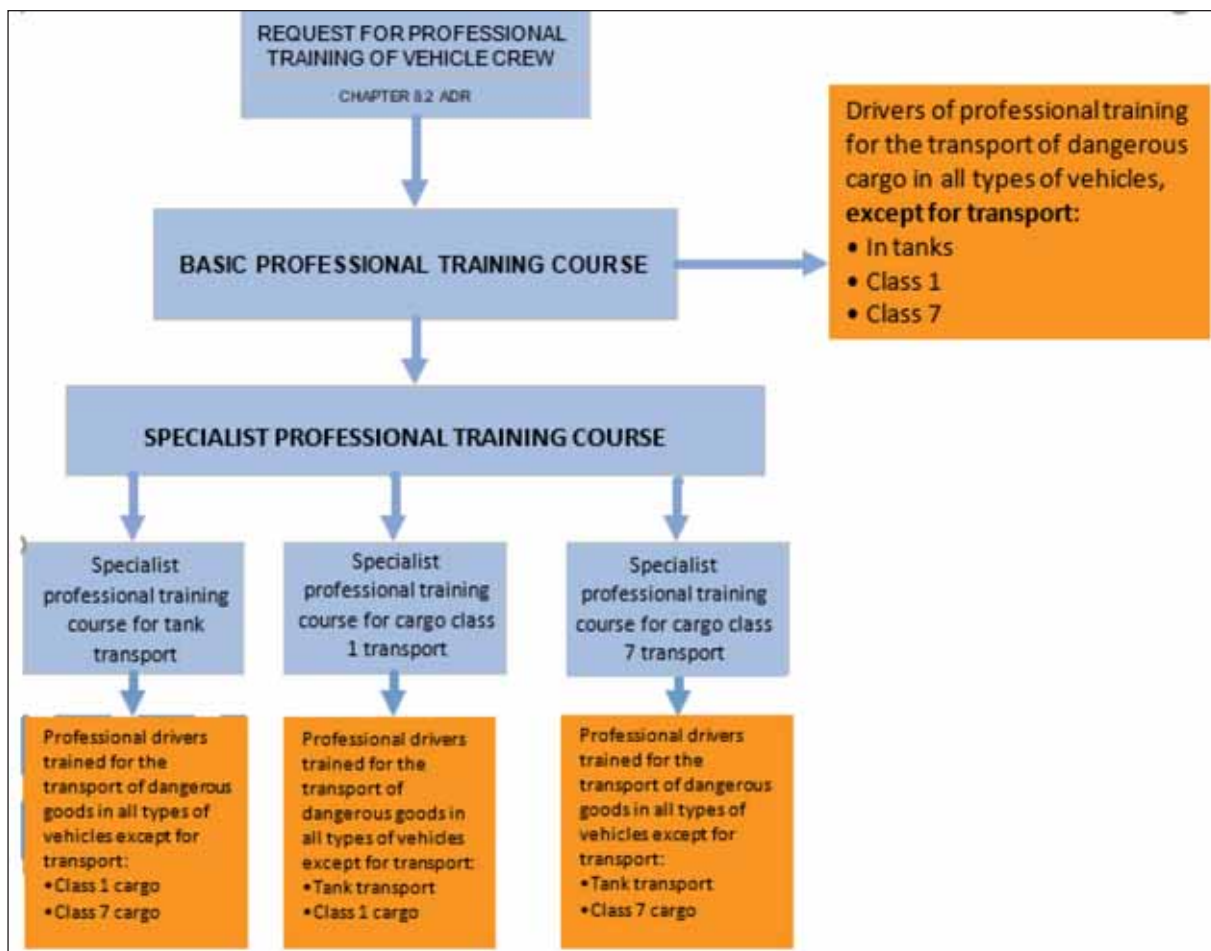
It is possible to provide an appropriate level of knowledge to all drivers who transport dangerous goods on the territory of countries that have accepted the provisions of the ADR, by adopting a unique program and content that is implemented in a certain period of time. Depending on the mode of transport and the type of cargo, different courses for drivers are defined, Chapter 8.2 of the ADR, Figure 3. All drivers must complete an initial basic vocational training course. After passing the exam and obtaining the certificate, they are able to transport dangerous goods in appropriate packaging, except for the transport of explosives and objects with explosive substances (class 1 ADR) and the transport of radioactive materials (class 7 ADR) for the transport of which it

