

CROSS-BORDER TUNNEL INTERVENTION MANAGEMENT: GUIDELINE PROPOSALS FOR THE EUROPEAN UNION

N. Rosmuller
NIBRA, The Netherlands

ABSTRACT

Cross-border aspects hampered the emergency response actions in for example the Mont Blanc tunnel inferno and the Eurotunnel fire. The EU recognized cross border issues and aimed at harmonizing the various procedures and appointment in the EU [EU, 2004].

To harmonize the cross-border aspects of tunnel emergency response actions, and part of broader European Union program, called SafeT, Nibra [2005] studied typical cross-border intervention aspects and formulated guidelines. Literature study and case studies of the Mont Blanc and the Eurotunnel revealed the elementary cross-border aspects that hampered tunnel emergency response actions. A study of operational tunnel procedures of the Fréjus (France and Spain), Chunnel (France and United Kingdom), Öresund (Denmark and Sweden) and Karawanken (Austria and Slovenia) revealed multiple solutions to deal with various cross-border aspects, which resulted in fourteen guidelines. The guideline proposals concern both language issues and issues such as coordination, organization, training and liability.

1. INTRODUCTION

In Europe, an increasing number of road tunnels are realized. In 2002, 398 Trans European Network (TEN) tunnels existed, and between 2002 and 2010, additional 114 TEN road tunnels will be operated [1]. Several of these tunnels cross national/juridical borders, such as the Mont Blanc (France-Italy) or the Somport (Spain-France). A number of large-scale tunnel accidents, such as in the Mont Blanc and The Eurotunnel made clear that accidents in tunnels may have some particular aspects in situations, in which more than one country is involved. Examples of these are the language problem between the French and Italians and the differing administrative levels involved between the French and the British. Apart from these special issues there also is a lack of knowledge in general of how deal with cross-border aspects when dealing with tunnel incidents.

In particular the cross-border aspect may hamper the evacuation of people in tunnels in case of an accident by among other things the language problems mentioned above, as was recognized by the EU:

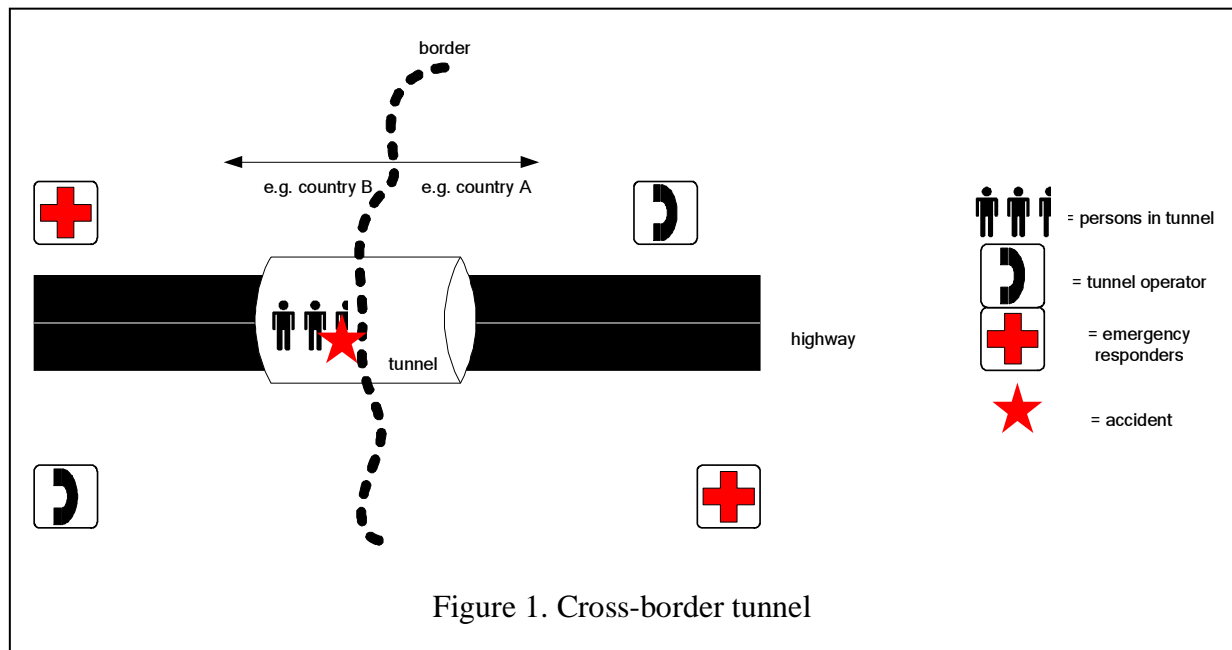
"Insufficient co-ordination has been identified as a contributory factor to accidents in trans-boundary tunnels. Moreover, recent accidents show that non-native users are at greater risk of becoming a victim in an accident, due to the lack of harmonisation of safety information, communication and equipment" [EU, 2004].

