Abstract: Capacity and complexity of cableways designed to carry persons are constantly growing and the cableway market, both in Europe and all over the world, is rapidly increasing, as well as the number of innovations in this field. Therefore, the cableway safety represents an actual issue constantly facing new challenges. At the EU level, a unique cableway safety system has been established in 2000 by the adoption of the Directive 2000/9/EC laying down a set of essential safety requirements, scope of application and conformity assessment which must be the same for all the EU member states, without flexibility in its transposition. All the other aspects of safety regulation are completely left to national rules leaving a lot of space to adjust the solutions to local specificities. On the other hand, we have harmonized standards in the field of cableways with detailed requirements and rules in the area of safety, whose implementation into the national legislation is however not mandatory. In March 2016, there was adopted the Regulation on Cableways 2016/424/EU which applies as of April 2018 and repeals the Directive 2000/9/EC and which defines more precisely certain segments of cableway safety and thus reduces the possibilities of inconsistency in national rules. This paper presents an overview and analysis of certain segments of cableway safety regulation. A special mention is made of the safety segments regulated by the EU legislation. Those are first of all the instruments which allow achieving higher safety, including, among others, a compulsory safety analysis, safety reports and conformity assessment of the safety components and cableway subsystems. Besides that, it mentions the fields regulated exclusively by national rules including the answer to the question whether this undermines the uniformity of the cableway safety system. Finally, the paper analyses and discusses how these segments have been regulated in the Republic of Serbia and gives possible future solutions in accordance with the EU trends.

Key words: cableways, essential safety requirements, safety analysis, safety management

1. INTRODUCTION

From the point of view of safety, it is only when a serious accident occurs that cableways designed to carry passengers attract great public attention with questions of who is responsible and what is the real cause of the accident. Generally, the main causes of cableway accidents are mechanical faults (derailments of cable, cable breakdown, etc) and external causes (wind, ice, avalanches, etc), but in many cases the cause also lies in the behaviour of passengers (imprudence, forbidden or law-breaking behaviour etc).

As illustration, we will mention only some of the larger and characteristic cableway accidents including a large number of casualties:
- 1999 France: Derailment of cabin from the bearer cable - 20 casualties;
- 2003 India: Broken cable, 3 cabins fell on the ground - 7 casualties;
- 2005 Austria: Gondola hit by a helicopter propeller - 9 casualties.

Records and statistics of emergencies on cableway installations are mandatory and available, especially of those which resulted in at least one seriously injured or dead person. However, at the moment there are no set criteria which could serve as basis for analysis illustrating how safe the cableway transport really is and which is the acceptable risk rate. For example, in railway traffic there is a generally accepted safety criterion which consists of the number of casualties by train-kilometre. When cableways are concerned, there is still no such criterion, that is, it has
not been set yet, so we cannot mutually compare emergencies in cableway transport or compare those events with other modes of passenger transport.

International meeting of national authorities in charge of cableways (ITTAB\(^1\)) is the most important international summit dedicated to the safety of cableway operation and transport. ITTAB has established a unique system of classification of emergencies according to the cause and consequences, as well as codes for their identification including the type of installation where they occurred and number of minor and serious injuries suffered by the participants, either passengers or cableway workers or third persons.

All the participating countries of ITTAB (34 countries from all around the world\(^2\)) are asked to provide data on emergencies in the previous year according to the prescribed classification of emergencies on cableways and specific traction installations before the meeting. That analysis covers the most important and most frequent problems leading to emergencies and measures taken to prevent them.

The table 1. presents cumulative data for all the members of ITTAB for 2015 regarding emergencies on cableways and specific traction installations.

