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BEST PRACTICE FOR ROAD TUNNEL EMERGENCY EXERCISES

Technical Committee C.4 – Road Tunnel Operations

WORLD ROAD ASSOCIATION
MONDIALE DE LA ROUTE
AIPCR PIARC

STATEMENTS

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The study that is the subject of this report was defined in the PIARC Strategic Plan 2008 – 2011 approved by the Council of the World Road Association, whose members are representatives of the member national governments. The members of the Technical Committee responsible for this report were nominated by the member national governments for their special competences.

Any opinions, findings, conclusions and recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of their parent organizations or agencies.

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SUMMARY

Exercises should be regarded as an integral part of the tunnel emergency planning process and not as an isolated option.

Emergency exercises highlight good practices and deficiencies, assisting all participants to be prepared for real events.

Road tunnel safety regulations in many countries specify the time intervals between emergency exercises, along with the direction that the practice should be as realistic as possible, but few of these regulations are really precise and helpful in practice.

Most organisations responsible for tunnels are strongly convinced of the need and usefulness of periodic real-scale exercises to maintain the training of their safety team in optimal conditions, but the reality is that this kind of practice is not as consistent as it should be. One of the main reasons for this is the effort needed to prepare and coordinate with external agencies to lead to a realistic exercise.

This report is about good practice for road tunnel emergency exercises, inspired by a survey of current international experience in this field of expertise. It is a step by step guide to define the objectives, perform the preparation, carry out and evaluate an exercise in the most efficient and productive way. It also includes practical information about the resources and people, the cost and the results to achieve.

For non-experienced emergency exercise planning officers, this report can help to clearly define the objectives to achieve, the steps to be completed before the practice can be done, and to choose the extent and type of exercise to execute.

The report is also useful as a checklist for exercise planning officers.

INTRODUCTION

In producing this guidance the objective of PIARC C.4 Working Group 1 has collated current international experience about emergency practices in tunnels, to produce guidance based on the best knowledge of these practices.

The report describes the process to define the objectives of the exercise, details the different types of exercises that are possible, from a seminar exercise to a live full scale exercise, specifying the resources and the obtainable results of all of them.

This report helps those responsible for tunnels, in the process of defining the emergency exercise scenario; describes the teams, documents, the human and technical resources needed to activate; it defines the different kinds of observers and controllers during the exercise and, finally, describe the post exercise analysis and the results report to be written.

The objective of any type of emergency exercises is to develop most appropriate response strategies to deal with each of the identified risk scenarios. These strategies should be incorporated to the Tunnel Operator's Manual and to the Operational Manuals of the involved Emergency Services in a continuous improvement process.

1. INFORMATION GATHERING AND QUESTIONNAIRES

In order to assess the importance of exercises in the safety tunnel process in each country a questionnaire was sent out to all countries represented on the working group, the results received were analysed and the feedback is summarised in the sections below.

In addition to the questionnaires, countries were invited to provide details of the requirement to carry out emergency exercises in road tunnels. Those countries that responded to questionnaires or provided details of their countries requirements are listed in *table 1*.

The detail of the countries requirements are in Appendix B of this report.

TABLE 1 – NUMBER OF QUESTIONAIRE AND COUNTRY REQUIREMENT RESPONSES

Country	Questionnaire Responses	Country Requirements
Australia	1	See appendix B
Austria	1	
Czech Republic	1	
Finland	1	See appendix B
France	2	See appendix B
Greece	1	
Italy	1	
Japan	1	
Netherlands	0	See appendix B
Slovenia	1	See appendix B
South Korea	0	See appendix B
Spain	2	
United Kingdom	1	See appendix B
United States	1	
TOTAL	**14 responses from 12 countries**	**7 responses**

The questionnaire dealt with:

- frequency of exercises;
- services involved in the organization and execution of exercises;
- feedback and debriefs.

1.1. LIMITATIONS OF THE STUDY

The Working Group has studied and compared the results of the *"Tunnel emergency exercises survey"* responses. The responses were based on the standards and guidelines that are currently defined in the respective countries. The exercises are performed in single and multiple tube tunnels with uni-directional and bi-directional traffic flow and on motorways.

In the document there is neither the description of the Emergency Services work nor the resources and the organisations of these services.

HAI VAN TUNNEL EMERGENCY EXERCISE, HIGHWAY NO. 1, VIETNAM

1.2. ANALYSIS OF THE EXERCISE QUESTIONNAIRES

All countries that have answered the questionnaire have included exercises within their tunnel safety policy. Their frequency varies from country to county but it is widely recognised all tunnels should carry out one exercise per year whether this be a live exercise or tabletop style exercise, i.e. in Australia important tunnels like Sidney Harbour Tunnel had more than 10 exercises in last five years.

In general Full Scale Exercises have been carried out in all the countries. Internal Training Exercises and Table Top Exercises has not been a common practice in many countries.

The key players involved in exercises are: Tunnel Operator or Manager, Fire and Rescue services, and Tunnel safety officer where existing. We can point out that in some countries the Administrative Authority is also involved in the exercise.

To obtain value from the lessons learned at exercises, it is important to ensure that issues identified are acted upon *(see chapter 6, page 27)* feedback to confirm this is essential. However we noted from the questionnaires that in majority of countries there is neither agreed feedback mechanism nor coordinator to identify: outcomes, training needs, learning points, equipment deficiencies.

Wherever feedback takes place all key points mentioned in the questionnaire are discussed and analysed:

- command & control;
- communications;
- performance of tunnel safety equipments;
- actions of tunnel operators, fire and rescue service, police, ambulance services;
- logistics;
- safety and welfare;
- learning points identified.

Whilst the questionnaires identified that most organisations take responsibility for closing out issues identified in the post exercise analysis on an individual basis, there are generally no processes in place to close out issues collectively.

1.3. CONCLUSION OF THE ANALYSIS

- Tunnel emergency exercises are commonly practiced in all countries who responded to the questionnaire;
- even if there is no agreed feedback mechanism this feedback is performed and is covering all the topics ranging from technical equipments availability to procedures and training needs;
- there is evidence that there is a clear lack of coordination in some cases between the Tunnel Operator or Manager and its staff and Emergency Services.

2. PREVIOUS PIARC GUIDANCE

Topics discussed in this paper namely; Exercise planning and feedback from exercises, tunnel operation and incidents, to learn from real events has already been discussed in the previous PIARC papers listed below:

- *Management of the operator - Emergency teams interface in road tunnels* (2008) [1];
- *Guide for organizing, recruiting and training road tunnel operating staff* (2007) [2];

- *Integrated approach to road tunnel safety* (2007) [3];
- *Systems and equipment for fire and smoke control in road tunnels* (2007) [4];
- *A comparative analysis of the Mont-Blanc, Tauern and Gotthard tunnel fires* (2004) [5];
- *Good Practice for the Operation and Maintenance of Road Tunnels* (2004) [6];
- *Traffic Incident Management Systems used in Road Tunnels* (2003) [7].

From a European perspective, the Directive 2004/54/EC on road tunnel safety (2004) [8] also provides guidance on the frequency of emergency exercises.

The above mentioned PIARC papers were produced during the last eight years. Exercises in general have been recognised as very important part of safety management of road tunnels. Involved players must first become fully familiar with tunnel equipment and rescue plan procedures and that knowledge has to be then permanently regularly tested. Only on that basis, can the effective response of operator staff and rescue services in actual emergency cases be expected. Not only saving lives, protecting the environment and material goods, but also to limit the overall damage on the lowest possible level and to contribute significantly to the return to normal operation of the traffic in shortest possible time.

We can hope that tunnel operators in conjunction with rescue teams will conduct regular exercises and that it will become common practice worldwide.

In the case of emergency and especially in the case of fire in the road tunnel responsible players have to react according to the tunnel rescue plan in a speedy, coordinated and professional manner.

Therefore, to be fully prepared for all eventualities; regular exercises have to be performed. This is also the lesson learned from the recent serious road tunnel fire incidents and incorporated as good practice for the operation and maintenance of road tunnels.

Previous PIARC papers mention the importance of the proper immediate feedback after exercises and from real incidents to feed back into the planning systems and upgraded and develop rescue plans. It is stated, that in the field of safety, the post accident analysis will assist in the review of the human, material or financial consequences of fires and incidents to reduce future costs. Major and also minor incidents should be analysed.

Having in mind that every road tunnel incident or exercise has to be analysed individually and that no common detailed solutions are possible, continuous assessment and feedback for all tunnels is necessary.