In this paper the aspects that are involved cross-border tunnel incident management are discussed and guidelines are proposed to improve the management of this type of incident. In

section two, we present the research approach. Section three provides the data and the analysis thereof. In section four, we draw the conclusion of research and propose guidelines for cross-border tunnel incident management. The paper concludes with a discussion on the research in section five.

2. RESEARCH APPROACH

A cross-border situation is any situation where tunnels or infrastructure crosses national borders or borders between autonomous regions within countries, such as the Bundesländer in Germany, the Cantons in Switzerland, the counties in Norway, the departments in France or the provinces in Greece, Spain and the Netherlands. This definition of cross-border is broader than only trans-boundary situations: cross-border situations within countries (e.g. juridical autonomous regions), might involve typical problems with regard to legislation and administrative levels during emergency management as well. In the annex of Nibra [2005], based upon <http://home.no.net/lotsberg/>, a list of European cross-border tunnels is presented. Figure 1 visualizes a cross-border tunnel and the parties involved in incident management.



For a situation such as presented in figure 1, the question is what typical cross-border issues are involved in incident management. To assess the cross-border issues, a four-step research approach was followed.

- Phase 1: In order to develop structural knowledge with regard to cross-border evacuation management for tunnel situations, draw lessons from cross-border emergency management in general. Hence, apart from tunnels and evacuation, cross-border emergency response activities might give clues for aspects that need to be considered for tunnel situations as well. Hence, literature and the Internet were searched for clues with regard to cross-border emergency response activities; such as for example cross-border wood fire or earth quakes.
- Phase 2: Several large-scale cross-border tunnel accidents were selected such as the Mont Blanc inferno (1999) and the Eurotunnel accident (1996). The investigations reports and

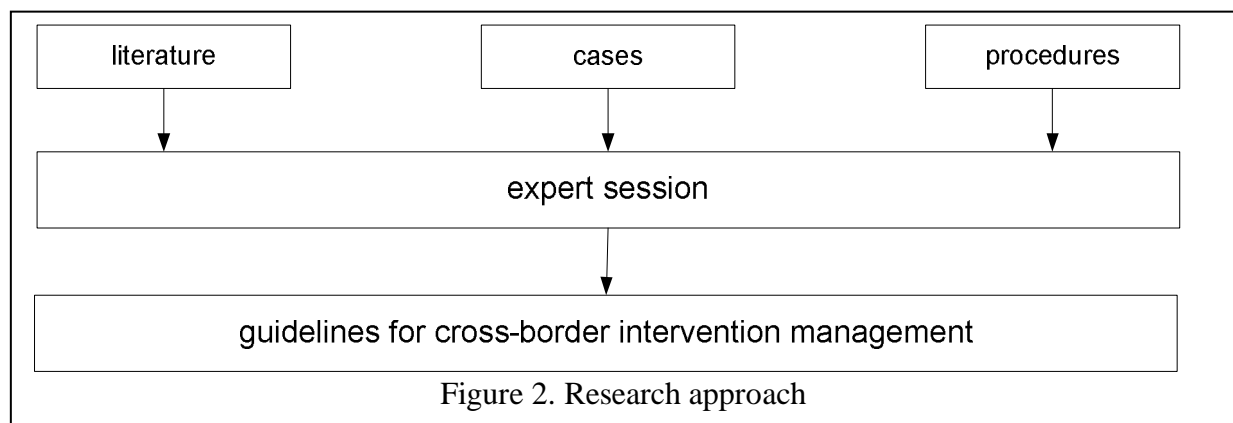
the recommendations have been studied, in particular searching for cross-border evacuation aspects.