*Tab. 1. Emergencies on cableways and specific traction installations for 2015*

<table>
<thead>
<tr>
<th>Ord. No</th>
<th>Type of cableway or traction installation</th>
<th>Total number of all emergencies</th>
<th>No of slightly injured persons</th>
<th>No of seriously injured persons</th>
<th>No of casualties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reversible cable cars</td>
<td>30</td>
<td>8</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Unidirectional cable cars</td>
<td>267</td>
<td>237</td>
<td>80</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Funicular railway</td>
<td>12</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Drag lift</td>
<td>69</td>
<td>68</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>Specific traction installations</td>
<td>15</td>
<td>13</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

This table shows that emergencies on unidirectional cable cars were by far the most numerous (267) which also resulted in the most harmful effects. However, the final opinion on the level of safety cannot be given without data on the work realized regarding the number of transported passengers for each of the cableways separately or the total number for one type of installation, one country or total number according to another criterion in case we provide a general analysis or estimation.

An analysis aiming at reducing the number of emergencies shall certainly include an overview of parameters to be included in standards and rules in the field of cableways in order to reduce the risk of unwanted events and confirm whether this is enough, as well as answer the question of which instruments are necessary in order to regulate safety of cableways. In order to answer all those questions, we shall first analyse the parameters affecting the safety of cableways.

2. CABLEWAY SAFETY PARAMETRS AND INSTRUMENTS USED FOR THEIR REGULATION IN THE EU RULES

From the theoretic point of view, the safety of cableways is dominantly affected by the quality of equipment and structure of cableway installations, manner of putting in place, manner and control of operation and environmental conditions.

That influence can be defined through parameters affecting safe operation of a cableway which can be divided into:

- Technical-technological,
- Operational-technical,
- Organizational and
- Parameter of environmental influence.

Technical-technological and operational-technical requirements for maintenance and exploitation are laid down by basic safety requirements in the Directive 2000/9/EC, that is, in the Regulation 2016/424/EC\(^3\) and they are applied to design, construction and placing in service of a cableway installation.

Those parameters are generally presented in the basic safety requirements and they are included, with more details, in harmonized standards of which the following represent the key standards:

- EN 1709- Safety requirements for cableway installations designed to carry persons – Pre-commissioning inspection, maintenance, operational inspection and checks
- EN 1908 - Safety requirements for cableway installations designed to carry persons – Tensioning devices
- EN 1909 - Safety requirements for cableway installations designed to carry persons – Recovery and evacuation

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1 International Meeting of Technical Authorities for Cableways
2 Republic of Serbia become participant of ITTAB in 2016.
3 Regulation 2016/424/EC entered into force on 21.4.2018 and repealed the Directive 2000/9/EC, but national rules of the EU member states are at the moment still mostly harmonized with the repealed Directive 2000/9/EC
- EN 12397 - Safety requirements for cableway installations designed to carry persons - Operation
- EN 12927-1 to EN 12927-8 - Safety requirements for cableway installations designed to carry persons - All requirements for cables
- EN 12929-1 - Safety requirements for cableway installations designed to carry persons - Part 1: Requirements for all installations
- EN 12930 - Safety requirements for cableway installations designed to carry persons - Calculations
- EN 13107 - Safety requirements for cableway installations designed to carry persons – Civil engineering works
- EN 13223 - Safety requirements for cableway installations designed to carry persons – Drive systems and other mechanical equipment
- EN 13243 - Safety requirements for cableway installations designed to carry persons – Electrical equipment other than for drive system
- EN 13796-1 to EN 13796-3 - Safety requirements for cableway installations designed to carry persons - Vehicles

The Regulation 2016/424/EC also prescribes the manner of proving the conformity of safety components and cableway subsystems with the basic safety requirements through conformity assessment. The conformity assessment is carried out before placing parts of a system on the market by a designated body for conformity assessment and each cableway safety component and subsystem placed on the market must bear a conformity designation and conformity documents, which are made mandatory for manufacturer, distributor and importer by these rules and which guarantee the safety of components installed on new cableways.

Moreover, there is an additional instrument of EU legislation related to the regulation of these two parameters consisting of safety report and safety analysis which shall be drafted within the design of a cableway installation and attached to the main design.

Namely, safety analysis is realized according to one of the recognized methods of risk assessment taking into account the environmental conditions and the most inconvenient circumstances. The analysis contains a list of risk factors and dangerous situations. The result of this analysis must be provided in form of a safety report including a list of measures for overcoming of all risk factors.