BELL COMMON TUNNEL, EMERGENCY EXERCISE, M25 UK

Previous PIARC papers discuss exercises and feedback matters only on general level. They give the user some basic information and allow for more detailed description and guidance to be developed. The previous papers are not intended to deal with these topics in detail. The present report aims at filling this gap.

3. GENERAL CONSIDERATIONS FOR EMERGENCY EXERCISE PLANNING

3.1. ROAD TUNNEL EXERCISE OBJECTIVES

A road tunnel emergency exercise typically has the following main objectives:

- to prepare all parties and personnel for the best possible response to incidents;
- to demonstrate the adequacy of response by the Emergency Services;
- to test the planned response strategies in the Tunnel Operator's Manual and the Operational Manuals of the Police and the Emergency Services;
- to test Emergency Services' procedures and effectiveness of their training methods in dealing with large-scale accidents or incidents in the tunnel having regard to inter-service liaison;
- to test and familiarise all parties with the various tunnel services including power supplies, lighting, ventilation, environmental control, communications, fire fighting, security and traffic surveillance and management;

- provide practical combined training for the participants representing the three principal Emergency Services; Fire Service, Police and Ambulance Service) and the tunnel operating authority including interagency communications;
- to practice and prove the effectiveness of inter agency understanding;
- to demonstrate the correct operation of all safety and emergency equipment for the road tunnel;
- to test the validity of any assumptions made.

3.2. EMERGENCY PLANNING PROCESS

Exercises should be regarded as an integral part of the tunnel emergency planning process and not an isolated option. It is important that emergency plans have been prepared and the appropriate staff trained in their roles before an exercise is planned. After any exercise, the plan should be reviewed and amended from lessons learned.

It is not possible to train for all possible scenarios, but well trained personnel through emergency exercises will be better prepared to respond to all situations they are presented with.

3.3. TYPES OF EXERCISE

The choice of exercise is important: It should provide the most appropriate and cost effective way of achieving its aim and objectives. There are basically four types of exercise, although there are variations on the theme of each:

- **seminar –** also known as workshops or discussion based exercises;
- **table top –** also known as floor plan exercises;
- **control post –** also known as training without troops; and
- **live exercises –** also known as full scale, practical, operational or field exercises.

New plans or players would normally be tested or take part in a seminar or table top exercises before a control post or live exercise was planned.

3.3.1. Seminar Exercises

Seminar exercises are generally low cost activities and inform participants about the organisation and procedures which would be invoked to respond to an incident. The emphasis is on problem identification and solution finding rather than decision making. Those involved can be either new to the job or established personnel. This type of event will bring staff together to inform them of current developments and thinking. These events may take place within the framework of a seminar which also includes and/or panel discussions and are primarily designed to focus on one particular or a number of specific aspects of the response.

3.3.2. Table Top Exercises

Table top exercises are a very cost effective and efficient method of testing plans, procedures and people. They are difficult to run with large numbers, but those players who are involved are provided with an excellent opportunity to interact with and understand the roles and responsibilities of the other agencies taking part. They can engage players imaginatively and generate high levels of realism. Participants will get to know key procedures in a realistic manner, along with the people with whom they may be working in an emergency. Those who have exercised together and know each other will provide a much more effective response than those who come together for the first time when an incident or a disaster occurs.

An element of media awareness can be introduced under controlled conditions, such as the preparation of press releases at the tactical level, or the use of trainee journalists, under the direction of their tutor, to play news hungry reporters.

3.3.3. Control Post Exercises

In control post exercises, using only a simulated control room response the team leaders (and communications teams) from each participating organisation are positioned at the control posts they would use during an actual incident or live exercise. This tests communication arrangements and, more importantly, information flows between remotely positioned team leaders from participating organisations. By not involving front line response staff, these exercises are cost effective and efficient in testing plans, procedures and key people.

3.3.4. Live Exercises

Live exercises range from a small scale test of one component of the response, like evacuation ranging from a building or *"incident"* site to an affected community through to a full scale test of the whole organisation's response to an incident. Live exercises provide the best means of confirming the satisfactory operation of emergency communications and the use of *"casualties"* can add to the realism. Live exercises provide the only means of testing fully the crucial arrangements for handling the media. A live exercise would not normally be undertaken until you had confidence in those involved.

HOLMESDALE TUNNEL, EMERGENCY EXERCISE, M25 UK

3.4. FINANCIAL IMPLICATIONS

The amount of expense of planning, running and reviewing an exercise will be dependent on the type, location, timing and duration.

There are several ways to optimise the way exercises are delivered with the available funding:

- a model manufactured for floor or table top use may mean an initial expense but could be used for different scenarios on a number of occasions and by different organisations. Some Countries, organisations or tunnel operators are required by law to hold exercises to test their emergency plans. It is recommended that Emergency Services and other stakeholders work with the tunnel operator to develop a scenario which would enable a range of plans and organisations to be tested;
- the expense of live exercises may be reduced by limiting the number of players and by scheduling them to fall within working hours to avoid overtime payments. It may also be possible to rearrange training to coincide with the exercise. However, some exercises have to be held outside normal hours as for safety or commercial reasons, for example it might be difficult to close tunnels during working hours;
- for live exercises which involve large numbers, it may be possible to use some players to act as evacuees.

3.5. INSURANCE

It is important to consider liability and insurance implications for those taking part in the exercise and ensure this is addressed during the planning stage. This may include establishing additional insurance cover or agreeing on waivers, with all participants agreeing to provide cover for their own staff.

4. EXERCISE DESIGN AND PREPARATION

4.1. EXERCISE PLANNING GROUP

In some Countries, a group (i.e. Emergency Planning Liaison Group involving the Emergency Services, local authorities etc., or a tunnel safety committee) might already exist. Such a group would already have been involved in preparing plans, training etc. It would, therefore, be logical to involve its members in planning your exercise.

If no such group exists, it is important to establish one involving representatives of all the principal agencies who have a role in the plan. This group needs to liaise with all participating agencies in the planning stage. It needs to decide, as its first task and with regard to the agreed objectives, whether to test the whole plan or only certain components. All agencies having a role to play, either in the whole plan or the component(s) to be tested, should be invited to take part in the exercise, including of course the planning stage, and subsequent reviews.

Most exercises are time consuming and cannot be undertaken frequently. Therefore every opportunity should be given to all appropriate agencies to take part when a plan is tested. Tunnel Managers and Safety Officers must keep executives or chief officers etc. informed of plans and progress as their support is vital for success. The group needs to allocate sufficient time (which may mean several months prior to the event) to plan the exercise thoroughly.

Ideally, those involved in planning the exercise should not participate directly. They are better used as Referees or Observers. If possible, and particularly for small tunnel operators, help should be sought from neighbouring tunnels with similar operations.

4.2. ESTABLISHING DETAILED AIM'S AND OBJECTIVES

The aims and objectives of the exercise should be the first item on the planning group's agenda and should include clear outcomes that need to be established at the outset. The overall aim of the exercise should be agreed by the senior management of all participating agencies and be based around the question *"what are we hoping to achieve by the exercise as a whole?"* e. g. measuring a certain emergency service response time.

It is important that objectives should be set by each individual participating agency and that they be consistent with the overall aim of the exercise to ensure they do not contradict or compromise those of another agency.

4.3. SCENARIO

A realistic scenario based on those identified in the risk planning for the tunnel should be considered to take into account the type of exercise being planned. The scenario should be adequate to include all the objectives that need to be tested. When the next exercise is planned the scenario should be different than the previous exercise.

Credible incident scenarios should already have been identified in the tunnels emergency documentation. The planning group needs to develop a realistic scenario based on those identified; to ensure that participants will take the exercise seriously. The exercise should also have a realistic timescale.

The scenario should include:

- day, date and time;
- nature of incident (a credible scenario, consistent with exercise location in the tunnel);
- other considerations that could impact on operations might be to define :

  – weather conditions including wind speed and direction;
  – visibility;
  – traffic conditions;
  – progression of incident (e. g. different phases);
  – people involved (e. g. young, elderly etc.).

Always remember, however, that planning based on detailed assumptions regarding a likely future scenario may be too inflexible to adapt to the unforeseen. In most exercises the objective will be to test arrangements and procedures which can be brought into play if needed regardless of the cause.

4.4. TIME-LAPSE EXERCISE

A decision to be made at an early stage is whether the exercise will flow in real time or consist of *"snapshots"* i.e. a series of descriptions of how the scenario has progressed over time. For example, participants may spend a relatively short time considering the immediate actions to be taken before moving to a scenario *"X hours into the incident"* so that recovery issues can also feature. Also consider whether exercise time will be stopped at any point during the exercise to allow for review or consideration of variables, e. g. weather and time of day or year.

