ABSTRACT

With the entry into force of the EU-Directive “on minimum safety requirements for tunnels in the Trans-European Road Network” an important step towards the aim of reaching a harmonization of safety requirements for European road tunnels has been made. This directive defines – among other things – the aims which have to be pursued in order to ensure higher safety standards. Uniform organisational structures in all member states shall ensure that the measures indicated in the Directive are translated into practice and shall also assess the conformity of each individual tunnel with safety standards on the basis of a safety documentation. The safety measures which have to be taken are given in Annex I of the Directive. Several of the mentioned parameters differentiate between tunnel in design stage and tunnels already in operation as well as between various traffic volumes. Additionally, uniform traffic and information signs shall ensure that in case of danger or break downs escape routes and emergency stations can be found easily by tunnel users.

1. INTRODUCTION

The disasters which occurred in 1999 and the following years have led to far-reaching changes as far as dealing with questions of safety in road tunnels is concerned. Because of the intensive public discussion of the above mentioned events nowadays these issues are subjects of great political interest whereas in earlier times they were left up mainly to experts. As a result, the importance of aiming at a harmonization of measures to improve tunnel safety has been recognised and has led to a revision of national guidelines as well as to the drawing up of national rules and international regulations and guidelines. At first, on European recommendation a group of experts has been established within the frame of the economic commission of the UNO (UN/ECE). The experts of this group have worked out a programme of measures to improve tunnel safety which was published in December 2001. But the Directive of the European Parliament and of the Council on minimum safety requirements for tunnels in the Trans-European Road Network has a far more binding character. In December 2002 the European Commission presented a first draft of this Directive which in the meantime has been discussed in the European Parliament and Council so that the Directive probably will enter into force in spring 2004.

Furthermore, a series of other initiatives consisting in new guidelines, European research programmes and thematic networks have been taken in various European countries.

2. AIMS OF THE DIRECTIVE

The European Union considers it to be its task to ensure a high, standardized and constant level of safety on the Trans-European Road Network. Tunnels of over 500 m in length are considered important structures which facilitate communication between large areas of Europe and play a decisive role in the functioning and development of regional economies. Therefore the Directive includes minimum safety requirements for tunnel users which are aimed at
• preventing events that may endanger human life, the environment and tunnel installations.
• reducing the consequences of incidents and fires. To achieve this objective the measures which have to be taken shall
  o enable people involved in incidents to rescue themselves
  o allow immediate intervention of road users to prevent greater consequences
  o ensure efficient action by emergency services and
  o limit material damage.

3. ORGANISATIONAL STRUCTURE

The Directive has to be applied on tunnels being in design, construction or operating stage which are longer than 500 m and are situated on the Trans-European Road Network. Each member state has to convert the regulations of this Directive within 24 months after its entry into force into national rules (law). In order to reach this aim, every single member state shall designate an Administrative Authority which shall present a link to the European Commission. This Administrative Authority shall ensure that all safety conditions are met and therefore shall have the power to suspend or restrict the operation of a tunnel. Additionally, it shall ensure that tunnels are tested and inspected on a regular basis and organise the training and equipping of emergency services.

The Administrative Authority shall identify as tunnel manager the public or private body responsible for the safety of a tunnel under all aspects whether it is in the design, construction or operating stage. Furthermore, every significant incident or accident occurring in a tunnel shall be the subject of a report prepared by the tunnel manager which shall be forwarded to the Administrative Authority.

Finally, every two years each member state shall compile reports on fires and accidents occurring in a tunnel, analyse and evaluate them in terms of effectiveness of safety facilities and measures, and transmit the reports to the European Commission. In order to exchange experiences these reports shall be available for all member states.

Furthermore, the tunnel manager shall nominate for each tunnel one Safety Officer who shall coordinate all preventive and safeguard measures. The Safety Officer shall take part in the definition of safety schemes and the specification of structure, equipment and operation in respect of both new tunnels and modifications to existing tunnels and shall also be responsible for maintenance and repairing of the tunnel installations. In addition to that, the Safety Officer shall ensure the coordination with emergency services and take part in the preparation of operational schemes. Moreover, he shall verify that operational staff and emergency services are trained and take part in the organisation of exercises.

Inspections, evaluations and tests shall be carried out by Inspection Entities which must be functionally independent from the Tunnel Manager.

4. PROCEDURES FOR APPROVAL AND COMMISSIONING OF A TUNNEL

An important new aspect of the Directive of the European Union is represented by the regulation that all tunnels which fall within its scope have to be assessed in terms of safety in every stage by exactly defined procedures which are given in Annex II of the Directive. The fundamental basis in every stage is the safety documentation of the respective tunnel which has to be compiled and continuously updated by the tunnel manager.
The safety documentation for a tunnel in the design stage shall include
- a technical description of the planned structure
- a description of preventive and safety measures for tunnel users with respect of people with reduced mobility and disabled people
- a traffic forecast study specifying and justifying the conditions expected for the transport of dangerous goods, together with a risk analysis
- a specific hazard investigation which specify and substantiate measures for reducing the likelihood of accidents and their consequences
- an opinion on safety from an expert not involved
- a description of the organisational structure in terms of operation and maintenance of a tunnel
- an emergency response plan which also shall take into account people with reduced mobility and disabled people
- a description of the system of permanent feedback of experience through which significant incidents and accidents can be recorded and analysed

The safety documentation of tunnels already in operation shall additionally include
- a report and analysis on significant incidents and accidents
- a list of the safety exercises carried out and an analysis of the lessons learned from them

The above mentioned safety documentation for a tunnel in design stage shall be submitted to the appropriate authority before the construction of the tunnel begins. As far as tunnels in construction stage are concerned, on the basis of the safety documentation the Administrative Authority shall assess the tunnel in terms of its conformity with the requirements of the Directive. Tunnels already in operation are assessed on the basis of the safety documentation and of an inspection in terms of their conformity with the requirements of the Directive. In Austria the documentation of the design and the facilities of a tunnel can be compiled on the basis of an already existing data bank which will have to be adapted in an appropriate way.