is necessary to have a certificate exam belonging to the specialist. For transport in tanks, it is also necessary to attend and pass a specialist course for tanks. Taking the exam according to the program of the specialist course is possible after passing the exam according to the program of the basic course.

The validity of the certificate is five years. Due to the need to know the changes in ADR or national regulations as well as the need to update the acquired knowledge, the same courses can be attended as courses for knowledge renewal and take the exam in the last year of validity of the certificate. The new certificate is valid from the date of expiration of the previous certificate.

In addition to the unique type of courses that drivers for the transport of dangerous goods attend, a training program and a fund of classes for each of the courses have been determined, Picture 4. Drivers who attend the initial basic training course attend classes for 18 teaching section. The specialist course for transport in tanks lasts 12 teaching section and the specialist courses for the transport of dangerous goods of class 1 and class 7 are eight lessons each. A maximum of eight teaching section per day is allowed.

Individual practical exercises covering the topics of first aid, extinguishing a fire and measures to be taken in



Picture 3: Types of training courses for drivers transporting dangerous goods in accordance with ADR

the event of an emergency or accident must be held as part of theoretical professional training.

Drivers who attend refresher courses have the opportunity to attend a reduced number of teaching section in classes.

The training program according to the type of course includes defined teaching topics for the basic course, subsection 8.2.2.3.2 ADR, for tank transport, specialist course subsection 8.2.2.3.3, for transport of explosives and objects, class 1 ADR specialist course, subsection 8.2.2.3.4 and for the transport of radioactive materials, class 7 ADR, specialist course, subsection 8.2.2.3.5 ADR, Picture 4.

The program of the initial basic course must contain, in the narrowest scope, the following teaching topics:

- General requirements governing the transport of dangerous goods;
- Main types of hazards;
- Information on environmental protection, control of waste transport;
- Appropriate preventive and safety measures for various types of hazards;
- Post-accident procedures (first aid, road safety, basic knowledge of the use of protective equipment, etc.);
- Marking and marking of packaging and vehicles;
- Driver's actions during transport, permitted and impermissible actions;
- Purpose and manner of operation of technical equipment on vehicles;
- Prohibition of joint loading in the same vehicle or container;
- Precautions to be taken during loading or unloading of dangerous goods;
- General information on civil obligations;
- Information on multimodal transport operations;
- Handling and stacking pieces i
- Traffic restrictions in tunnels and instructions on behavior in the tunnel (prevention and safety, procedure in case of fire or other hazards, etc.);
- Awareness of the importance of security

For a simpler visual presentation of teaching topics from the training program, the graph shows six teaching areas, Picture 4:

1. General rules regarding the transport of dangerous goods;
2. Documents;
3. Vehicles, devices, equipment, marking;
4. Obligation of the driver;
5. Cargo and classification and
6. Packaging and labeling.

The training program for tank transport includes the following teaching topics, Figure 4:

1. Behavior of vehicles on the road, including movement of cargo;
2. Special requirements relating to vehicles;
3. General theoretical knowledge of different charging and discharging systems;
4. Special additional provisions applicable when using these vehicles (documents, markings, markings, etc.).

Training program for the transport of Explosives substances and substances with explosive substances, class 1 ADR, includes the following teaching topics, Figure 4:

1. 1. Special types of hazards related to explosive and pyrotechnic substances and objects;
2. 2. Special requirements for mixed cargo composed of substances and articles of Class 1.

