Association mondiale de la Route

ANNEXES DU RAPPORT DU C18 "ÉTUDE SUR LA GESTION DES RISQUES ET DES CRISES TOUCHANT LES ROUTES"

World Road Association

APPENDICES TO C18 "STUDY ON RISK MANAGEMENT FOR ROADS

2005

Comité AIPCR Gestion des risques (C18)
PIARC Committee on Risk Management (C18)

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ANNEXE 1: INTERNATIONAL SURVEY ON RISKS CLASSIFICATION OF RISKS

1. INTERNATIONAL SURVEY ON RISKS

1.1. Purpose of survey

The purpose of the international surveys on risks on roadways is to allow a first identification and classification applied in various countries and thereby to summarise risk and crisis management practices in countries that are advanced in these fields. The first survey allows data to be collected and the second survey provides analysis in more details. Their results set guidelines and recommendations for risk and crisis management. The following presentation represents an indicative list but is not exhaustive.

1.2. Survey Forms

First Survey

Survey forms of the first survey in the year 2000 are shown in the Appendix 1.1. of this chapter.

Second Survey

Survey forms of the second survey in the year 2000 are shown in the Appendix 1.2. of this chapter.

1.3. Summary of results of surveys on natural disasters, before 1999

The G2 group conducted a first questionnaire survey on road disasters in 1991 and 1996, and collected information concerning the likely types of damages to road and road transportation facilities. The G2 received answers from 21 countries. Road disasters can be classified into five groups as follows:

1. Landslide, including debris flow, rock falls, and slope failure,
2. Earthquake,
3. Flood,
4. Snow Avalanche,
5. Other hazards: volcanic eruption, tsunami, storm surge, dense for, heavy snow, strong wind, wildfire, sand accumulation and downburst for example.

Natural Disasters Until 1999

The G2 Group received responses from 29 countries at the second survey. The new survey covered the 1994 Northridge Earthquake, the 1995 Kobe Earthquake and other recent major disaster in the world. From the survey it was found out that landslides and floods most frequently occurred among the four major disaster categories of landslides, earthquakes, floods and avalanches. The number of countries reported earthquake damages depends on the location of each country. Other disasters reported were volcano eruption, cyclones, rock-fall, snow blizzards and wind storms.

Table 1.1 Number of Various Natural Disasters Causing Major Road Damages

(Reported from 29 Countries: 1996 Survey)

Country	Landslide	Earthqua-ke	Flood	Avalanche	Others/Notes
Australia	-	-	7	-	Bushfires
Bahamas	-	-	1	-	More minor floods
Canada-Quebec	6	1	143	-	Floods between 1990 and 1996 reported
Chile	1	1	1	-	Mud flows
Colombia	Many	1	-	-	
Congo, Democratic Republic of	-	-	-	-	
Cuba	-	-	4	-	Caused by hurricanes
Denmark	-	-	*	-	Floods of harbour report
Finland	-	-	-	-	No large scale disasters
France	7	1	4	4	Emergency plan
Germany	5	-	8	*	Rock fall
Greece	2	-	1	-	
India	6	4	4	3	Damages by cyclones
Ireland	-	-	-	-	Emergency plan
Japan	9	5	4	3	Volcano eruption
Lithuania	-	-	1	-	
Malaysia	2	-	-	-	
Mexico	267	-	2	-	Minor disaster included
Nepal	3	-	8	-	
Netherlands	-	-	1	-	
New Zealand	1	-	2	*	Minor snow avalanche
Norway	2	-	1	-	Snow blizzards
Poland	-	-	-	-	Small landslides exist
Slovakia	-	-	1	-	
Slovenia	2	-	2	-	
Spain	-	-	5	-	
Switzerland	1	-	4	*	Yearly avalanche
U. K.	-	-	5	-	Snowfalls
U. S. A.	-	1	5	-	Wind storms

1.4. Summary of the results of C18 survey

1.4.1. First Survey

PIARC C18 conducted a survey in November 2000 to gather information relating to the likely types of risks and damages to road and road transport facilities which may cause major socio-economic problems as a result of human and industrial activities as well as natural disasters in PIARC member countries. Information was also sought on organisations, manuals and other data dealing with risk management in each country.