4.5. CONTROLLED OR FREE PLAY

In controlled exercises, the scenario and all events or incidents are pre-scripted. The evolution of the exercise is tightly managed. This can be a very thorough way of testing specific aspects but may not evaluate whether a plan is sufficiently flexible to deal with the unexpected.

Free play exercises are much more spontaneous. Once the opening scenario has been established, the participants' actions dictate subsequent events. This requires a large directing staff, a comprehensive scenario and access to much more background information. Although these can be stimulating in terms of realism and having to cope with the unexpected, it is possible that whole areas of a plan which require validation may be by-passed.

It is possible to combine control with free play in order to test both the degree of flexibility of the plan and the validity of any pre-identified aspects.

4.6. EXERCISE LOCATION

Whatever type of exercise is to be held the planning group should visit the location at a similar time or day as the exercise to ensure that it is appropriate, i.e. to maximise the intended learning potential. They should also seek written permission from parties which have a claim to an area and inform any potential users that it may be out of bounds on a certain date.

4.6.1. Seminar or Table Top

The venue needs to be large enough to accommodate a floor model or table model. Wall space for maps may be required. Ensure that the necessary audio/visual training aids, if required, can be used with ample space and viewing for participants. A lecture theatre or similar tiered venue may be suitable for certain seminar exercises. If the exercise is to be syndicated then additional rooms will be required. Separate space for exercise directors is helpful.

4.6.2. Control Posts

The site(s) for these exercises should be self-selecting since participating organisations should use their designated control centres.

4.6.3. Live

The selection of a suitable site for an exercise is of crucial importance. Obviously, in the case of fixed site exercises, such as a tunnel, there is little scope for choice.

However for generic type major disaster exercises e. g. fire or Hazardous incident selecting a suitable site or location in the tunnel, should be undertaken in the early stages of exercise planning, this should be based on risk analysis to point out the most critical areas or zones in the tunnel. As the site or location need to be acceptable to all participating agencies, several options may need to be explored depending on the scenario. The location must be safe and with a reasonable access for vehicles and personnel. Owners of the site (for example, the tunnel Administrative Authority) should be fully aware of and, participate in the exercise.

4.7. TEMPORARY TRAFFIC MANAGEMENT

Traffic management is an important consideration for live exercises: Tunnel closure will only be required if acceptable arrangements can be made for diverting traffic as this will require full or partial closure of the tunnel.

Limitations on this may be:

- the availability of a suitable diversions route;
- the resources required to establish the traffic diversion.

Such limitations will dictate when and what type of exercise can take place.

4.8. EXERCISE BASE

The need for an *"exercise base"* arises for live exercises, sometimes for control post exercises, and is particularly helpful for large scale exercises. A suitable building, preferably in the ownership of one of the participating agencies (e. g. the tunnel control centre), should be selected close to the exercise site. It can then act as an assembly point for *"exercise directors"*, observers etc. where briefing can be given and casualties, if used, can be made up. Ample car parking should be provided.

If the exercise base is further than walking distance from the site then consider providing minibus transport. Bear in mind that live multi-agency exercises attract many vehicles and it would be helpful to ensure that non-essential vehicles at the site are kept to a minimum.

4.9. SAFETY

(See also Briefings chapter)

The safety of personnel during the exercise is of paramount importance. In live exercises, all participants - including exercise directors, Referees, volunteers and observers should be made aware of any hazards within the area and reminded of

safety issues. Exercise participants may not be familiar with the location and control may be needed to ensure that players are kept within the confines of the exercise area.

Before a live exercise, a safety risk assessment should be completed to ensure that safety precautions are taken and no unseen dangers are present on the site (e.g. asbestos in tunnel service buildings). The risk assessment should be carried out by each organisation taking part to reflect their specific work practices, it is also important to risk assess and traffic diversions and the potential of live traffic entering the exercise area. A safety officer must attend the exercise to ensure that all participants comply with the safety requirements and do not place themselves, or others, in danger. At complex exercises, or where conditions are particularly hazardous, each participating organisation may need its own safety officer. The exercise cannot be seen as a reason not to comply with health and safety requirements.

First aid cover should be provided to deal with any health problems or injuries sustained during the exercise. For safety reasons, exercise directors should adopt an agreed procedure for intervention into the exercise, including ending the exercise where necessary. The planning group should devise a codeword for this purpose (see Codeword's below) and the means of relaying it to those participants without radio communication.

Ensure personal accident insurance is in place for all participants, including volunteers.

4.10. WELFARE

Consideration should be given to welfare arrangements during exercises. Welfare needs may vary depending on the type, timing and duration of the exercise. You may need to provide refreshments, changing, washing and toilet facilities before, during or after the event. The use of casualties adds realism to exercises but their welfare needs to be taken into account. Exercise *"casualties"* should not be placed in unsuitable conditions e.g. cold, wet or hard surfaces without appropriate care. Invariably the length of time envisaged for the activity turns out to be much longer. An area which is warm and dry should be available.

4.11. CODEWORD'S

Exercises may be given a codename which should then be mandatory as a prefix to all messages - verbal or written - during the exercise. The group must take care that the codeword chosen is phonetically distinct from other key words that are use in communications. Neither should such words be used for other purposes in emergency response operations (e.g. Gold, Silver, Bronze).

The use of Codeword's will ensure that everyone involved is aware that they are part of the exercise and not a real incident. Control Rooms and operations centre's of all participating organisations must be informed about the codename, prior to the exercise. In addition, a member of the exercise planning group may attend the appropriate locations to ensure that the exercise is not treated as a real incident.

A codeword, which can be used to identify that a real incident has occurred and is not part of the exercise, should be agreed and circulated to all participants prior to the event. This could also be used if there are real casualties during the exercise, e.g.; examples of commonly used codeword's in the UK are *"Safeguard"* or *"No duff"* [9].

Here some common terminology:

exercise [Codename] – *"Startex"* = start of exercise;
exercise [Codename] – *"Hold"* = suspend exercise for a period;
exercise [Codename] – *"Resume"* = start again after a hold;
exercise [Codename] – *"Safeguard"* = real incident or message outside of exercise scenario;
exercise [Codename] – *"Abort"* = early termination;
exercise [Codename] – *"Endex"* = end of exercise.

4.12. EXERCISE STAFF AND OBSERVERS

4.12.1. Exercise Controller

An Exercise Controller needs to be appointed who has overall oversight and the authority to alter the planned programme, including early termination for safety reasons (e.g. adverse weather) or because the aim cannot be met due to outside influence (e.g. a major incident elsewhere requiring redirection of participant resources).

4.12.2. Exercise Directors

Exercise Directors play a role in both table top and control post or live exercises. They have access to the whole exercise programme and ensure that it proceeds according to plan.

In table top or control post exercises they often feed information to players to enable them to make management decisions in response. This can be done verbally or by written message and is known as a *"paper feed"* exercise. Sometimes this can be timed in advance with information fed to the players at pre-set intervals regardless of the previous responses. However, flexibility will allow the directors to use their own judgement and experience in timing the inputs. In control post or live exercises,

the director's role should be less prescriptive. The directors should act as a team in constant communication and facilitate rather than orchestrate the exercise.

Intervention should be minimal and a last resort. The players need time to correct problems themselves. Nevertheless, it should be clear to Exercise Directors, whether those taking part in the exercise; usually work together, or are coming together for the first time; it should also be clear if the object is to build a team or to exercise an existing team in an unfamiliar role? This will help Directors decide, for example, how much advice to give and whether to be in the same location as exercise players.

Exercise directors should intervene when there is confusion about the scenario or an organisational problem outside the control of the players. They should also intervene if failure to do so will compromise the exercise objectives or when one person's action or inaction is jeopardising the opportunities afforded by the exercise.

4.12.3. Referees

Referees watch and listen to the exercise with the particular brief of measuring whether activities are happening in the right place, at the right time and involving the right people. Their role differs from Exercise Directors in that Referees have no responsibility for the mechanics of the exercise. They need to be very clearly briefed on what they should look for in order to assess whether or not the objectives are being met. Their role in subsequent de-briefing is crucial.

4.12.4. Observers

An observer is someone who has no role to play in the exercise but is witnessing events either to assess the preparations of the organisation or individuals within it, or to learn lessons. A central pool of *"Observer"* tabards (vests which identify roles) should be obtained, but each agency will be responsible for inviting their own observers within a maximum which the exercise planning group may wish to impose.

