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Ad hoc Multidisciplinary Group of Experts
on Safety in Tunnels (rail)

REPORT OF THE AD HOC MULTIDISCIPLINARY GROUP OF EXPERTS ON SAFETY IN TUNNELS (RAIL) ON ITS SECOND SESSION (25-26 November 2002)

ATTENDANCE

1. The Ad hoc Multidisciplinary Group of Experts on Safety in Tunnels (rail) held its second session in Geneva on 25 and 26 November 2002. Representatives of the following UNECE member countries participated: Austria; Finland, France, Germany, Italy, Monaco, Netherlands, Russian Federation, Slovakia, Switzerland, and the United Kingdom. The International Union of Railways (UIC) and the UNECE Trans-European Railways Project Manager also participated. At the invitation of the secretariat, a representative of Eurotunnel also attended.

ADOPTION OF THE AGENDA

Documentation: TRANS/AC.9/3.

2. The agenda was adopted without change.

ELECTION OF OFFICERS

3. Mr. G. Fudger (United Kingdom) was the Chairman and Mr. K.-J. Bieger (Germany) the Vice-Chairman of the session.

RESULTS OF THE QUESTIONNAIRE ON SAFETY IN RAIL TUNNELS

Documentation: TRANS/AC.9/2002/4; TRANS/AC.9/2002/5; TRANS/AC.9/2002/6; TRANS/AC.9/2002/7; TRANS/AC.9/2002/8; TRANS/AC.9/2002/9; TRANS/AC.9/2002/10; TRANS/AC.9/2002/11; TRANS/AC.9/2002/12; TRANS/AC.9/2002/13; TRANS/AC.9/2002/14; TRANS/AC.9/2002/15; TRANS/AC.9/2002/16, and Informal document No. 18.

4. The Ad hoc Group reviewed replies to the questionnaire on safety in rail tunnels circulated to member Governments and the summary document prepared by the secretariat (Informal document No. 18). It was noted that, although national legislation regulating safety in rail tunnels exists in many countries, there is a need for harmonization of many elements of railway safety in tunnels when considering international railway transport. The review of existing legislation as well as plans for future revisions and other information contained in replies, could be used by member countries as the reference documentation in future work on development of safety provisions for railway tunnels at the international level.

REVIEW OF DOCUMENTATION REGARDING SAFETY IN TUNNELS

Documentation: Informal Documents No. 8–17.

5. The Group noted that member Governments provided a large amount of documentation referring to safety in rail tunnels which could be used by other member countries wishing to further develop their own national regulations and standards or by interested parties aspiring to get a deeper insight into the range of issues related to various aspects of safety in rail tunnels. The Group also appreciated that contributed documentation would be made available at the UNECE Internet site. The Group also noted that, even though safety is regulated at national level and national authorities define the legislation governing safety rules, interoperability aspects must also be considered at the international level. In drafting its recommendations, the Group will therefore take into account both the limitations imposed by national regulations and the variety of practical approaches to the security among member countries, as well as the need to establish a certain degree of harmonization of safety measures, including interoperability, in an international context.

CONTINUATION OF DISCUSSION ON SPECIFICC TUNNEL SAFETY ISSUES

Documentation: TRANS/AC.9/2/Add.1.

6. The focus of the Group's discussion was the UIC document - Report on Safety in Railway Tunnels. The representative of the UIC informed the Group that, since its last meeting, the amended version was prepared as the Draft of the UIC leaflet on Safety in Railway Tunnels. He further asked the secretariat to distribute the new version to all Group members. Bearing in mind that only the introductory part in two versions was modified, the Group decided to consider the text as circulated in document TRANS/AC.9/2/Add.1.

7. The Group agreed that, when considering safety in rail tunnels, all issues related to infrastructure, rolling stock and operations must be considered together. The Group further agreed on the general principle and related actions based on the four elements: prevention of

accidents, mitigation of the impact of accidents, facilitation of escape and facilitation of rescue. This approach will ensure that all aspects of safety in rail tunnels are dealt with appropriately.

8. The Group discussed at some length the scope of recommendations, including the issue of the length of tunnel, the type of traffic (high speed – conventional, passenger, freight, mixed), and implications of each of these considerations for safety measures in various types of tunnels (single bore – single track, single bore - double track). The group agreed that its recommendations will refer to new tunnels longer than 1,000 metres. For old/existing tunnels and tunnels longer than 15 kilometres, specific and additional safety measures might be necessary and they will be referred to when and if appropriate. The recommendations of the Group will consider only railway tunnels on the open tracks and will not consider underwater tunnels, Alpine tunnels, underground platforms, underground railways/subways and tunnels in urban areas.