The C18 received responses from 31 countries out of 92 countries to which questionnaire was sent. The names of thirty-one countries for the survey are Australia, Austria, Belgium, Bulgaria, Canada, Chile, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Japan, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Philippines, Poland, Slovenia, South Africa, Sweden, Chad, Turkey, U.K., U.S.A. and Zimbabwe. They reported major disasters to road since 1990.

From the survey it was found out that disasters caused by incidents during transportation of dangerous goods most frequently occurred in the category of human, social and industrial disasters (man-made disasters). Other major risks on or near roads reported on the Form I and Q 1 are fires in tunnels, fires near roads, chemical industry accidents, nuclear energy accidents, terrorism and miscellaneous other events.

The survey indicates that the results of previous studies on natural disasters by G2 are confirmed.

Social and Industrial Disasters (Form I)

Each country was expected to enumerate up to 5 examples of each of major types of recent (in last ten years) human, social, or industrial disasters (man-made disasters) that have caused road catastrophe in the country. The table summarised the results in each country.

Table 1.2 Summary of Major Human, Social or Industrial Disasters (man-made)

Country	Kind of Disasters	Kind of Damages (Casualty, Property Damages)
Australia	Ship collision to a bridge Transport of dangerous materials and accidents	12 dead. 3 span bridge collapsed closing traffic for 34 months.
Austria	Fire in tunnel	12 dead. Tunnel closed for 3 months. (Tauern Tunnel)
Belgium	-	
Bulgaria	-	
Canada	Civil unrest, chemical release (by traffic accidents), fire and explosion caused by traffic accident,	
Chile	Oversized (height) loading	
Czech Republic	-	
Denmark	-	

Finland	Railway accident, forest fire, transport of dangerous goods,	TDG caused fire resulting in the over-bridge collapse
France	Fire in tunnel	40 dead, tunnel closed for two years (Mont-Blanc Tunnel)
Germany	-	
Greece	-	
Holland	-	
Hungary	Taxi drivers' blockade, ammonia spillage, wartime explosive	TDG caused several injured.
Italy 1939-45	War bomb, chemical-industrial disaster	
Japan	Nuclear energy plant accident next to roads	Road blockage continued for maximum about 20 hours.
Latvia	Tanker overturn under viaduct	Viaduct structure demolished
Luxembourg	Tanker accident, airplane crash to roads, explosion	All involved deaths and injured.
Mexico	Derailment, explosion of chemical plant, dam collapse,	
New Zealand	Hazardous/toxic spills- tanker overturn, over (and oversized) loading, insecure loading, vehicle mechanical faults, aircraft crashes, fires next to roads, terrorism, strikes, outbreaks of disease	
Norway	Explosion in road tunnel under construction	3 dead and 14 injured
Philippines	Civil disturbances, bomb explosion,	No infrastructure damages were reported.
Poland	-	
Slovenia	-	
South Africa	Tanker carrying LP gas overturn causing fire, trailer overturn spilling a load of paint-related products, head-on collision, toxic spills, fire next to roads	
Sweden	-	
Chad	-	
Turkey	-	
U.K.	Terrorist bomb, fuel duty protests	Flyover was affected by the bomb.
U.S.A.	**Impossible for FHWA to complete Form I and II with accuracy due to decentralised record-keeping system.	
Zimbabwe	Traffic accidents	3 accidents with a lot of casualties were reported

Note: TDG: Transport of Dangerous Goods

During the survey / study period a major disaster occurred in Switzerland: fire in tunnel with 11 dead and tunnel closed for two months (Saint Gotthard Tunnel - 24.10.2001).