Too many observers can, if not carefully managed, cause confusion. They should have a real interest in the exercise. An advantageous "viewing area" may be helpful rather than carte blanche access to wander the site. This will also assist in ensuring their safety. A quality briefing for them is essential prior to and during the exercise. Wherever possible, a member of the directing staff should be available to explain events and procedures as the exercise unfolds.

Observers may not be invited or able to attend the debriefing after the exercise, but their views should always be sought. An *"Exercise Evaluation Form",* sent with the invitation, would go some way to achieving feedback. Alternatively, written comments could be forwarded to the exercise planning group for consideration at the debriefing.

4.12.5. Identification

To avoid confusion, non-participating personnel such as the exercise controller, exercise directors, observers etc. should be clearly identifiable from exercise participants. In a control post or live exercise, this may take the form of reflective tabards marked clearly front and back with *"observer"* or *"exercise controller or director"*, reflective or luminous armbands or reflective jackets. Access to certain areas of the exercise may be restricted by pre-arrangement to identified personnel. Care needs to be taken not to create confusion between participants and observers and white, non-reflective tabards have been introduced for observers in some areas to minimise the risk of confusion.

It is important in all types of exercise to be able to identify which agency each person represents by uniform or badge.

4.13. COMMUNICATIONS

Communications both equipment and process will invariably play a key role in the success of exercises. An agreed channel of communication needs to be set up between directing staff so that they can be kept aware of any developments or changes. In respect of control post or live exercises the agreed communications used by directing staff must be separate to those being used by players.

An element of the exercise may be to test interagency communications. Messages should be prefixed with an agreed codeword so that everyone involved is aware that they relate to the exercise and not to a real incident. All control rooms need to be aware in advance of the agreed codeword's.

To ensure that the communications equipment will work in the exercise environment, a test should be carried out beforehand. All cellular telephone numbers to be used in live exercise should be registered with the exercise planning group. Communications need to be in place in the event of the exercise having to be stopped due to a real incident occurring.

4.14. LOGGING AND RECORDING

An important means of communication, particularly after a real incident or live exercise, will be contemporaneous records and logs. These can be particularly important at subsequent public enquiries. In exercise, those taking part should understand the importance of keeping an accurate log of actions and decisions. Exercise planners should not assume that players will bring their organisations' logging practices to the event - even where they exist.

4.15. PUBLIC INFORMATION

The exercise planning group should agree whether there should be any prior publicity. It may be advisable to issue prior public information to members of the public in the vicinity of the exercise to prevent any undue alarm, particularly for exercises at hazardous sites. However, this may attract a crowd of uninvited spectators. *"Exercise in progress"* signs may be strategically positioned. This can detract from the realism but reassures the public or uninvolved agencies, particularly in sensitive areas. The planning group should take account of a likely crowd and ensure public safety by deploying additional staff.

If public information is issued, the participants may also find out about the exercise and this could affect realism. The planning group may consider issuing information by letter, to the public on the day of the exercise. Details for the media could be embargoed until the day of the exercise.

4.16. MEDIA PARTICIPATION

Dealing with the media is a major part of responding to any incident and therefore should be practised as often as possible. The exercise planners could deploy student journalists, (i.e. for UK, coming from the Central Office of Information) or reporters from local newspapers to test the different agencies' response to the media. For major exercises, a representative from the national media should be invited to attend. Exercise press conferences and interviews can be used.

The media might arrive, unplanned; to cover the exercise and arrangements must be in place for this possibility. Public relations staff should be allocated to keep the media informed during the exercise. Designate a good viewing point and useful locations for photo-opportunities.

4.17. BRIEFINGS

The types of briefings depend on the exercise's aim. As a general principle it is advisable that each agency's representative on the exercise planning group takes responsibility for briefing his/her staff who are involved in the exercise. Further briefing may be required on arrival at the place of deployment. Particular attention needs to be paid to volunteers.

The briefing should give information as outlined in Appendix A. (This Appendix is based on legal advice given following UK court rulings. Participating Organisations should check their actions with their own legal advisers).

Further briefing will be required for additional exercise directors and observers. It is advantageous to give these briefings at the exercise base before it begins.

5. PRE-EXERCISE FINAL ARRANGEMENTS AND REALIASATION

These are the responsibilities of the members of the exercise planning group so that all possible measures have been taken to ensure that the exercise itself is not compromised by poor planning and organisation. The following are examples of the arrangements which need to be in place.

TABLE 2 - PRE EXERCISE ARRANGEMENTS

	Live Exercises	Control Post Exercises	Table Top AND Seminar Exercises
Participants should be briefed prior to the exercise.	X	X	X
The scene is set with casualties made up and in place.	X		
Observers briefed, in position and suitably identifiable (tabards).	X	X	X
Exercise directors briefed, in position and suitably identifiable (tabards).	X	X	X
First aid support (if necessary) in place and clearly identifiable.	X		
External groups are briefed and in place.	X	X	
Welfare arrangements (refreshments, temporary toilets etc.) in place.	X		
Media arrangements made.	X	X	
Communication checks complete	X	X	X
Room layout and environment checked, visual aids in place.			X
All necessary equipment; paper, pens, flip charts etc available.			X

For live exercises the participation of the focus for the exercise e.g. a large goods vehicle fire or hazardous goods vehicle incident has been guaranteed or an alternative scenario has been prepared to discount its absence.

It should be remembered, particularly in live exercises, that although the exercise on site has been completed other elements may need to continue for some time, e.g. control rooms, media etc.

Note: it should be agreed how the exercise will start and by whom. Agreement also needs to be reached on how the exercise will progress to different phases, if relevant. The method of ending the exercise should also be agreed.

5.1. CONTINGENCIES

A back-up plan should be prepared to take into account the possibility of tunnel system mal-function and/or the unavailability of emergency services due to the possibility of attending real incidents that occur at the same time as the planned exercise.

5.2. EXERCISE CHECKLIST

The check list below is a useful tool to assist in carrying out pre-exercise briefing:

- agree the aim, objectives, scenario and extent of the exercise with senior management;
- assemble a multi-disciplinary exercise planning team and agree the objectives for each area to be exercised;
- sketch out and then develop the main events of the exercise and associated timetables;
- determine and confirm the availability of the outside agencies to be involved, such as the media or voluntary agencies;
- ensure the availability of tunnel systems to be tested during the exercise; it is important to test the resilience of tunnel equipment to confirm an adequate level of maintenance;
- list the facilities required for the exercise and confirm their availability e.g. transport, buildings and equipment;
- ensure that all communications to be used during the exercise have been tested at some stage prior to the exercise. If a control post or live exercise, test radios, mobile phones etc. in the locations in which they will be used as near to the date of the exercise as possible;
- check that Referees for each stage of the exercise are clearly identified and properly briefed;
- ensure that directing staff are clearly identified and properly briefed, and have good independent communications with *'exercise control'* throughout the exercise;
- if the exercise links a number of activities or functions which are dependent on each other, confirm that each has been individually tested beforehand;
- ensure that all participants have been briefed;
- ensure that all players are aware of the procedures to be followed if a real emergency occurs during the exercise;
- if spectators are to be invited, including the media, ensure that they are clearly identified and properly marshalled, and arrange for them to be kept informed of the progress of the exercise. Ensure their safety;
- for the longer exercise, arrange catering and toilet facilities;
- ensure that where appropriate outside agencies are indemnified in the event of exercise accident;
- warn the local media, Emergency Services, switchboards and controls and any neighbours who might be worried or affected by the exercise. Position *"Exercise in Progress"* signs if appropriate;

- ensure that senior management, directing staff, Referees and key players are aware of the time and location for the 'hot' debrief, and circulate a timetable for a full debrief;
- agree and prepare a detailed set of recommendations, each one accompanied by an action addressee and timescale;
- prepare a clear and concise summary report of the exercise to distribute to all organisations and groups which took part, together with major recommendations;
- discuss with senior management the outcome of the exercise and agree the future exercise programme;
- thank all personnel and outside agencies which took part.

6. DEBRIEFING – POST EXERCISE INCIDENT ANALYSIS – FEEDBACK

A review of the responses to an exercise by the Emergency Services and agencies giving assistance is essential. This provides an opportunity to evaluate efficiency, to learn from experience gained and also offers a source of information to assist in future planning, training and exercising.