9. The Group unanimously agreed with a general recommendation that, in case of fire on board of a train passing through a tunnel, the first preference of the train driver must be to get the train out of a tunnel and stop it in an optimal position to allow the self-evacuation of passengers and easier access to emergency and rescue services. With the new European regulations on fire resistance for railway passenger wagons, application of this recommendation could be carried out relatively easily. Deriving from this recommendation, the Group further felt that safety measures for tunnels regardless of their length should be given special considerations in cases where the rolling stock is not of the most modern type.

10. The Group also noted that the Technical Specifications for Interoperability (TSI) for High Speed lines have already been published by the European Commission, and that TSI for conventional rail will be drafted by the newly established European Association for Railway Interoperability (AEFI). As defined by the EU Directive 16/2001, the TSIs are mandatory specifications and they will cover, among other elements of railway transport, infrastructure, rolling stock, operations and installations.

11. After a preliminary discussion, the Group then moved on to review and discuss each of the safety measures as proposed by the UIC draft document.

Infrastructure

<u>Prevention of incidents</u>

- Speed monitoring/signalling system (I-1)
- Train radio: operations centre – train crew – passengers (I-2)
- Train detection (axle counter, track circuit) (I-3)
- Train control equipment (blocked brake, hot boxes) (I-4)
- Arrangement of switches (I-5)
- Track inspection (I-6)
- Access control (security) (I-7)
- Inspection of tunnel condition (I-8)

12. The Group agreed that all these measures should give positive safety, although technical ways for particular control measures may differ from one country to another. Speed monitoring of the locomotive or speed checking sections on the train, by radar ahead of signals using signal-based safety controls, should prevent trains from overrunning a stop signal and exceeding the maximum speed. The signalling system should be radio-based and protect trains by preventing collisions caused by driver's errors or derailments caused by exceeding speed limits. A train radio is highly recommended as a particularly effective device since it provides a communication channel between the operations centre, train crew and passengers. It should include both fixed installations in tunnels and equipment on board trains.

13. Tracking the status of the train before entering the tunnels, although not specific to tunnels only, is recommended as a standard measure. Train detection information, obtained through either axle counters or track circuits, together with the information on the position of the train in the tunnel should be made available to the operations centre in order to prevent collisions or to prevent movements of trains into occupied track sections. Other types of train detection before entering the tunnel, such as thermo checking, effectuated by scanning of the particular control points on the train engine and rolling stock for occurrence of heat out of the permissible range, are also recommended as a preventive measure that could indicate possible fire danger.

14. Appropriate train control equipment (blocked brake, hot boxes), although equally important on open stretches of lines, is particularly important for sections with many tunnels. Fixed line side temperature sensors for the detection of hot axles and wheels prevent fire caused by overheating and derailments due to broken wheels and axles. As noted, there are less and less railway staff available along lines to check passing trains visually so the importance of technical detection equipment is becoming more important.

15. Installation of switches should, whenever possible, be avoided in tunnels and on the approach to tunnel entrances, thus reducing the danger of accidents in tunnels due to derailments or collisions. Systematic track condition monitoring is highly recommended as it reduces track defects as a cause for accidents.

16. The Group agreed that both control of access to tunnels, i.e. prevention of unauthorized access to the tunnel portals or exits, and regular inspection of tunnel conditions represents standard measures in respect not only to safety but also to security of traffic in tunnels. If carried out systematically and thoroughly, at tunnel entrances, emergency exits, technical buildings at entrances, rescue areas and access roads, both measures reduce risks and increase safety in tunnels.

Reduction of effects

- Double-bore single-track tunnels (I-20)
- Cross section of double-track tubes (I-21)
- Fire protection requirements for structures (I-22)
- Fire, smoke and gas detection in tunnels (I-23)
- Fire extinguishing systems (sprinkler or similar installations) (I-24)
- Smoke extraction systems/ventilation system (I-25)
- Track drainage system (drainage and retaining basin)

17. The Group noted that, in addition to cost aspects, both single-tube double-track and double-tube single-track tunnels have their advantages and disadvantages in terms of safety. Single-bore double-track tunnels are generally cheaper to construct than double-bore tunnels. Single-tube single-track tunnels might be safer as they avoid accidents caused by derailments obstructing the adjacent track and they provide the second tube as a safe place. On the other hand, double-track tunnels have more space not only for an eventual rescue operation but also more space for smoke and fire spreading. For high-speed trains, double-track tubes might be preferable and for mixed traffic, taking into account aerodynamic factors, a single tube single track might be more convenient. The choice should be the result of a thorough evaluation of all parameters.