The assessment of all tunnels already in operation must be carried out by the Administrative Authority within 30 months after the entry into force of the Directive. If necessary, the tunnel manager shall draw schemes for modifying the tunnel in order to fulfil the regulations of the Directive.

Every member state shall present a report including the schemes of all necessary modifications within 36 months after the entry into force of the Directive.

The inspection entity shall carry out inspections at regular intervals of at most 6 years in order to ensure a standard of tunnel safety corresponding to the Directive of the European Union.

5. RISK ANALYSIS

The risk analysis represents a special issue of the Directive of the European Union. It is on the one hand an obligatory part of the safety documentation of a tunnel but on the other hand the method to carry out the risk analysis is not defined and each member state is required to work out on national level a precise and clearly defined procedure and to revise it within the following five years with the aim of reaching agreement with the other member states of the European Union.

The risk analysis shall include all aspects of the system consisting of infrastructure, operation, users and cars. All parameters relevant in this respect are defined in Annex I of the Directive; they range from the length to the geographical and meteorological conditions of a tunnel.
In Austria the already existing Austrian Guideline Code for the Planning, Construction and Maintenance of Roads (RVS) with regard to ventilation systems and operating and safety facilities in tunnels includes a risk analysis which on the basis of four parameters analyses the risk potential and the safety coefficient of a given tunnel. The procedure of assessment shall be re-examined and redefined taking into account the latest recognitions. The RVS shall include also in future a more simplified method of assessment.

In order to evaluate the existing risks in Austrian road tunnels and to analyse the effectiveness of each individual measure a quantitative risk analysis is being worked out. Its main emphasis is laid on the relative comparison of the risks existing in tunnels of various configurations and frame conditions. In order to evaluate the extent of damages the most frequent accidents and incidents are analysed. To evaluate the existing risk of accidents involving dangerous goods transports the QRA-method regarding the transport of dangerous goods worked out on the basis of the OECD/PIARC study shall be applied.

6. SAFETY MEASURES

The safety measures corresponding to the minimum requirements of tunnel safety are indicated in Annex I of the Directive. They mainly regard infrastructure and operation of a tunnel. Important measures regarding vehicles and driving lessons for tunnel users - as defined in the report of the group of experts of the UN/ECE - shall be regulated on the basis of other EU-Directives. In Austria in this regard several initiatives have already been taken (informative material, revision of documents used in driving schools etc).

The requirements mentioned in Annex I are subdivided in requirements regarding measures of construction and requirements regarding operating and safety facilities such as ventilation systems, lighting, surveillance systems, communication systems and fire resistance of operating facilities. Since several measures - above all those regarding construction - show a negative benefit-cost relation and some modifications cannot be carried out in a tunnel already built, e.g. diminishing a too high longitudinal gradient of a tunnel, the Directive differentiates between tunnels being designed and tunnels already in operation.

Furthermore, the Directive may accept the implementation of risk reduction measures as an alternative to the requirements laid down in Annex I provided that the alternative measures will result in equivalent or improved protection. The efficiency of these measures shall be demonstrated through a risk analysis.

Most part of the individual regulations governing the implementation of constructional measures to improve infrastructure are exactly defined. They range from laying down the degree of prognosticated traffic volume which in case it is exceeded requires the construction of two tubes to regulations regarding tunnel drainage in case of dangerous goods transports. As far as safety facilities are concerned all relevant components are mentioned but the technical specifications in this regard are only a few e.g. minimum required waste air exhaustion or luminance. These specifications have to be laid down in the respective national guideline codes (standards). However, in future the effectiveness of the individual measures will have to be analysed and assessed in a more detailed way.

Austria has taken part actively at the Consultations about the Directive of the European Union. Therefore, most part of the Austrian guidelines already correspond to the regulations defined in Annex I or have even set higher standards, e.g. regarding electrical equipment.
7. SIGNING FOR TUNNELS

The Commission of the European Union is particularly interested in the harmonization of signs and symbols used in a tunnel, especially as far as forms and colours characteristic of individual classes of signs are concerned. In Annex III all member states are required to indicate escape routes using the sign for emergency exits corresponding to the Vienna Convention, and to indicate the two nearest emergency exits and the respective distances. The emergency stations and lay-bys shall be indicated by uniform signs, too.

8. CONCLUSION

On the basis of the experiences made because of the tunnel disasters occurred in the last few years in Europe activities in order to harmonize directives and regulations regarding safety of road tunnels have increased. In this context the publications of the PIARC working group which form also the basis of many national regulations have to be mentioned in particular. Another important step in this regard has been made by the group of experts of the UN/ECE publishing its report on measures to improve tunnel safety.

But the most important contribution to reach the aim of harmonization is represented by the recently published Directive of the European Parliament and of the Council on minimum safety requirements for tunnels in the Trans-European Road Network. This Directive makes clear that tunnel safety can be defined only considering the entirety of many aspects which are connected with each other. Above all, the long tunnels situated in the alpine member states have to be dealt with applying specific requirements and measures which have been laid down in the Directive of the European Council and have been realized in collaboration with the member states involved. As far as Austrian standards are concerned, it has to be emphasized that they already correspond to a high level so that the translating into practice of measures regarding infrastructure will not be a problem. The structural reorganisation and the related points of view yet call for continuing with detailed work. However, in view of the important aim to increase tunnel safety for all users this should only be another incentive to go on.