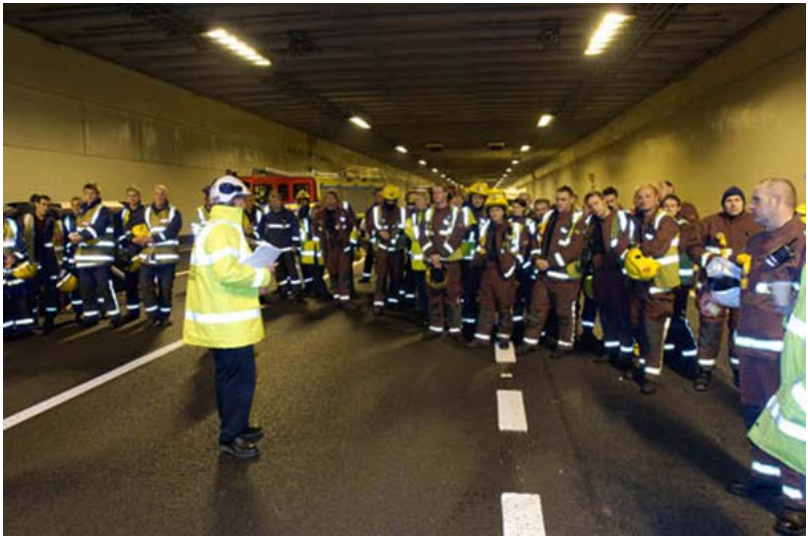
This process can be best achieved by a series of debriefings at all levels within all agencies involved and concluding with a multi-agency debrief. Hot de-briefs (those which take place immediately after the event) can be a useful way of capturing instant reaction which may not be revealed by the cold de-brief (that which takes place after an interval). All actions identified by the debriefing should be taken forward by a nominated person or agency and given a timescale.

Organisations may wish to consider appointing a neutral debrief co-ordinator. It is important that a non-threatening atmosphere is created so that people are not afraid of being honest about their experiences and problems.

6.1. SINGLE SERVICE DEBRIEFING

The methods of debriefing personnel involved in a major incident may vary within each individual service. It will, however, be beneficial to debriefing if consideration is given to the following:

- debrief as soon after the exercise as is practicable;
- everyone involved, including personnel remote from the area of operations (e. g. control room staff) should be afforded the opportunity to contribute to debriefing at some stage;
- the need for additional debriefing sessions for personnel involved in specific or specialist operations;
- note: recordings made at the exercise, particularly video recordings and photographs, along with written reports will assist in debriefings.



HOLMESDALE TUNNEL, HOT DEBRIEF OF FIRE-FIGHTERS, M25 UK

6.2. MULTI-AGENCY DEBRIEFING

The debriefing process should culminate in a multi-agency forum which includes not only the Emergency Services but also any other agency which may have assisted in the overall response. It is important that each service is represented by personnel actually involved in operations, as it will be necessary to give first-hand accounts of events.

Depending on the scale and nature of the exercise it may be advantageous to hold joint debriefings for specific levels of command, e.g. Incident Control Team (Tactical level) and/or for personnel deployed on tasks requiring multi-agency involvement. Such meetings should, of course, be a pre-cursor to the final multi-agency debriefing and should add to its content.

Note: facts emerging from the debriefings should be documented and problems identified. Lessons learnt should be shared with all who may be required to respond to major incidents even if they did not participate. Training needs individual, organisational and multi-agency should be identified.

6.3. MEDIA AND DEBRIEFS

For exercise or incident debriefing to be effective it relies on frank and open discussion of the participants. Having media personnel there at this time could adversely affect the process, inhibiting participants from participating fully. In order to maximise the benefit of the debriefing process it is therefore recommended that media and press are excluded from this process.

7. EXERCISE REPORTING

A major multi-agency exercise can be both costly and time consuming to arrange and undertake. It is essential, therefore, to produce an exercise report after the debriefing. This should be well presented and brief so that the busiest manager has no excuse not to read it. The report should cover the aim, objectives, scenario, the planning process and both positive and negative observations from the exercise concluding in recommendations for the future. It is also important that the recommendations are acted upon and a follow up report prepared no later than 6 months after the publication of the Exercise Report noting what action has been taken and what is planned.

Most organisations involved in emergency preparedness will benefit from other people's experiences of exercise, if the report is open and honest, and the needs of financial and service sensitivity are genuinely respected.

The main purpose of this feedback is to improve total measures, including; emergency operation, cooperation with emergency services and facilities for next exercise and real case incidents. Therefore, feedback must include following data such as:

- time of detection by the tunnel operator;
- time of call to emergency services by the tunnel operation centre;
- arrival time of fire and rescue service, police, ambulance compared to last exercise, or real case incident if possible;
- facilities or procedures to be improved;
- feedback from both real case incident and exercises can also be use to prepare the objectives of the next exercise.

8. CONCLUSIONS

In road tunnels, exercises should be regarded as an integral part of the tunnel emergency planning process; not an isolated option.

All countries that responded to questionnaires have included exercises within their tunnel safety policy. And it is widely recognised all tunnels should carry out one exercise per year whether this be a live exercise or tabletop style exercise.

Most organisations responsible for tunnels are strongly convinced of the need and usefulness of periodic real-scale exercises to maintain the training of its safety team in optimal conditions, but the reality is that this kind of practice is not as consistent as it should be. One of the main reasons for this is the effort needed to prepare and coordinate with external agencies to lead to a realistic exercise.

For non-experienced emergency exercise planning officers, this report can help to clearly define the objectives to achieve, the steps to be completed before the practice can be done, and to choose the extent and type of exercise to execute and provide an understanding that debriefing and reporting are also essential components of emergency exercises.

The report is a useful as a checklist for exercise planers to:

- establish exercise objectives;
- choose the most appropriate type of exercise to meet those objectives;
- establish the human and technical resources needed;
- how to control an exercise ;
- conduct a post exercise analysis;
- evaluate the result of the exercise.

9. BIBLIOGRAPHY/REFERENCES

[1] PIARC report *"Management of the Operator – Emergency teams interface in road tunnels"* report ISBN : 2-84060-201-6, reference 2008R03

[2] PIARC report *"Guide for organizing, recruiting and training road tunnel operating staff"* report ISBN : 2-84060-193-1, reference 2007R04

[3] PIARC report *"Integrated approach to road tunnel safety"* report ISBN 2-84060-195-8, reference 2007R07, 2007

[4] PIARC report *"Systems and equipment for fire and smoke control in road tunnels"* reference 05.16.B (2006)

[5] Routes/Roads features R/R324 *"A comparative analysis of the Mont-Blanc, Tauern and Gotthard tunnel fires"* (2004)

[6] PIARC report *"Good Practice for the Operation and Maintenance of Road Tunnels"* reference 05.13.B (2005)

[7] PIARC report *"Traffic Incident Management Systems used in Road Tunnels"* report ISBN 2-84060-159-1, reference 05.15.B, 2004

[8] European Parliament and the Council, *"Directive 2004/54/EC of the European Parliament and the Council, dated 29 April 2004, on minimum safety requirements for the trans-European network tunnels"*, L201/56 European Union Official Journal, 7-6-2004

[9] The Derbyshire Emergency Planning Liaison Group UK *"The exercise planners guide"* adopted by the British Cabinet Office- latest revision May 2010

GLOSSARY	
Term	**Definition**
Cold debrief	Can be a single service or multi agency debrief carried out at an agreed time following the exercise to formally record outcomes including, learning points, training needs and make recommendations.
Control Post	Exercise involving only control personnel. Also known as training without troops.
Controller	The Exercise Controller has overall, oversight and the authority to alter the planned programme, including early termination for safety reasons.
Debrief	The process of reviewing the outcomes of an incident or exercise. Can include Hot debrief and cold debrief.
Director	Exercise Directors play a role in both table top and control post or live exercises. They have access to the whole exercise programme and ensure that it proceeds according to plan.
Hot debrief	Gathering of information and feed back immediately following an incident or exercise.
Live Exercise	Also known as full scale, practical, operational or field exercises.
Observer	An observer is witnessing events either to assess the preparations of the organisation or individuals within it.
Referee	Referees watch and listen to the exercise with the particular brief of measuring whether activities are happening in the right place, at the right time and involving the right people.
Seminar	Also known as workshops or discussion based exercises.
Table Top	Also known as floor plan exercises.

APPENDIX A – GUIDELINES FOR BRIEFING THOSE TAKING PART IN EXERCISE

These Guidelines should form a basis around which a pre-exercise briefing can be developed. Individual agencies should adapt this for their own use including additional points relevant only to their organisation and personnel.

It is essential that all persons who will or could take part in an exercise are fully briefed. Failure to do so could lead to the possibility of litigation should someone who has taken part in the exercise suffer physical or mental injury, citing poor advanced preparation by the organisers as a contributory factor.