18. Double-track tunnels should have a sufficiently large diameter so that, when two trains are passing, hazardous pressure transients do not occur. The definition of cross sections of double track tunnels needs to take into account such elements as: train speed and type of traffic, aerodynamic aspects, geology of terrain and construction method, space for escape routes and construction costs. The cross sections should be sufficiently large as they, among other advantages, reduce possible interaction related to the aerodynamic effects, enable larger walkways, reduce the possible collision in the event of a derailment, etc.

19. Fire protection requirements for structures in rescue stations and safe places represent an important element of higher safety in tunnels. Similar fireproof standards for tunnel structures need to exist in all countries. They need to be based on temperature curve, type of construction material used and related to the nature of structures (with people or without). Tunnels should have such fireproof features that would allow sufficient time for rescue and evacuation operations. Certain fireproofing materials may bring their problems, i.e. limited life, need for costly replacement and renovation, and may have faults that may damage trains. The temperature curve should be commonly used to assess the fire resistance of concrete and other structures in tunnels and specified fire-resistance material, capable of sustaining specific fire and temperature maximums for a specified time, should already be used in the construction phase.

20. Fire, smoke and gas detectors in tunnels enable a rapid location of fire in the ignition phase. Available technology allows fast and reliable detection of visible fire and smoke but problems might be created with false alarms caused by ambient or brake dust, sea mist, etc. The difference is made between location of these detectors in the main tunnel and technical rooms. While installation of fire, smoke and gas detectors might not be required as a standard measure in all tunnels (relatively low frequent traffic), it is highly recommended in all technical rooms as it could alert technical crew to quickly leave. Gas detectors are recommended for tunnels with a low point in the tunnel (u-shaped) and if gas could enter the tunnel from surroundings. A view was expressed that fire and smoke detectors installed on rolling stock and locomotives themselves might be more effective than those installed in tunnels. On-train detectors signal to the train crew the presence of the potential fire risk, and in combination with radio communication, allow the crew to transmit this information to the operations centre. This solution, however, may require special training for the train crew.

21. The type of fire extinguishing systems, for both main tunnel and technical rooms should be determined depending on the potential causes of fire. An automatic-triggered fire extinguishing system might be less reliable, due to potential malfunctions or false alarms, and

they are not recommended for main tunnels but are recommended for technical rooms with highly sensitive technical installations.

22. Depending on the type of tunnel, there exist a variety of smoke extraction/ventilation systems. However, if the natural airflow in the main tunnel is sufficiently strong, it would guarantee one smoke-free side where people would be safe and rescue operations can take place, and therefore installation of smoke extraction/ventilation systems might not be necessary. Ventilation and smoke extraction might be useful or essential in providing access to a safe haven. Smoke extraction in specific places in the main tunnel (double-track/double-tube single-track and passages between double-tube single-track tubes) could prevent smoke spreading into sections defined as safe parts and reduce the likelihood of smoke reaching other trains. Smoke extraction and ventilation systems must be designed in such ways (produce overpressure) to keep emergency exits, cross passages or a parallel safety tunnel free of smoke and might need to be installed in these safe places.

23. A track drainage system is an important safety feature provided that it has appropriate dimensions and retaining basins. The system facilitates extraction of snow or rain water brought into the tunnel by trains, spills, water from the fire fighting, but also could retain polluted extinguishing water or run out of dangerous goods if there is transportation of dangerous goods, and thus it has an additional role to reduce the environmental damage at tunnel portals. It may not be an essential measure for tunnels only reserved for passenger traffic, while it is highly recommended for tunnels used for freight traffic, especially if dangerous goods are often transported.

Facilitation of escape

- Escape routes (routes, handrails, marking) (I-40)
- Emergency tunnel lighting (I-41)
- Emergency telephones/communication means (I-42)
- Escape distances (I-43)
- Vertical exits/access (I-44)
- Lateral exits/accesses (I-45)
- Cross passages (I-46)
- Parallel service and safety tunnel (I-47)

24. After noting that self-rescue practice and rescue procedures are different from one country to another, the Group noted that those had to be streamlined at the international level and continued discussing the possibilities of having more standardized measures for facilitation of escape. It was also noted that passengers need to be properly instructed in advance how to behave in case of accident or fire in the tunnel because the crew might not be available (high-speed trains have fewer crew available on board than conventional trains). All rail operators must therefore plan methods for instructing passengers on procedures in emergency situations. These plans need to be discussed with fire brigades and other rescue services involved in rescue operations, as different standards may need to be applied to different networks (high-speed, freight, etc.). These plans also need to be integrated in railway operators' operating procedures as well.