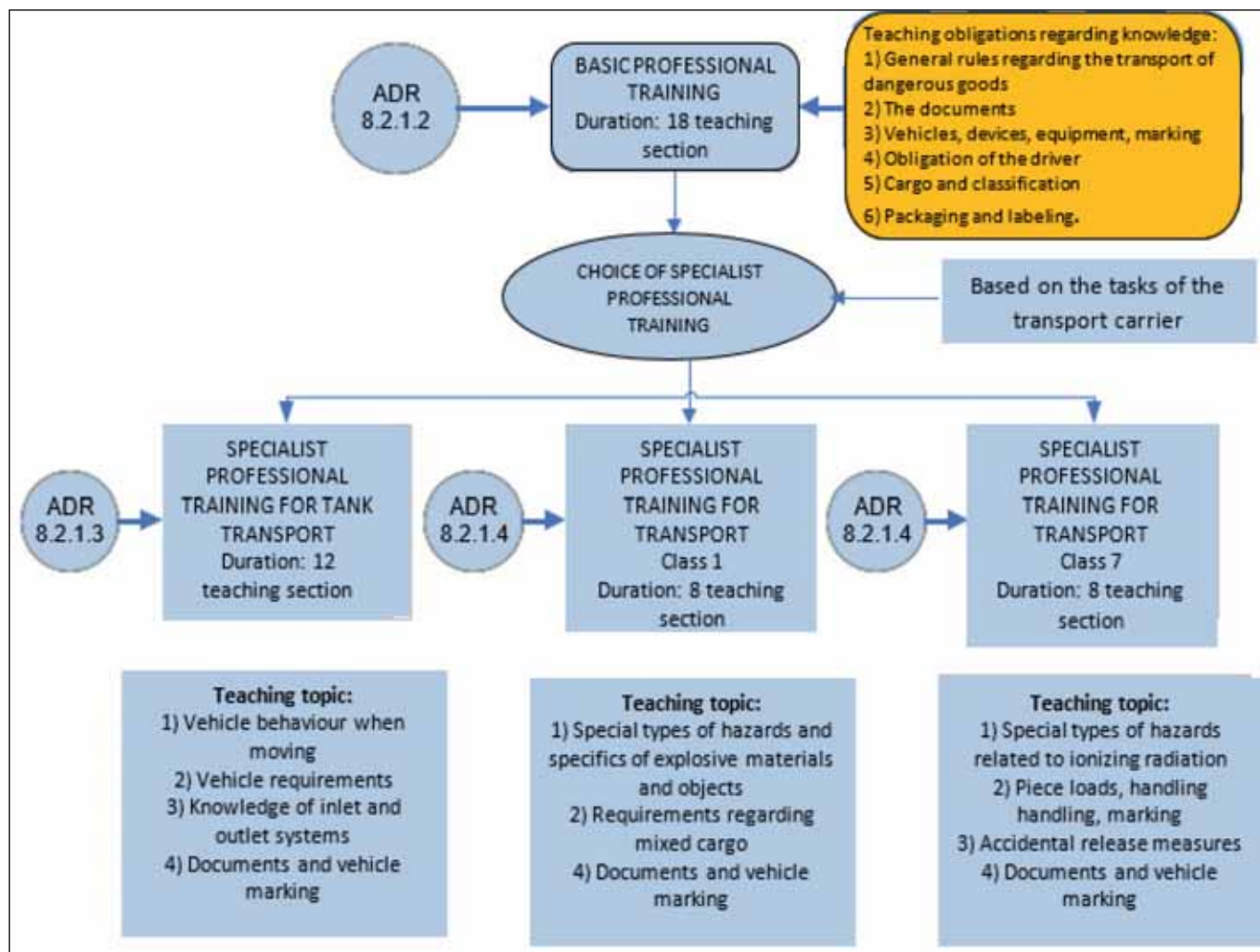
The training program for the transport of Radioactive Materials, class 7 ADR, includes the following teaching topics, Picture 4:

1. Special types of hazards related to ionizing radiation;
2. Special requirements for the commands, handling, joint loading and stacking of radioactive materials;
3. Special measures to be taken in case of accidents during transport of radioactive materials.