The briefing must be reasonably near in time to the exercise (i.e. not more than one month beforehand). The degree to which participants are briefed will vary according to the type of exercise being held and it is unlikely that the same depth of briefing will be required for a table top exercise as for a live exercise.

Essential Briefing Points

A verbal and written list of all participants in the exercise should be presented at the beginning of the briefing. The main briefing will wish to include the following items:

The exercise will take place between the following dates: …… and/or the following times …….. / ……..

The approximate duration of the exercise is: ……..

The exercise code name is e.g. *"Exercise Red Card"*. The exercise code name should be used as a prefix on all written, radio and telephone messages relating to the exercise.

This is/is not a multi-agency exercise. The other agencies involved are (Delete as appropriate)*:

- fire & Rescue Service*;
- police* ;
- ambulance Service* ;
- recovery operatives*;
- environmental agencies*;
- others……

The exercise scenario will/will not involve the following:

- a site contingency plan;
- simulated casualties;
- hazardous substances;
- simulated hazardous substances;
- fire;
- simulated fire/ smoke;
- smoke;
- effects toxic / harmless.

A safety officer will be present identified by : ……..

Exercise directors will be present, identified by : ……..

Exercise observers will/will not be present identified by : ……..

Any concerns regarding personal health and safety or the health and safety of others during the exercise should be drawn to the attention of the safety officer or an exercise director immediately. An assessment will be made as to whether the exercise can continue.

If a genuine injury is sustained (as opposed to a simulated injury) use and repeat the code word "……" to attract attention under no circumstances should these words be used by role playing casualties.

Notification of exercise suspension / abandonment / completion will be given by : …… (e. g. code words or audible signals)

(*) A health and safety risk assessment has been undertaken and your attention is drawn to the following (if applicable): Protective clothing and equipment required, over and above standard issue Areas of the site which are prohibited Physical hazards on site (sharp points, trip hazards etc.)

All participants in the briefing now have the opportunity to raise questions relevant to health and safety.

Any participants who wish to raise concerns about their personal health and safety or to pose questions relevant to health and safety after this briefing but before the exercise should see ……..or their line manager.

Will all participants ensure that they have signed the briefing attendance sheet which will be kept on record.

(*) A *"health and safety risk assessment"* of the planned exercise is essential good practice. The method to undertake this should be an early consideration of the Exercise Planning Group. Each participating organisation must assess whether there is the need for an individual assessment or whether one agency (e.g. the Fire Service along with the site owners) should undertake the risk assessment and share information with other participating agencies.

APPENDIX B – NATIONAL GUIDELINES

1. AUSTRALIA

1.1. Pre-incident Emergency Incident Planning (Austral Asian Fire Authorities Council Guidance)

Undoubtedly one of the most important exercises in pre-planning for an emergency is to prepare and document an Incident Management Plan (IMP), specifically for the tunnel and its approaches, that incorporates the roles and responsibilities of all agencies that may have a part in combating any emergency incident.

To ensure safe operation of the tunnel, the IMP should be prepared by the operators of the tunnel in close collaboration with all the emergency agencies and principal user groups. This representation is best achieved through the establishment of an Emergency Management

1.2. Committee

The Incident Management Plan should be clear, concise and as brief as possible and identify the roles and responsibilities of all members of the agency staff in the event of an emergency.

Specifically it should identify who does what, when, where and under what authority. The wide variation in local factors and tunnel characteristics mean that each contingency plan must be tailored to fit specific circumstances. Existing agency Standard Operating Procedures may need to be revised or adapted or new ones developed. The following guidance notes should therefore be seen as general indicators of a range of planning considerations which tunnel operators and brigades may wish to take into account whilst preparing or reviewing their local plans.

Development and detailed documentation of an IMP to cover all emergency situations needs to include the following:

- identification of all potential incidents and the possible size and complexity based on the type of vehicle and the type of load allowed in the tunnel;
- establishment of clear emergency management hierarchy in accord with local arrangements, methods of activation and person responsibilities Incorporation of the recommendations of principal user groups, i.e.:

  – Tunnel Operators;
  – Road transit authority;
  – Rail authority;

– Public transport authority;
– Commercial transport groups;
– Environmental Protection Agency;
– Disability Group.

- identification of roles and responsibilities of all tunnel management staff in an emergency;
- identify special training need for tunnel operating staff;
- development of standard operational procedures by the emergency combat organisations integrating the tunnel emergency procedures;
- identification with integration of links to local authority emergency sub-plans and state or territory emergency management arrangements;
- management of maintenance procedures and contractors;
- acknowledgment and documentation of fire safety and OH&S issues in repairs and maintenance procedures.

1.3. Testing the plan

Regular scenario and practical exercises involving tunnel management and all response agencies need to be carried out at frequent intervals to test individual parts of the management plan and major exercises to test the integration of the plan into response agency procedures.

2. FINLAND

2.1. Regulations concerning rescue exercises

Finland's laws and statutes currently contain no decrees concerning rescue exercise. However, FINNRA's Central Administration has put forth regulations concerning planning and implementation of rescue exercises before a tunnel is taken into operation and while it is in operation. FINNRA's regulations are based on the regulations given in the EU tunnel directive, which have been adopted taking into consideration Finland's rescue organisations and operating mode.

The main principles of implementing rescue exercises and the parties involved shall be specified in the tunnel's safety documentation. The parties involved shall together compile a detailed plan of the exercises beforehand. The convenor is usually the tunnel manager and the safety officer.

2.2. Rescue exercises before a tunnel is taken into operation

Rescue exercises carried out before a tunnel is taken into operation normally consist of the following:

- a training event covering the tunnel's characteristics, safety systems;
- parties involved in rescue operations and practical arrangements of rescue operations in various emergency situations field visits to the tunnel;
- technical equipment facilities and traffic control centre exercises related to components (e.g. water supply system test, smoke ventilation test, etc.);
- a final exercise before the tunnel is opened to traffic;
- this is a full-scale exercise that corresponds to a real incident (burning vehicles, smoke, injured people, etc.).

A report of the exercises shall be compiled, which shall include an evaluation of the success of the exercise, observed deficiencies and proposals for improvements.

2.3. Exercises while a tunnel is in operation

Full-scale exercises shall be arranged every four years according to the regulations of the European Directive. At the time of the exercise the tunnel or at least one of its tubes shall be closed.

Smaller-scale exercises shall be arranged every one or two years. These are normally implemented as so-called desktop exercises, whereupon the tunnel does not need to be closed. In these exercises the co-operation, responsibilities and operations of the parties involved are simulated. These exercises also include training and orientation of new rescue and operating personnel.

3. FRANCE

3.1. Regulations concerning rescue exercises

The national French regulation is concerning tunnels above 300 m whatever is the tunnel manager (the State, local public authorities, concessions).

In its principle, each year, one exercise per tunnel above 300 m has to be performed and analysed. These annual exercises are collectively organized by the tunnel manager and the services of intervention for tunnel staff and for emergency services staff.

If some tunnels are located in a close area and are operated the same way by the same people (tunnel operator or manager, fire and rescue service and police), one single exercise can be performed for all those tunnels.

3.2. Guidelines

At this moment no guideline has been approved. But a document is in progress and should be available in 2013. This document is prepared by CETU which is a state agency in charge of the national promotion of tunnel safety.

3.3. Practices

Practices among tunnel managers are very different either on the type of exercises or on their frequency. For instance, the region of *"Alps"* (mountains) has already performed more than 150 exercises of all types (seminar, table top, control post or live exercises) whereas local authorities in the cities and their suburbs only perform few of them in urban tunnels.

4. NETHERLANDS

4.1. Regulations concerning exercises

The Dutch Law on Safety for Road Tunnels (*WARVW: Wet Aanvullende Regels Veiligheid Wegtunnels*) is primarily a process law describing the process of planning, designing and commissioning a new tunnel as well as refurbishing existing tunnels so that they can comply with the EU Directive 2004/54. This law dates back to 2006. In December 2011 the Minister of Infrastructure and Environment has send a revised bill to parliament. The minimum technical requirements are stipulated in the Building code (Bouwbesluit). In 2011 Rijkswaterstaat developed a Tunnel Standard for its Road tunnels. The ministerial ruling on the Safety of Road Tunnels (*RARVW: Regeling Aanvullende Regels Veiligheid Wegtunnels*) sets minimum requirements to the process of risk- and scenario analysis, the safety documentation and joint education, training and exercise programs.