25. Escape routes are essential for allowing easier and faster self-rescue. They have to be planned in the construction phase, equipped with handrails at an appropriate height, properly lit and should be marked with standard signs (pictograms). In double track tunnels, it is recommended to have escape routes on both sides of the tunnel. The cross section in new tunnels could also be used as an escape route. While the height of the walkway depends on the specific tunnel situation, it is recommended that the minimum width in new tunnels should be larger than 70 cm and preferably 1.20 metres. If there are only freight trains, escape routes might not be absolutely necessary as in tunnels with mixed or passenger traffic. Emergency tunnel lighting, on one or both sides of the tunnel, reliable and operating under autonomous conditions, visible under smoke and other poor visibility conditions, is highly recommended especially in tunnels used by passenger trains.

26. Emergency telephones should always be at key points in tunnels – cross passages, on escape routes, shafts and should be able to work in a specific tunnel environment with a potentially high noise and not very well lit. Therefore, they should ideally be placed in an enclosed space, sound hood, where the noise could not affect conversation. The telephones should be linked to an emergency centre, railway operations centre, which could alert and stop oncoming trains and should not be linked directly to fire or other rescue service. Some members of the Group thought that, given the presence of a direct radio link between the train and operations centre and a growing number of mobile telephones used by the public and able to operate in tunnels, emergency telephones might be on the far end of safety measures.

27. It was also mentioned that emergency telephones should never be located at the entrance of the tunnel, as this location should primarily be used for managing and coordinating rescue operations. Also, it was noted that only staff should be allowed to operate emergency telephones and not passengers themselves, as the staff are trained and know how to operate them. Managing communications in case of emergency is vital for quick and efficient rescue operations. An increased flow of information, with radio, mobile, regular emergency and ordinary telephones in case of accident multiplies the workload and could impede the efficiency of the staff in control and operations centres. Therefore, management of communications in such situations has to be set up, planned and practiced in advance.

28. The distance between escape exits still differs in practice from one country to another. The determination of the maximum and safe escape distances is connected, among other elements, with the type of rolling stock, topography of the tunnel, length and type of the tunnel and other aspects. A maximum distance between two safe places (portal of the tunnel, cross passage, emergency exit) will be defined in such a way that it enables easy and quick self-rescue. However, the exact distance varies depending on the local situation, operating parameters and the safety concept. In double-tube single-track tunnels and parallel safety tunnels, this distance could be set at 500 metres. Bearing in mind cost-effectiveness criteria, it is advisable to use cross passages between two parallel tubes rather than exits to the surface. In addition, following the same criteria, construction shafts and places close to the surface should be used for emergency exits. In any case, a maximum distance between escape exits should not be longer than 1,000 metres.

29. The effectiveness of emergency exits focuses on fire scenarios and the ability of reaching a safe place in the event of fire. However, even with short distances to safe places, consequences cannot always be reduced to zero. The distance between safe places in the tunnel is also a

function of the expected situation such as a smoke spread and the need and possibility for rapid displacement and evacuation. Short escape distances normally ensure rapid escape in the event of fire and smoke, as well as short access distances for emergency services in the main tunnel. The optimal escape distance between escape exits will be a function of an evaluation which takes into account all relevant parameters influencing safety, daily traffic, traffic mix, tunnel length, type of rolling stock, rescue concept and other safety measures present in the tunnel.

30. Vertical exits/access should, in principle, be provided in single-tube tunnels. However, they may be possible only if the tunnel lies near the surface and, in any case, their maximum height should not be over 30 metres with stairs of about 1.20 metres. Vertical exits should ideally also be equipped with proper lighting and communication means. These exits should be designed in such a way that it prevents smoke from spreading into the safe place (locks, ventilation system). The higher the exit is, the less it is practical. Stairs should not be higher than 6 metres and, above that height, it might be necessary to install lifts, which could be also used for faster and easier access of fire brigades with their equipment, medical assistance and evacuation of handicapped people. As well as stairways, lifts should also be pressurized and/or equipped with means to ensure a smoke free environment.

31. Lateral exits/access should also generally exist in single-tube tunnels. Optimally, they should be located in the areas near the surface and locations preferred for lateral exit and access by emergency services. A cross section of exits will be determined on the basis of other safety elements but ideally it should be 2.25 x 2.25 metres with a maximum length of about 150 metres. The same installations that ensure a smoke-free, visible and otherwise safe environment in vertical exits should also be planned in lateral exits.