- Phase 3: To assess cross-border tunnel procedures, an overview of cross-border tunnels in Europe was developed. Subsequently, we selected several tunnels for a closer view on the cross-border aspects. Selection criteria that were used are the size of the road (national roads/highway), (inter)national (involving multiple countries), and trans-boundary (involving multiple autonomous regions within a single country). For the selected tunnels, a study into the procedures was conducted.

Based upon literature, case studies and the analysis of procedures a draft document with proposals for cross-border tunnel incident management was written.

- Phase 4: The proposed guidelines were discussed by a pan-European group of tunnel safety experts, in the end resulting in a final set of incident management guidelines for cross-border tunnels.

The four-phase research approach is visualized in the figure 2.



3. DATA ANALYSIS

Following the four phase research approach described above, in this section we will present the data obtained by literature study, case study analysis of procedures and expert sessions and subsequently conduct the analysis.

3.1 Literature

Cross-border evacuation management itself is not specific for tunnels. Other application fields were found, such as natural disaster management (e.g. bush fires, floods, earth quakes). In the spring and summer of 2004, we searched the journal of Tunneling and underground space technology and the Internet. The former did not generate relevant information for this research. The Internet was searched in march 2004 (Google) based on a number of search strings as depicted below:

- border evacuation management plan; cross-border evacuation plan; cross-border evacuation management plan;
- cross-border emergency evacuation; trans-frontier emergency evacuation; cross-border evacuation procedure; cross-border emergency operations; cross-border emergency tools; cross-border emergency management; cross-border incident management; cross-border fire fighting;

- tunnel evacuation management procedure cross-border; tunnel evacuation procedure cross-border; tunnel evacuation management procedure; tunnel evacuation procedure; tunnel evacuation cross-border; tunnel evacuation cross-border; evacuation cross-border; tunnel cross-border issues; tunnel cross-border procedures.

The information found could be ordered by phase of the so-called safety chain: preparation – consisting of proaction and prevention –, suppression – consisting of preparation and suppression – and post-event care [BZK, 1993]. However, because the focus is on reacting to accidents (evacuation), the phase's proaction and prevention are left out here. Proaction and prevention deal with causes of an accident. Prevention could for example involve escape route or cross passages.. Table 1 summarizes the aspects that have been identified and to which attention has to be paid in cross-border tunnel incident management. In the first row, the phase of the safety chain is given. Below each of these phases the relevant cross-border aspect are listed. In this table, in preparation information and communication are especially important. A specific subject in this category is the language in which actors communicate.

Preparation	Suppression	Post event care
administrative arrangements ¹	Scenario prediction	casualty information
organizational structure	information and communication	accident investigations
operational procedures	on-scene actions	juridical investigations
Planning	technical measures	insurance procedures
Resources		securing possessions of victims
Exercises		
information and communication		
technical measures (other than inf. and communication)		

Table 1. Cross-border evacuation aspects

3.2 Case studies

In this paragraph, we will summarize the main cross-border evacuation lessons that have been learned from two major cross-border tunnel accidents: the Eurotunnel (1996) and the Mont Blanc Tunnel (1999).

Eurotunnel tunnel fire (November 18th, 1996)

In November 18th, 1996 a severe fire occurred in the 50-kilometre Eurorailtunnel between the united Kingdom and France. One of the trucks on the train caught fire before the train entered the tunnel. The train was one of the Euro tunnel's lorry shuttles on which the truck drivers travel in a separate car next to the locomotive. There were no fatalities, 2 persons got injured. The damage to the tunnel was huge. Persons in the staff car and the truck drivers managed to evacuate through the neighboring door leading to the parallel service tunnel. After 29 hours, the fire was under control [Desfray and Beech, 1997].

Cross-border lessons from this incident are:

- As the two nations on both sides of the tunnel speak different languages, it is necessary to take care of good coordination and communication. It is of paramount importance/essential to have the fire fighters both from the first line and from the second line of response (FLOR and SLOR) train practice together so that they're familiar with each other's equipment and tactics.

¹ See for example the bi-national agreement between The Netherlands and Belgium in the Brabant border area with regard to cross-border emergency response protocol.