Exercises are referenced in article 9 of the RARVW: *'the tunnel manager shall conduct regular exercises together with the emergency services under the supervision of the safety officer'*. In article 11 of the RARVW the Safety Officer is asked to verify that the tunnel operators and emergency services are trained. This is done by a realistic exercise once every 4 years and in the intermediate year's simulation / table top or scaled down exercises. The exercises are thus a means to verify that the operators and emergency services understand the technical operating conditions and are capable of working according to the procedures and protocols that are defined in the safety plan. This plan is designed in such a way that it is possible to cope with the possible incident scenario's that were defined in the scenario analysis.

4.2. Education, Training and Exercises

Each tunnel manager has an education, training and exercise programme. Education is used to acquire basic knowledge of the road tunnel in terms of technology and procedures.

Education, course material and regular site visits are used to keep this knowledge up to date. Training is used to acquire and maintain individual and team skills that are necessary to accomplish the roles and tasks within multi-disciplinary response teams. Where available, operators can use the secondary operating desk with the means of computer simulation. Emergency services use scheduled maintenance intervals to visit the tunnel and stay acquainted with the special environment. The exercise program is used to put the acquired skills and knowledge into practice. Exercises are used to evaluate the quality of the emergency response organization or to test new procedures in a controlled environment. Since the people that are potentially involved in the emergency response is far greater than the amount of people that can participate in a realistic exercise the emphasis of the ETE programme is geared to education and training.

Rijkswaterstaat has recently developed a standard multi-year plan (structured plan/ programme) for education, training and exercise. This standard plan will be used by its tunnel managers. The plan includes a framework for targets for exercises, multi-year agreements with the emergency services about exercises, and visits to the tunnels. On the basis of a multi-year plan, annual plans must be made. An annual plan contains the specific training courses and exercises for existing and new employees in that year, and also the exercises with the emergency services (and other relevant organizations and services).

The ETE programme will ultimately lead to qualified tunnel staff. Currently Rijkswaterstaat is developing a qualification policy that will ensure that tunnel staff meets the qualification requirements. Until 2011 the Westerscheldetunnel was the only tunnel with an annual qualification test for its staff because this was a mandatory requirement in the permit released from the local authorities prior to EU 2004/54 Directive was put into force.

4.3. Exercise in new and refurbished tunnels

Before a new or refurbished tunnel can be opened to traffic, the municipal authority has to give a permit. The Safety Officer advises the Tunnel Manager on the safety aspects of the tunnel and the readiness of the tunnel operators and emergency services to cope with incident scenarios. The Safety Officer uses at least one or more (realistic) multi-disciplinary exercises with the Emergency Services to judge whether the emergency safety organization is ready. Depending on the nature of the change(s) for refurbished tunnels, the Safety Officer advices that training and mono- and/or multidisciplinary exercise (or additional training and practice in specific parts) is required.

Where the Emergency Response and Tunnel Manager operate more than one tunnel in a specific area, it is allowed to conduct only one exercise to limit the impact of realistic exercises on the availability of the tunnel. The current regulations on the minimum requirement of having an exercise once every 4 years and scaled down

exercises in the intermediate years creates a capacity problem with the emergency services in areas where there are multiple tunnel managers in one emergency services district. The emergency services have a limited number of hours available to hold exercises. The greater Amsterdam region has for example, municipal, provincial and Rijkswaterstaat tunnels resulting in three different Tunnel Managers, three different safety officers with the same emergency response team.

With the introduction of the WARVW in 2006 the realistic exercises were focussed on training / performing standard operating procedures from the emergency services. This included for example rescuing passengers out of cars through cutting cars open. Today the exercises are geared towards familiarity with the object (are you in the right place?) and are you capable of working with the procedures (especially communication). All means that can be trained and exercised outside the tunnel is done outside in separate often mono-disciplinary training and exercises.

4.4. Current situation (State owned road tunnels)

The following list shows the exercises held and evaluated in recent years. In addition, *"object visits"* are organized for the staff of the tunnel and the emergency services. At these visits (additional) information is given about safety procedures and (technical) facilities in the tunnel.

TABLE 3 – EXPERIENCE OF THE NETHERLANDS

Tunnel	Date of exercises	Type of exercise
TUNNEL A2 LEIDSCHE RIJN (TERN > 500 m)	2011	Two multidisciplinary exercises (realistic in tunnel). These exercises were held prior to the (partial) opening of the tunnel in January 2012. The exercises connected to a wide range of mono-disciplinary training and exercises, and visits for the staff of the tunnel operator and the emergency services to the tunnel, the emergency rooms and the traffic control centre (education, coordination, testing, etc.).
BENELUXTUNNEL (TERN > 500 m)	2011	Multidisciplinary exercise (realistic in tunnel). The exercise started with the use of simulation images in the traffic control centre (severe collision). This resulted in a realistic handling of the incident through the operator(s) and the services at the area of the tunnel. The exercise scenario was practiced 2x in a variety of tunnel tubes.
	2002	Multidisciplinary exercise (realistic in tunnel).
BOTLEKTUNNEL (TER; > 500 m)	2010	Multidisciplinary exercise (realistic in tunnel).

TABLE 3 – EXPERIENCE OF THE NETHERLANDS (follow)		
Tunnel	**Date of exercises**	**Type of exercise**
THOMASSENTUNNEL (TERN > 500 m)	2009	Multidisciplinary exercise (realistic in tunnel). Including the release of toxic substances. In June 2012, again a multidisciplinary exercise will be held.
HEINENOORDTUNNEL (TERN > 500 m)	2009	Multidisciplinary exercise (realistic in tunnel).
TUNNEL DE NOORD (TERN > 500 m)	2006	Some small realistic exercises by local fire brigades. Including interpretation and testing equipment and systems (fire).
DRECHTTUNNEL (TERN > 500 m)	2012	Multidisciplinary exercise (realistic in tunnel). 2 pre-meetings to inform all parties involved in emergency response on the tunnel specific equipment (i.e. ventilation, evacuation routes) and revised emergency response procedures that are described in the emergency response plan.
	2005	Some small realistic exercises by local fire brigades. Including interpretation and testing equipment and systems (fire).
ROERTUNNEL (TERN > 500 m) + TUNNELSWALMEN (TERN; < 500 m)	2011	Multidisciplinary (system) exercise. The incident (disaster/ major accident) was not actually staged, but simulated by means of visual support.
	2009	Realistic object exercises for tunnel staff and fire (a total of 3 exercises). Including testing of systems / tunnel equipment, and practicing the road structure approach of the incident (emergency), etc.
	2007	Several exercises by emergency services (fire, police, ambulance), supported by the staff of the tunnel manager (realistic in tunnel).
SCHIPHOLTUNNEL (TERN > 500 m)	2008	Multidisciplinary exercise. The incident scenario (disaster/major accident) was also related to the Schipholtunnel and simulated by means of visual support. Including scaling to the board of the administrative authority and the tunnel manager/ Ministry of Transport and Environment.
WIJKERTUNNEL (TERN > 500 m)	2004	Multidisciplinary exercise (realistic in tunnel) (2x).
VLAKETUNNEL (TER; < 500 m)	2011	Multidisciplinary exercise (realistic in tunnel).
	2003	Multidisciplinary exercise (realistic in tunnel).

TABLE 3 – EXPERIENCE OF THE NETHERLANDS (follow)		
Tunnel	**Date of exercises**	**Type of exercise**
SIJTWENDETUNNELS: 1. SPOORTUNNEL (no TERN < 500 m)	2011	Multidisciplinary exercise (realistic in tunnel). The exercise started with the use of simulation images in the traffic control centre. This resulted in a realistic handling of the incident through the operator(s) and the services at the area of the tunnel. Prior to this exercise, 3 meetings were organised for managers and tunnel staff and staff of fire and police. At these meetings procedures were practiced using simulation.
2. PARKTUNNEL (no TERN < 500 m)	2003	Small coordination exercises fire (3x) (in tunnel and tunnel environment). Including interpretation and testing equipment and systems (fire).
ZEEBURGERTUNNEL (no TERN > 500 m)	2011	Multidisciplinary exercise (realistic in tunnel).
COENTUNNEL (no TERN > 500 m)	2001	Multidisciplinary exercise (realistic in tunnel).
VELSERTUNNEL (no TERN > 500 m)	2009	Multidisciplinary exercise (realistic in tunnel).
	2004	Table top exercises (models/Marquette).

5. NORWAY

There are more than 500 tunnels above 500 m operated by the NPRA (Norwegian Public Roads Administration)

Exercises for every fire- and rescue service are carried out every two years, not every tunnel since some communities have 10-15 tunnels that are very similar. Exercises are predominantly focused on Fire and Rescue Services response. The NPRA is responsible for ensuring the exercises take place, but the Fire & Rescue Service carry out the detailed planning and coordination of exercises together with the Tunnel Safety Officer.