32. The purpose of cross passages is to connect the main tunnel with safe places. They should usually be constructed between the tubes of double-tube single-track tunnels or a double-track tunnel and a safety tunnel. Cross passages should be equipped with lighting and communication means and designed in such a way as to prevent smoke from spreading into a safe place. The Group discussed what type of doors should be recommended for installation on exits to cross passages. There was a general agreement that, at the minimum, they should be able to sustain fire for 30 minutes and easily operated by hand, whether heavy and with a fully motorized or mechanical opening system or of the other type. It was also noted that, in some cases where natural ventilation does not exist, installing two doors (several metres apart) would ensure increased safety both by raising resistance to fire and by ensuring a pressurized environment.

33. The availability of a parallel service and safety tunnel is not generally a recommended measure and any decision should be based on an evaluation of optimal conditions and cost-effectiveness considerations for each tunnel.

Facilitation of rescue

- Earthing device (I-60)
- Access to tunnel entrance and tunnel exits (I-61)
- Track accessible for road vehicles (I-62)
- Rescue areas at tunnel entrance or exits (I-63)
- Water supply (I-64)

- Electrical supply for rescue service (I-65)
- Radio installation for rescue service (I-66)
- Reliability of electrical installations (I-67)
- TV monitoring (portals and tunnel) (I-68)
- Provision of rescue equipment (I-69)
- Control system (I-70)
- Rail vehicles for rescue (tunnel rescue train) (I-71)
- Road/rail vehicles for rescue (I-72)

34. Disconnection of the overhead electricity lines for the entire tunnel should be possible from entrances, portals and emergency exits. Only the railway company (through operations or tunnel control centre) should have the possibility to disconnect the main power supply in order to prevent the train (or its safe part) from being trapped in the tunnel and to guarantee the safety of rescue services. If fire brigade or other rescue services shall carry out earthing, clear and stringent rules and procedures including training would be necessary. Disconnection of the power supply could be done either manually or automatically. The disadvantage of manual disconnection is that it has to be done by someone (fire brigade, personnel) at the tunnel portals without information on conditions of power lines inside the tunnel. Automatic, remote disconnection is faster and safer. In very long tunnels, it is recommended to segment overhead power lines so that only sections could be switched off if necessary.

35. Where possible, road access to the portal of the tunnel should exist and a free area (500 m^2) should be set aside for rescue vehicles. For easier access to tunnel entrance, simple areas of tarmac to accommodate 2-3 vehicles and small buildings to enable fire, medical and other rescue services should be made available. The location (both ends of the tunnel or only one, access by road vehicles or dual-mode vehicles) and size of these areas should be set up in agreement with emergency and rescue services. It is, however, recommended that rescue areas should be set up at both ends of the tunnel as well as at emergency exits. The area at the entrance of the tunnel should include access solid surface road drivable with fire engines, possibility for two vehicles to cross on the way, power supply, lighting, fixed communication installations, water supply, etc. Similar facilities should exist at the other end of the tunnel. If fire brigades or rescue services use dual-mode vehicles (road-rail), it is recommended that platforms for mode changing should be installed before the tunnel entrance. It was also noted that various railways use different systems (road vehicles, rail/road fire vehicles, rescue trains) or their combination for various rescue operations.

36. Accessibility of track for road vehicles is not generally recommended and may be reasonable only if access for road vehicles is part of a comprehensive intervention and rescue concept based on fire brigades.

37. Water supply in tunnels should have constant pressure and uninterrupted quantity and flow. In the designing phase, the tunnel designer should consult with the fire brigade regarding elements of the design for water supply. Flow rates and water pressure required for fire fighting in tunnels is not standardized across Europe and differ from one country to another. The water supply system should be regularly tested and checked and water should be occasionally completely discharged. Water discharge will also, at the same time, be used for testing the tunnel drainage system.

38. Electricity power distribution system should be suitable for emergency/rescue services' equipment in tunnels. It is recommended to have standard socket outlets with residual current circuit breakers. All power outlets for rescue services should be regularly maintained and checked.

39. Radio installation for emergency services should be a standard measure in tunnels to ensure communication between emergency services, the operation centre and railway personnel. The location in the tunnel depends on engineering and other features of the tunnel. The system used may differ from continuous feed to several antenna intervals, but it must be reliable and as an alternative to fixed installations, it is possible to have mobile wire telephones, mobile radio network or other types.

40. Electrical installations (technical components, wiring, cables) in tunnels must be protected against mechanical impact and heat or fire. Emergency lighting, communication systems, and other users of power should have an independent supply by two sources available to provide power for 60 minutes.