By defining teaching topics and classes for each of the courses, they provide conditions for the uniqueness of training in all ADR signatory countries. All certificates of professional competence which comply with the requirements of ADR and which are issued in the form defined in ADR, by the competent authority of a contracting party or another organization recognized by those authorities, must be accepted (recognized) by the competent authorities of other contracting parties, during the entire period of validity of the certificate, subsection 8.1.2.6 ADR.

Considering the above-mentioned facts about the importance of training, defined teaching topics and the duration of training, it is an extremely dangerous phenomenon that, in accordance with that, pre-established rules are not respected in all ADR signatory states. The collapse of the training system cannot pass without consequences. In the first place, there is a threat to transport safety, as well as various administrative measures that will be taken by the institutions of countries that seek to preserve the required training system or level of training of participants in the transport of dangerous goods to protect their territory and population.

In addition to the driver, there may be a co-driver and a companion in the vehicle for transporting dangerous goods. The co-driver, as a member of the vehicle



Picture 4: Vocational training program and number of teaching section for drivers transporting dangerous cargo in accordance with ADR

crew, has the same obligations and conditions as the driver. An escort is a person who for certain reasons (safety, professional competencies, loading, unloading, etc.) accompanies the cargo and is listed as a crew member. He has the appropriate training in accordance with the jobs he performs in transport. All members of the vehicle crew must have personal protective equipment, must be trained in the use of fire extinguishers and must have completed appropriate training.

CONCLUSION

The safe transport of dangerous cargos, among other influencing factors, depends to a large extent on the driver, who is a central component of the overall human resource. Drivers are expected to act correctly at all times during the transport process and thus make a full contribution to preventing the accident or reducing its consequences. All this implies their ability to act correctly, starting from the assessment of the situation to the appropriate situational response.

It is rightly expected that the carrier, ie the organization, will establish the practice of providing competent drivers for safe transport of dangerous goods who acquire their competencies in the system of education and training. In the formation of driving resources, a special place must be given to checking their qualifications, both starting with checking competence before employment, and during the working life, when trying to raise the level of qualification for the jobs they perform through various types of training. This is especially important because the tasks of drivers become more complex and demanding from year to year.

The unique driver training program and content, through various courses appropriate to the modes of transport and types of cargo, provided by the ADR is a reliable and proven framework for providing an appropriate level of knowledge to all drivers transporting dangerous goods in countries that have accepted the provisions of this international agreement. The pursuit of profit by carriers or institutions engaged in various types of training must not call into question the justifica-

tion of the established system of driver training as one of the most important participants in the transport of dangerous goods.

In addition to training drivers, very important pre-conditions for safe transport of dangerous goods are the adoption of appropriate regulations and their implementation, professional training of all other participants in the transport process for jobs within their tasks and mandatory training of institutions and services tasked with supervision and control of transport this type of cargos.

LITERATURE

- [1] Zakon o trgovini, "Sl. glasnik RS", br. 52/2019
- [2] Zakon o prevozu tereta u drumskom saobraćaju ("Sl. glasnik RS", br. 68/2015 i 41/2018)
- [3] Stanković B.; Stanojević Lj. i Berberović D.: Upravljanje rizikom od hemijskog udesa –kroz propise Republike Srbije, Institut za kvalitet radne i životne sredine 1.Maj-Niš 1996.
- [4] Sabrina Mansion: International transport of dangerous goods by road, UNECE, Geneva, 5 July 2017
- [5] Ugarak D., Stjelja Ž., Jovanović D., Petrović LJ.: Risk managing while transporting dangerous goods, XIX th INTERNATIONALSCIENTIFIC CONFERENCE »TRANSPORT 2009«, Bugarska, Sofija, 2009
- [6] ADR -European agreement concerning the international carriage of dangerous goods by road, Njujork i Ženeva, 2018.
- [7] Vilotjević M., Didaktika III, Organizacija nastave, Zavod za udžbenike i nastavna sredstva, Beograd, 1999.