This results in approximately 50-100 exercises per year of different types testing all tunnel equipment and staff and responders.

Some tunnel fire exercises are used to show the fire & rescue service how a real fire in one or two cars would develop in the tunnel, and how the ventilation copes with the smoke. I.e. they do not put the fire out but control the heat to prevent it damaging the tunnel walls and ceiling. Only very seldom is a full scale *"carry and comfort"* exercise carried out.


FIGURE 1 & 2 – FIRE EXERCISE IN A NEW TUNNEL IN NORWAY

Figures 1 & 2 of a fire demonstration in a new tunnel for the Fire & Rescue Service are showing that if a fire is too large, efforts are focused on cooling the structure rather than tackling the fire.

6. SLOVENIA

In Slovenia a general Rule Book on Exercises in the Field of Protection against Natural and other Disasters is in force. It is based on the Law of Protection against natural and other disasters, which is in domain of Ministry for Defence of the Republic of Slovenia.

The Rule Book details the exercises to be completed including the requirement for exercises for highway tunnels longer then 500m.

Paragraphs in the Rule Book are:

6.1. General Provision

6.2. Types and Goals of Exercises

Types of exercises depending on the scope and participants:

- small-scale exercises;
- verification of a comprehensive preparedness exercises;
- international exercises;
- other.

Types of exercises according to the organizers, the duration and means of verification standby:

- exercises organized by the Emergency Services and non-governmental organizations;
- one or more days;
- theoretical simulations, and operating procedures, practical or combined;
- purpose and objectives of the exercises.

6.3. Conducting Exercises

- design of exercises;
- coordination of exercises;
- contents of the plan for the implementation of exercises;
- decision on the implementation of exercises;
- exercise assumption;
- list of participants;
- exercise scenario;
- plan of imitation;
- communication connections;
- plan of the material-technical resources;
- plan of insurance of exercise area;
- plan of observation of exercise;
- financial plan;
- pr plan;
- instructions and a reminder for participants;
- preparation of a plan to carry out the exercise.

6.4. Management, Monitoring and Evaluation of Exercises

- head and leadership of exercise;
- observation and evaluation;
- criteria for evaluation ;
- assessment of exercise.

6.5. Analysis and Records

- analyse of exercise;
- report of exercise;
- record-keeping of exercises.

In the Rule Book there are no special paragraphs for exercises in highway tunnels. However type of exercises and their frequency in highway tunnels are prescribed in

the Regulation on technical norms and conditions for the design of road tunnels in the Republic of Slovenia, based on the Law for roads. These two regulations fully and in the same extend implement requirements of Directive 2004/54/EC on road tunnel safety also in exercise issues.

7. SOUTH KOREA

7.1. Legal basis

KEC (Korea Expressway Corporation, government invested company) is the biggest operation & maintenance authority in South Korea and it has about 4,000 km of expressway including 281 tunnels in operation as of 2010.

KEC established hierarchical and procedural regulations for emergency exercise which is done by annual plan and feedback.

- disaster and Safety Management Act;
- presidential Instruction 229 (Instruction for national crisis management);
- expressway Disaster Management Manual(2003);
- emergency Manual for Expressway Tunnel Accident (2006);
- action Plan for Expressway Tunnel Accident (2006).

7.2. Annual plan

KEC has done emergency exercises against tunnel fire since year 2002. Basically every branch office should practice one exercise per every year and, if they have tunnels longer than 1 km which are in operation, additional exercise per each should be done.

Detailed plan & method of emergency exercises are:

- objective;
- reduce the damage and casualties;
- minimise the traffic restriction;
- strengthen the cooperation (with fire brigade, police, etc.).

Target:

- all tunnels > 1 km;
- at least one tunnel for each branch office;
- integrate exercises when tunnels are in the same fire service district;
- integrate tunnel emergency exercises with other exercises such as against heavy rain and snow, etc.

Method (type of exercise):

- seminar;
- table top;
- control Post;
- live exercise;
- scenario.

Branch offices are supposed to make *"Scenario"* for each exercise to bring more reality to the exercise post and HQ provides 4 themes to be considered as following:

- **fire size:** 4 phases by the Heat Release Rate;
- **location of fire:** near entrance, Middle of the tunnel, Near Exit;
- **type of fire:** *"A: General"* to the *"E : Gas"*;
- **accessibility:** elapsed time for arrival of fire brigade.

Scenario can be varied and modified, such as random exercise by order from Regional office and/or exercise against terrorism in tunnel (In this case military forces are involved during live exercise).

7.3. Feed back

It is very important that HQ (and/or Regional Office) evaluate improvement performance from branch office and share them each other to plan and implement improved exercise next years. Following are the examples of typical improvement:

- tunnel Safety Theme Park at Service Area;
- Soonchun branch office built a Tunnel Safety Theme Park at Service Area, Sumjin Riv. where customers can experience the fire situation of tunnel and the facilities inside. They also can experience how to evacuate from the tunnel fire and use the fire hydrants.

EXTERIOR

INTERIOR

WATER HYDRANTS

Video Clips – How to react against tunnel fire:

Honam Regional office brought up very important issue about how they can teach the new operators and/or people who's not familiar with tunnel fire reaction. They made video clips and send it to HQ to share with. HQ supervised and revised it before distribute it to whole operators and managers in KEC.

Branch offices bring up some financial issues which are related to the improvement and/or replacement of facilities in the tunnel. During the Exercise they are supposed to use and activate the facilities in tunnel, they can easily find some deficiencies and defects then investigate them to find out if they need to be fixed or replaced.

HQ evaluates those issues and makes a financial decision to support them.

HQ also implements analysis of real fire case (expressway tunnel fire accident) every year. It is an important reference how much the exercises can help operators and organization to react the real fire case. For example, elapsed time to arrival of fire brigade on year 2009 was dramatically decreased from the average of last five years. [Expressway tunnel fire case analysis, paper of ITS Busan, 2010].

8. UNITED KINGDOM

Extract from Highways Agency Guidance BA 72/03 Appendix f - Guidance on Emergency Exercises.

During the planning and design of a road tunnel potential incidents and emergencies should be identified and related to the tunnel layout and to standards of equipping communications, traffic information and control systems. Formal risk assessments should be carried out and recorded for each of the identified risk scenarios. Having identified, defined and ranked the scenarios, appropriate response strategies should be developed to deal with them and incorporated into the Tunnel Operator's Manual and the Operational Manuals of the Police and the Emergency Services.

It is important to test the effectiveness of such response strategies in a realistic exercise before the tunnel is opened to traffic and amend them based on lessons learnt from the exercise. It is good practice for the future tunnel operator to be fully involved with the exercise.

The same procedures are applicable when a road tunnel is refurbished, modified or when there is any change in the organisations operating the road tunnel or attending emergencies.

Regular emergency exercises should be carried out throughout the operational life of the tunnel to ensure the continued effectiveness of the planned response strategies.

It is common practice in the police and the Emergency Services for personnel to be rotated between postings. Regular emergency exercises help the new staff to become familiar with the response strategies and the road tunnel and to meet colleagues from the other services and develop good relationships in a non-critical setting.

8.1. Frequency of Exercises

- Exercises should be undertaken:

  – before a new tunnel is opened to traffic;
  – when a tunnel is modified or refurbished;
  – as part of the Principal Mechanical & Electrical inspection, this is normally carried out every 3 years.

HOLMESDALE TUNNEL EMERGENCY EXERCISE, M25 UK

APPENDIX C – EUROPEAN DIRECTIVE 2004/54/EC GUIDELINES

Item 5 of Appendix II: "Approval of the design, safety documentation, commissioning of a tunnel, modifications and periodic exercises" of the Directive stipulates that :

Periodic exercises

The Tunnel Manager and the emergency services shall, in cooperation with the Safety Officer, organise joint periodic exercises for tunnel staff and the emergency services.

Exercises :

- should be as realistic as possible and should correspond to the defined incident scenarios;
- should yield clear evaluation results;
- should prevent any damage to the tunnel;
- may also, in part, be conducted as table top or computer simulation exercises for complementary results.

a. Full scale exercises under conditions that are as realistic as possible shall be conducted in each tunnel at least every four years. Tunnel closure will only be required if acceptable arrangements can be made for diverting traffic. Partial and/or simulation exercises shall be conducted every year in between. In areas where several tunnels are located in close proximity to each other, a full scale exercise must be conducted in at least one of those tunnels.
b. The Safety Officer and the emergency services shall evaluate jointly these exercises, draw up a report and make appropriate proposals.