41. TV monitoring of portals and interior of the tunnel is not recommended as the standard safety measure but rather as a security measure.

42. The main issue in providing rescue equipment is its location. Breathing equipment is necessary for any rescue operation. Wherever located, either at the nearest fire station or secured in the tunnel, it should be provided by rail operators and regularly checked and tested. It is, however, preferable to locate breathing apparatus with the fire brigade because more reliable regular check-ups are likely than if stored in tunnels. The standard apparatus has to allow breathing for 30 minutes at the minimum, although trained professionals may also use long-time breathing equipment in special circumstances. It is advisable that the fire brigade not only regularly maintain breathing apparatus but also practice with it in regular circumstances so that it is accustomed and trained to use it in tunnel accidents.

43. Although some tunnels may require control centres, centralized tunnel control system centres are not necessary for tunnels shorter than 15 km. If not located in the same room with a train control centre, a fully coordinated communication between two centres must be ensured. It is preferable to have a single control system for a whole stretch of track (including tunnel) than separate centres for tunnels and train control, except in some cases of very long tunnels.

44. Specialized rail vehicles are recommended as a part of the rescue concept. Railway operators should operate railway rescue vehicles and provide particular staff for rescue operations. Rail/road vehicles for rescue are only recommended as a part of comprehensive rescue equipment provided by the fire brigade. The Group noted that different approaches and systems still exist in member countries. The most important fact is that rescue trains are manned by railway operator's staff and not a fire brigade, which may not be familiar with the use of railway vehicles and equipment and special railway procedures. The fire brigade should be encouraged to utilize either road vehicles they use in their daily work or rail/road vehicles. In any case, the most important recommendation is that the fire brigade should get into the tunnel with their equipment as fast as possible, regardless of the type of vehicles used.

Rolling stock measures

Prevention of incidents

- Fire protecting measures (fire load, prevent fire spreading) (R-1)
- Onboard fire detection (traction units and/or coaches) (R-2).

45. Fire protecting measures and onboard fire detection should be built in the rolling stock and concentrated in places where the potential for fire breaking is highest and where such installations would be most required (locomotives, power systems, below the floor). It may not be absolutely necessary to install fire detection installations in passenger wagons (“passenger’s nose is the best fire detector”). However, passenger sleeping cars should have fire detectors and automatic extinguishers. This is viewed as a relatively cheap measure that significantly increases safety not necessarily only in tunnels. Availability for communication between passengers and the train driver is crucial in the case of fire on passenger wagons. In the case of freight wagons, fire detectors are much more important and should be considered.

Reduction of effects

- Derailment indicators on train (R-10)
- (a) Emergency brake neutralization (R-11)
- (b) Maintaining the movement capability (R-11)
- Onboard fire extinguishing equipment (traction units and/or coaches) (R-12)
- Central control of air-conditioning (R-13)
- Ability to split trains (R-14)
- First aid equipment on board (R-15)

46. Tanker trains and other trains transporting dangerous goods represent special concern in case of derailment. In some countries, derailment indicators are standard equipment in freight trains and are recommended for those trains transporting dangerous liquids and other dangerous goods.

47. Emergency brake neutralization and maintaining the movement capability are directly linked as safety measures that increase the likelihood that, in the event of fire, a passenger train will be able to leave the tunnel. The Group noted that this particular measure needs to be further discussed. The issue is further complicated by the fact that different systems of brake neutralization exist in practice today, and an agreement might be necessary about the system to be used in international traffic in future. Another difficulty with emergency brake neutralization is the lack of harmonization as wagons from different systems coupled together may not all have the possibility of emergency brake neutralization. Some members of the Group therefore argued in favour of a complete removal of emergency brakes from trains, replacing it by an alarm system. They noted that the decision about stopping the train should be a responsibility only of the train operator and misuse or abuse by passengers could be detrimental for the safety of the train. It was also argued that an emergency brake could be active on all passenger trains up to a certain speed, after which the train operator should be responsible to disable it.

48. Portable onboard fire extinguishing equipment installation is recommended on both traction units and passenger wagons. They are recommended as a standard measure of safety as

they allow rapid fire fighting in a very early stage. In some countries, installation of portable fire extinguishing equipment in locomotives and passenger wagons is obligatory. While smoke detectors and portable extinguishing equipment are considered important for sleeping cars, some members of the group were doubtful about the benefits of automatic and portable fire extinguishing systems in passenger cars (vandalism). Automatic or manually operated extinguishing systems are particularly important and recommended on traction units. Installation in technical compartments, restaurant cars, toilets, etc. have both their advantages and disadvantages. A false alarm may trigger a train stop and provoke new risks (e.g. people leaving the train) and operating disturbances; installation is relatively expensive and maintenance costly. On the other hand, fire could be neutralized relatively quickly without a major emergency.