Regarding the parameter of environmental influence the following effects are taken into account:
- wind (causes inadmissible lateral movements of vehicles, derailment of cable, etc)
- ice (ice formed on the cable or other parts of the structure can cause many problems),
- temperature (the design of cableways must take into account extreme values of the outside temperature),
- geological-climate conditions (watercourses, landslides, soil erosion and avalanches)
- earthquake and
- fire.

These effects are partially included in the basic safety requirements, that is, harmonized standards, and safety analysis, but not completely. That is why some of the EU member states study and treat each of those effects as separate scientific units, especially avalanches as one of the most unpredictable and complicated effects concerning safety.

3. PARAMETERS AND SEGMENTS AFFECTING THE SAFETY OF CABLEWAYS WHICH ARE REGULATED ONLY BY NATIONAL RULES

Parameters related to the organizational structure of cableway manager, competences of managers and professional qualifications of the executive staff, internal control, possession of the appropriate documents (instruction manuals, maintenance manuals, evacuation manuals, etc) and defined feedback procedures, are not prescribed by the EU legislation. They are completely regulated by national rules or acts drafted by cableway manager, that is why this cableway rules are not uniform. The same goes for the administrative framework, that is, institutions drafting cableway rules, issuing authorisations for cableway operation and supervision of cableway operation.

Rules related to the authorisations for operation and supervision of cableways, professional competence of executive staff and expert-technical inspection of cableways, which represent mandatory segments within the regulation of this field, are also given over to national legislation. Although in the EU there are no uniform rules related to these fields, in practice, this uniformity is reflected in the establishment of cableway institutions which the most usually belong to the railway sector and are also in charge of drafting cableway rules. There is also a uniform approach regarding the issuance of authorisations for operation of cableway installations, as well as the elements related to the expert inspection of cableways. The part related to professional competences and training is usually regulated by acts drafted by cableway managers.

The practice has shown that all the institutional and legal instruments of safety control of cableways are indispensable, but not sufficient when we are talking about safety, since legislation cannot anticipate all the safety risks. That is why in a certain number of EU countries there is a trend of introducing Safety Management System (SMS) in national legislation related to cableways, with France as the leading
country introducing gradually a mandatory SMS for cableway managers.

Safety Management System (SMS) in the field of cableways represents a systematic application of management policies and procedures to the activities related to risks, that is, represents organisation and measures established by cableway managers in order to guarantee safe management of their activities. Since obligatory character and manner of application of SMS have not been laid down by the EU cableway legislation, as prescribed for the railway sector, although cableways belong to this sector, at the moment its application represents quite a challenge for national legislations.

4. REGULATION OF SAFE OPERATION OF CABLEWAYS IN THE REPUBLIC OF SERBIA AND POSSIBLE SCENARIO FOR FUTURE SOLUTIONS

In the Republic of Serbia, by the adoption of the Law on Cableways Designed to Carry Persons in 2015, our legislation was harmonized with the EU legislation in the field of cableways and the Action Plan for the harmonized field - (Chapter I – Free movement of goods) provided for the competent ministry to adopt a new Law on Cableways in the fourth quarter of 2019, which will be completely harmonized with the Regulation 2016/424/EC. This harmonization will not require essential changes comparing to the applicable law.

Therefore, the applicable law and its by-laws include all the parameters affecting safety of cableways laid down by the EU legislation. Moreover, national legislation includes all the mandatory segments related to the regulation of this field which have been prescribed according to the examples of best practice from the countries with rather rigorous safety controls and requirements (for example, more frequent expert-technical inspections of cableways). The reason why such an approach has been chosen is because until now this field has not been legally and institutionally regulated and therefore the role of the state must be stronger in the initial period.

The implementation of cableway rules is expected shortly in the Republic of Serbia. The practice will soon show all the positive and negative sides of this approach according to which the rules regulating this field will be corrected.

Moreover, the following period will require a discussion on the necessity to introduce a mandatory SMS for cableway managers and the manner of its implementation.

REFERENCES

[3] ITTAB, Instructions referring to the compilation of the ITTAB statistical data of incidents and accidents with ITTAB codes, Catania, 2016