Natural Disasters (Form II)

Table 1.3 Summary of Major Natural Disasters

Country	Landslides	Earth-Quakes	Floods	Avalanches	Other Hazards
Australia	2	-	12	-	Bushfires, Cyclones
Austria	2 *	-	-	6	*Including rock fall.
Belgium	-	-	-	-	Bad weather in winter
Bulgaria	1	-	3	-	90 days of road blockade during the landslide.
Canada	2	-	8	-	Snowstorm (4), Ice storm (1)
Chile	1	2	2 *	-	*Mud flood (2)
Czech Republic	5	-	5	-	
Denmark	-	-	-	-	Gale
Finland	-	-	-	-	All minor damages
France	1	-	2	1	Windstorm
Germany	-	-	-	-	
Greece	1	-	-	-	
Holland	-	-	1	-	Fog
Hungary	1	-	4	-	Heavy snow, rainstorms
Italy	-	4	13	-	
Japan	2 *	1	-	-	*Including rock falls. Heavy rainfalls by typhoon
Latvia	-	-	-	-	
Luxembourg	-	-	-	-	
Mexico	-	1	4	-	Volcanic eruption
New Zealand	3	1	1	1	
Norway	1	-	-	1	
Philippines	-	-	3	-	La Nina
Poland	-	-	1	-	
Slovenia	2	1	1	-	
South Africa	-	-	3	-	One of the floods caused 101 death and road blockage of 2 to 10 weeks.
Sweden	-	-	4 *	-	*Heavy rain (4), heavy snowfall
Chad	-	-	-	-	
Turkey	-	1	1	-	
U.K.	-	-	1	-	Widespread area in England
U.S.A.	**				** same as in the table 2
Zimbabwe	-	-	1	-	Maximum road blockage duration was 8 weeks.

Questionnaire (Form III)

Q 1 Kind of Risks on the Roadway

1. Aircraft crash, Hazardous material incidents, Explosion, Structural failure, Overloading, Objects on roads, Spillage of toxic materials, Collision with trains Collision with animals, Collision with highway structures, Transport of dangerous goods (Australia).

2. Overloading (height, weight); Bad maintenance of vehicles; Vandalism; Transport of dangerous goods (Chile).
3. Large fires near to transport routes; Nuclear energy accidents; Chemical industry accidents; Traffic accidents involving release of toxic/ radio active/ combustible materials; Traffic congestion; Terrorism; Military threats (Czech Republic).
4. Hazardous goods transport; Heavy goods transport (Denmark).
5. Fire in tunnel (Italy, France, Switzerland, Austria).
6. Dangerous materials spillage; Fire; Airplane crash to road (Mexico).
7. Transportation of dangerous goods (Sweden).
8. Mines; Explosives (Chad).
9. Toxic chemical spills resulting from accidents. (U.S.A.).

Q 2 Is there a specific organisation that deals solely with the Risk Management Policy beside the Public Works Department or Ministry?

1. Road & Traffic Authority, Environmental Protection Agency (NSW-Australia).
2. Permanent Commission for Defence (Bulgaria).
3. Emergency National Office, Ministry of Interior (Chile).
4. Danish Emergency Management Agency (Denmark).
5. Ministry of Interior (France).
6. Civil Protection Department (Italy).
7. General Direction of Civil Protection, National Center of Prevention of Disasters (Mexico).
8. Ministry of Justice (Norway).
9. Swedish Rescue Service Agency (Sweden).
10. Federal Emergency Management Agency (U.S.A.).

Other countries that replied “Yes” are: Belgium, Canada, Poland, Turkey and Japan.

Q 3 Is there an Emergency Manual (or Emergency Procedure) in your Government?

Yes: Australia, Belgium, Bulgaria, Canada, Chile, Holland, Japan, Luxembourg, Mexico, Norway, Poland, Slovenia, Sweden, Turkey, U.K., U.S.A.

Under Planning: Czech Republic, Finland, Italy, South Africa

Q 4 Is there an Emergency Manual specifically edited for road management in your government?

Yes: Australia, Canada, Holland, Italy, Japan, Mexico, Norway, Sweden, U.K., U.S.A.

Under Planning: Belgium, Bulgaria, Chile, Finland, France, Luxembourg, Poland

Q 5 Are there any regulations in your government with regard to the following items in order to maintain traffic safety?