49. Central control of air conditioning in an emergency should slow down the spread of fire and smoke in wagons. The problem emerges when the cause and location of smoke is not known, as it may come from outside of the train or be caused by a false alarm. In any case, it is recommended that air conditioning could be switched off centrally and that the train crew/driver could operate it quickly.

50. A train splitting measure is not recommended as a general concept, as it may be adequate in some specific situations. The decision to evacuate passengers by moving them into the intact part of a train and splitting this part and pulling it out with a traction unit should be based on time calculation and quick evaluation of each particular emergency situation. However, due to different coupling systems, decoupling of a passenger train may last too long and thus endanger passengers and crew. For freight trains with breaking fire, it may be advisable to tray decoupling wagons able to move and not on fire and pull them out of the tunnel.

51. Each train should be equipped with at least one first aid box. The location must be selected so that it is easily accessible for the train staff and secured and protected from vandalism. This measure is not to specific tunnel safety but is recommended as a general safety measure. It is also recommended that not only the train driver but also some other crew is trained to use first aid equipment.

Facilitation of escape

- Escape equipment and design of coaches (including access for rescue services) (R-20)

52. Passenger coaches (doors, windows, body shell) should incorporate defined emergency exits/accesses. Such exits/accesses should be visible and indicated for passengers and rescue services (from both inside and outside the wagon). The train crew should be equipped with megaphones, for communication with passengers in the event of evacuation, and lamps, which must be located in an easily accessible place. Future specifications of passenger coaches should incorporate the aspect of escape design (hammer and easily breakable windows, easily removable doors, etc.).

Operational measures

Prevention of incidents

- Regulations for operation (especially passenger/freight trains) (O-1)
- Regulations for transportation of dangerous goods (O-2)

53. Complete separation of operations for passenger and freight trains, applicable only to double-track tunnels, may not be feasible in all tunnels. Therefore, this measure is not recommended as a standard measure, but only for high-risk tunnels, and if operating conditions allow it. High-risk tunnels are considered those tunnels that are very long and/or have a lot of traffic, traffic mix with passenger and dangerous goods transport, etc. Although effective as a preventive safety measure, total separation of traffic may not be necessary if an optimized timetable could prevent passenger and freight trains from crossing each other in tunnels. In some countries, very heavy traffic through particular tunnels was made safer by optimization of the timetable and separation of operations of passenger and freight trains into day and night.

54. Restrictions on transit through tunnels, at the same time, of passenger trains and freight trains carrying dangerous goods are also recommended only for high-risk tunnels and if operating conditions permit. Restrictions on dangerous goods in general in practice means that all freight trains are concerned, as it is not practical to sort out single loads or wagons containing dangerous goods as well as all possible combinations of different freight loads that could be dangerous. Also, the total separation of freight – dangerous goods and passenger traffic might be extremely costly and more rigorous safety standards for freight wagons for dangerous goods could be more economical and an equally safe solution in cases of networks with high density of traffic. Therefore, this measure should primarily concern block trains carrying dangerous goods. In any case, the possible risk of accident involving dangerous goods should be reduced by closely evaluating each specific situation whether it concerns a particular type of dangerous goods or a particular tunnel.

55. The train crew is usually informed about the nature of dangerous goods in the train. The risk category of goods, fire risk, toxic hazard and other relevant information in each particular transport operation should determine the operational and eventual emergency procedures. Common operational regulations for the transport of dangerous goods may also require more harmonization of training and education of train drivers at the international level.

56. Risk analysis of safety measures involving dangerous goods are based on cost-benefit considerations of various options. For example, if freight trains carrying dangerous goods are diverted on routes without tunnels, risk on these routes may increase if the line passes through densely populated areas, in a sensitive environment or on lines with a lower track standard. It was suggested, therefore, that the Group’s future recommendations, concerning transport of dangerous goods (both prevention of incidents (O-2) and facilitation of rescue measures (O-32)) should be brought to the attention of the UNECE Working Party on the Transport of Dangerous Goods in order to harmonize particular recommendations with the opinions of the Working Party.

Reduction of effects

- Stop following or encountering trains (out of the tunnel) in case of incident (O-10).