- As a results of the lessons learned form the accident, exercises between the FLOR units and external units take place regularly.
- Also members of both the French and the English fire brigades now patrol the service tunnel in order to reduce response time to an incident.
- Communication was one of the major problems. Emergency personnel now are provided with a special handset, which they can plug into the landline when they arrive on the scene in the service tunnel.
- Radio frequency and the channels to use for communication are standardized for the French and the English side.
- A strict accountability system has been introduced in order to cope with the former personnel accountability. Both in Calais and in Folkestone are control boards.

Mont Blanc tunnel fire (March, 24th, 1999)

March 24th, 1999 a severe fire took place in the 11,6 km long Mont Blanc road tunnel between France and Italy. A lorry with flour and margarine got on fire. After several days, the fire was extinguished. In the end 39 fatalities were counted (including a fire fighter, tens of vehicles were destroyed and the tunnel was heavily damaged. It took about 55 hours to gain full control over the fire. The tunnel was reopened in 2002, march, 9th [Duffé and Marec, 1999].

Lessons learned from this incident:

- The installation of a SINGLE centre. There now is a main command post on the French side and a back-up command post at the Italian side, manned around the clock.
- First rescue services at both portals are coordinated.
- It is recommended to have one operating company in charge, even if there are more lessees, so the operating and investment policy is valid for the tunnel as a whole.
- Good communication inside the tunnel is indispensable during a crisis.
- Regular drills in which participate both nationalities have to be held.

3.3 Some cross border tunnel procedures

Cross-border tunnels are not new. These tunnels already exist and it might be that tunnel operators and emergency responders have already prepared covered cross-border aspects in order to facilitate evacuations from people that have become part of a tunnel accident. For tunnels in the Netherlands evacuation plans proved hardly to have been developed. Therefore, we searched several evacuation management procedures of existing cross-border tunnels.

To get the information of cross-border cooperation in general and with regard to cross-border evacuation management in particular, we followed three strategies:

- the SafeT partners where asked (minutes, action A-37,) in the Vienna meeting (June 2004) and in August 2004 to submit tunnel specific guidelines or national regulations [SafeT meeting, 2004].
- in December 2004, several tunnel experts in France, Slovenia, Sweden, Austria and the UK where asked by e-mail to submit tunnel specific guidelines or national regulations.
- in December 2004, the helpdesk of the tunnels as mentioned in table where asked by e-mail to submit tunnel specific guidelines or national regulations.

Table 2 lists the tunnels for which evacuation management information was received and for which subsequently emergency response procedures have been studied.

Tunnel	Between
Fréjus ²	France – Italy
Öresund ³	Denmark – Sweden
Eurotunnel (rail)	France – United Kingdom
Karawanken	Slovenia – Austria

Table 2. Tunnels of which incident management procedures have been studied

Below, we summarize the most important findings per tunnel with regard to cross-border incident management.

We conclude that several tunnels have already incorporated cross-border aspects in their evacuation and intervention management. However, there is a variety in cross-border aspects that are covered. Table 3 summarizes the results of the evaluation. In this table, the first row lists the cross-border tunnel; the first column lists the various cross-border aspects. The cells indicate (using √) per tunnel if the particular cross-border aspect is incorporated in the evacuation and intervention management.

	Fréjus	Öresund	Eurotunnel	Karawanken
bi-national emergency plan	√	√	√	
multi language emergency plan	√	√	√	
International cooperation of tunnel providers	√	√	√	√
One single commander in emergency management	√	√		
communication appointments	√	√	√	
Organizational match	√		√	
multi language user warnings		√		√
hybrid (bi-national) fire hydrants		√		
bi-national incident evaluation		√		
bi-national exercises		√	√	
emergency responders permission to cross-border		√	√	√

Table 3. Cross-border aspects in several TEN-tunnels

Sources:

Fréjus: SITAF and SFTRF, 2004.

Öresund: e-mail contact with health and safety manager of the Öresund.

Eurotunnel: Johnson, 2000.

Karawanken: Austrian and Slovenian Ministries of Transport, 1997 and 2003.