A. Transport of hazardous materials

Yes: Australia, Austria, Belgium, Bulgaria, Canada, Czech Republic, Chile, Denmark, Finland, France, Holland, Hungary, Japan, Latvia, Luxembourg, Mexico, Norway, Poland, South Africa, Slovenia, Sweden, Turkey, U.K., U.S.A.(Each State)

Under planning: Italy, Chad

B. Laws imposing penalties or fines for those who release dangerous goods on roads.

Yes: Australia, Austria, Bulgaria (Road Law), Canada, Czech Republic, Chile, Denmark, Finland, Holland, Hungary, Latvia, Luxembourg, Mexico, Norway, South Africa, Slovenia, Turkey, U.K., U.S.A.(Each State)

Under planning: Italy, Chad

C. Load limits on tires, axles and total vehicle weight.

Yes: Australia, Austria, Belgium, Bulgaria, Canada, Czech Republic, Chile, Denmark, Finland, France, Holland, Hungary, Japan, Latvia, Luxembourg, Mexico, Norway, Poland, South Africa, Slovenia, Sweden, Turkey, Chad, U.K.

Q 6 In relation to Q5, are there any fieldwork manuals that describe dangerous materials, the way to designate routes to be used by vehicles carrying dangerous materials and how to treat such materials once they are spilled on the road surface?

Yes: Australia, Austria, Belgium, Canada, Denmark, Finland, Holland, Hungary, Japan, Latvia, Norway, South Africa, Turkey (in Turkish), Sweden, U.S.A. (States)

Under planning: Mexico, Poland, Slovenia

Q 7 What public agency is responsible to inspect security of loads? Is there any legal punishment for release of materials on roads?

1. Police (Australia, Austria, Bulgaria, Finland, Holland, Italy, Japan, South Africa, Slovenia, Sweden, U.K.)
2. Department of Traffic and Works, Road Restraint Guide (Australia)
3. Norwegian Public Road Administration (Norway)
4. General Directorate of Federal Autotransport (Mexico)
5. Provincial Department of Transportation (Canada)

6. National Roads Directorate of the Ministry of Public Roads (Chile)
7. Ministry of Transport and Roads, Local Administration, Police (Czech Republic)
8. Federal Motor Carrier Safety Administration (U.S.A.)

Yes: As above and Belgium, Denmark, Luxembourg, Poland, Turkey, and Sweden

Under planning: Hungary, Latvia, Chad

Q 8 If there are load restrictions on the wheel, axle or total weight please describe the weights.

1. Wheel ( ) ton
2. Axle ( ) ton
3. Total Weight ( ) ton

Table 1.4 Weight Limits unit: ton

Country	Wheel Weight	Axle Weight	Total Weight	Total Weight	Remarks
Australia	-	6(single tire), 9(dual, tire axle)	15 (2 axles), 22.5 (3 axles), 26(4 axles), 42.5	42.5	
Austria	-	-		38	
Belgium	-	10, 12 (drive axles)	19 (2 axles), 26 (3 axles) 32 (4 axles), 39 (4 axle trailers), 44 (5/6 axle trailers)	44	
Bulgaria	-	11.5		40	
Canada	-				Determined by States
Chile	-	25 *		45	As max. 3 double axle
Czech Republic	-	10, 11.5 (drive axles)	18 (2 axles), 25 (3 axles) 32 (4 or more)	48	
Denmark	-	10	-	-	
Finland	-	10, 11.5 (drive axles)		60*	*More than 7 axles
France	-	-			
Germany	-	-			
Greece	-	-			
Holland	-	-			
Hungary	-	10, 11 (special case)	20 (2 axles), 24 (3 axles) 30 (4 or more)	40*	*5 or more wheel vehicles