57. This measure, intended to reduce the effects of the potential accident, is mainly aimed at double-track tunnels. Trains should be stopped outside the tunnel from following or oncoming other trains in case of accident. In order to apply this measure, adequate communication installations and stop signals at designated locations are necessary. Location of the stopping signal is particularly important, as it will determine the point where the train comes to a complete halt. For tunnels longer than 15 kilometres and double-tube single-track tunnels, additional or other procedures may be necessary.

Facilitation of escape

- Emergency information for passengers (preparation for emergencies) (O-20)
- Training of train crew (O-21)

58. The Group agreed that provision of emergency information for passengers represents an important measure for facilitation of escape and rescue. It was noted that different systems exist on different railways and that the content of emergency information in international transport needs to take into account all possible difficulties in communicating such a measure to a variety of passengers (language). There was a general agreement that emergency information for passengers should be presented in a simple language, and should include only basic rules and general recommendations ("in case of fire alarm by the crew, go to the next wagon", "do not leave train unless instructed by crew", "do not pull emergency brake in tunnel"… and similar).

59. Recommendations R-20 (escape equipment and design of coaches), emergency information for passengers (O-20) and training of crew (O-21) should all be considered together as linked elements of a same safety concept.

60. Training of train crew is considered a standard measure and should ensure that all staff and operators receive training. The training should correspond to their functions and responsibilities and should enable staff and operators to prevent and handle incidents in tunnels, verify an incident, report to the operations centre, make quick and right decisions, provide first aid, initiate and carry on fire fighting and trigger self-rescue actions, etc.

Facilitation of rescue

- Emergency and rescue plans (O-30)
- Exercises with rescue services (communication and co-ordination railway/rescue services) (O-31)
- Information on the transport of dangerous goods (O-32)

61. Preparation and regular maintenance of emergency and rescue plans is recommended as a standard safety measure. Although an emergency response is answered by different services in different countries (United Kingdom – fire, police, medical service; France – emergency manager, etc.) the general rule should be that the response time of rescue services and emergency response services should be minimized. In various countries, there exist different laws governing

emergency and rescue service deployment. Any train incident may involve train operator, tunnel operator, railway operations centre, fire brigade, rescue services, police, medical services and other actors. There is, therefore, the need to avoid confusion and emergency service planning might be developed even during the construction of the tunnel phase. If the safety concept and emergency services' intervention envisages separate plans or standard intervention strategies for railway operator and fire/rescue brigades, there is a strong need for separate actors not only to prepare together and regularly review their plans but also exercise jointly in various scenario situations.

62. Exercises of rail operators with rescue services on tunnel accidents are aimed at ensuring better cohesion, communication and coordination during a rescue operation. Recommended also as a standard measure, it maximizes the effectiveness of rescue services, reduces time delays for rescue operations under specific tunnel conditions and minimizes possible communication and coordination problems during the real accident. As full-scale exercises are extremely costly and difficult to organize as they may require closing down of the tunnel, all railways prefer a "table-top" type of exercise. Applying a table-top type of exercise allows a maximum flexibility in testing communications, building better cohesion between railway personnel and rescue services and testing various scenario cases. The Group also suggested that each tunnel should have a unique name and number and particular descriptive for each end of the tunnel to be used in all communications between emergency and rescue services and railway operators in order to minimize response time, avoid possible confusion and facilitate rescue.

63. Providing information of movements of exceptionally dangerous goods to rescue services to be prepared in the event of an emergency and to be able to respond accordingly is considered as a reasonable general safety measure but not recommended as a tunnel specific safety measure. For safety purposes, an information system, in accordance with RID regulations, defining relevant goods, must exist at international level and specific information must be passed quickly to the responsible operations' centre and rescue services. Although, information on loads is already available through train numbers and freight information systems, it must be available within the required time and the degree of precision needed for fire and emergency services. This information should also be made available in advance to rescue services, not only in order that it selects the appropriate emergency response and operation, but also to reduce the risk for rescue services (see also para. 56).

FUTURE WORK

64. The **next (third) session** of the Multidisciplinary Group of Experts on Safety in Tunnels (rail) **will take place in Geneva on 27-28 March 2003**. In order to advance preparations of the Group recommendations, the Group agreed that an Informal ad hoc meeting, involving the **Chairman**, **Vice-Chairman and the representatives of UIC and AEFI** could be held in order to prepare the first outline of the recommendations to be discussed by the Group at its third session. It was agreed that this **Informal meeting would take place in Geneva on 27-28 January 2003**.

REPORT

65. As agreed by the Ad hoc Multidisciplinary Group, this report was prepared by the secretariat after the session in consultation with the Chairman.