3.4 Expert session

Several draft documents [2] were sent to the SafeT partners (see www.safetunnel.nl for the partners and the involved experts). In November 2005, 12 proposals for guidelines were discussed by the partners. The experts supported the proposed guidelines. During these discussions, two additional subjects for guidelines were mentioned:

- Language between emergency responders
- Compatibility of emergency response communication systems

These additional subjects were subsequently incorporated in the guidelines as well.

² The research conducted after the Fréjus tunnel took place before the early June 2005 tunnel accident.

³ The Öresund tunnel connects Denmark and Sweden, but is completely on Danish territory.

4. CONCLUSIONS

Based upon the results of the investigation recommendation can be made or cross-border tunnel evacuation management. Some of the guidelines are specific for cross-border tunnels between countries with different languages (these are indicated with *).

1. the involved countries that are crossed by the tunnel should make appointments with regard to one sovereignty
2. at each TERN tunnel and with regard to intervention aspects, tunnel users should be informed in English and language(s) of the two countries that are crossed by the tunnel
3. for all TERN tunnel, the (intervention) information to the users should be provided using the same information format (harmonized)
4. for each TERN tunnel, the contingency plans should be prepared in the language(s) of the countries that are crossed by the tunnel*
5. for a whole TERN tunnel, there should be appointed one single primary official who is in the lead with regard to the emergency response intervention, including communication to the tunnel users, exploitation of tunnel installations, and emergency response tactics
6. communication between the responsible officials for the intervention management, should be in a predefined language*
7. countries' communication systems in use during intervention management should be compatible
8. the organizational structure of the emergency response teams (administrative as well as operational) should be matched between the two countries that are crossed by the tunnel
9. the emergency response teams in both countries that are crossed by the tunnel should use the same intervention scenarios
10. emergency response resources (material and equipment) should be useable in both countries that are crossed by the tunnel
11. emergency response training exercises should be held involving both countries that are crossed by the tunnel
12. in each country that is crossed by the tunnel, a casualty centre should be activated in case of an emergency. The coordination should be appointed to one single organization
13. one single insurance procedure must cover the complete tunnel
14. actual emergencies in tunnels should be investigated involving parties of both countries that are crossed by the tunnel

These recommendations should be the basis of the emergency arrangements for individual tunnels, which means that for each tunnel, these recommendations should be specified according to specific tunnel and regional characteristics. For example, for the Mont Blanc tunnel, guidelines 2, 4 and 6 could be further specified because in this tunnel users should be informed in English, French and Italian, contingency plans should be available in French and Italian, and it should be specified what will be the language to be used for communication between the Italian and French fire commander.

5. REFERENCES

1. Austrian and Slovenian Ministries of Transport, 1997, "Vertrag zwischen der Republik Oesterreich und der Sozialistischen Föderativen Republik Jugoslawien über den Karawankenstrassentunnel".

2. Austrian and Slovenian Ministries of Transport, 2003, "Beförderung gefährlicher Güter durch den Karawankenstrassentunnel".
3. BZK, 1993, "Integraal Veiligheidsbeleid", Ministerie van Binnenlandse Zaken, Den Haag.
4. Desfray, P.M. and J. Beech, 1997, "Inquiry into the fire on heavy goods vehicle shuttle 7539 on 18 November 1996", Department of the Environment, Transport and the Regions GB.
5. Duffé, M. and P. Marec, 1999, "Technical investigation of the 24 March 1999 fire in the Mont Blanc Vehicular Tunnel".
6. EU, 2004, "Directive of the European Parliament and the Council on the minimum safety requirements for tunnels in the Trans-European Road Network", 2004/54/EG, Brussels.
7. Johnson, E., 2000, "Talking across Frontiers", *International Conference on European Cross-border Cooperation: Lessons for and from Ireland*, pp 1-23, Queen's University Belfast, 29/9/00-1/10/00, Belfast.
8. Nibra, 2005, "Cross-border intervention management", D3.3 report, 5th Draft, December 2005, Arnhem.
9. SafeT meeting, 2004, "SafeT minute", Vienna, 2004.
10. SITAF and SFTRF, 2004, "Plano di soccorso binazionale: Traforo Autostradale del Fréjus/Plan des secours bi-national: Tunnel routiers du Fréjus" (translated Bi-national Emergency Plan of Intervention for Security in the Fréjus tunnel).