Italy	-	8 (2 axle vehicles), 10 (3 or more axle vehicles)	24 (3 axles), 40 (4 or more axle vehicles)	44*	*5 or more axle vehicles
Japan	5	10	20, 25 (designated highways)	27*, 36**	*trailer on other highways, **on expressways,
Latvia	-	10		40	
Luxembourg	-	13		32 44*	*trailer
Mexico	-	24.5		66.5	
New Zealand	-	-		-	
Norway	-	10		50	
Philippines	-	-		-	
Poland	-	8 - 10		42	
Slovenia	-	10		40	
South Africa	4	9.2		56	
Sweden	-	10, 11.5 (drive axles)		60	
Chad	6.5	13			
Turkey	-	10, 11.5 (drive axles)	18 (2 axles), 25 (3 axles) 32 (4 axles),	40*	*five or more axle vehicles, and trailers
U.K.	5.75	11.5	40 (5 axles), 41 (6 axles)	44	
U.S.A.	-		36 to 50 on interstate highways	50	Imposed by the States
Zimbabwe	5	10		56	

Q 9 At the road planning stage, do you have to consider avoiding any industrial or social facilities in locating the routes from the viewpoint of risk management? If there are any regulations please describe it.

1. Environmental Impact Assessment should include such risk management (Australia)
2. No specific regulation, but it is included in the EIA procedure (Austria).
3. Specified by the Road Design Standards (Bulgaria).
4. Risk are clarified on the basis of industrial or social activities by the method called evaluation of environmental effects (Finland).
5. Around industries with high level of danger (chemical…) national road may not be located (France).
6. There is no specific regulation, but the planning process does take into account
7. No specific regulation, but it is included in the EIA procedure (Austria).
8. Specified by the Road Design Standards (Bulgaria).
9. Risk are clarified on the basis of industrial or social activities by the method called evaluation of environmental effects (Finland).

10. Around industries with high level of danger (chemical…) national road may not be located (France).
11. There is no specific regulation, but the planning process does take into account the location of sensitive areas (South Africa).
12. Normal common sense (Sweden).
13. Yes, but must allow or provide for reasonable truck access. This is the responsibility of the States (U.S.A.).

1.4.2. Second Survey

Second stage of the survey was targeted to selected countries that we have known after the first survey to get more detailed information on risks and natural/man-made disasters in these countries.

Number of Countries Reported
Seven countries replied to the second survey out of 20 selected countries.

Name of Laws, Regulations, Codes and Guidelines (Q1)

There are considerable variations in the legal framework of the countries replied.

1. Austria has regulations for the transport of dangerous goods and tunnel ventilation.
2. Czech Republic has a wide range of legislation from general legislation (Constitutional Act on the safety of Czech Republic), state and area administration (Act on establishment of Ministries, municipalities, regions and districts), crisis management (Act on the police, fire rescue corps, fire prevention, integrated rescue system and crisis management ("Crisis Act"), economic measures (Act on economic measures for crisis situation) and traffic and ground communications (Act on ground communications, road traffic, traffic ground communications, etc.).
3. Hungary
    a. Traffic Law No. CXXVII. of the year 2000.
    b. Law No. XXV. of the year 2000 on Chemical safety

       Order No. 44/2000. (XII. 27.) issued by the Ministry of Health on „Detailed regulation of some proceedings and activities relating to dangerous substances and products".
    c. Joint Order No. 4/2000. (XII. 20.) of the Ministry of Transport and the Ministry of Health on the restriction of some activities relating to certain dangerous substances and products.
    d. MT (Council of Ministers) Order No. 122/1989. (XII.05.) as amended by Government Order No. 95/2001. (VI.15.), Provision No. 39/2001 issued by the Director General of the Ministry of Interior's National Directorate for Catastrophe Prevention /BM-OKF/, and Provision No. 5/2001 of the Deputy Director General of the BM-OKF on the route determination for motor vehicles carrying dangerous goods.

4. Italy has a "Law n. 225 of 24th February 1992" established National Service for Civil Protection

5. Japan has the following laws related to disaster situation:
    a. The Road Law provides for highway construction and administration. Highway administration section including MLIT executes it.
    b. The Road Traffic Law regulates traffic manner and control for motor vehicles. The National Police Agency executes it.
    c. The Basic Law on Disaster Countermeasures provides for disaster prevention plan, emergency management and post-disaster restoration and rehabilitation of national and regional governments and public sectors.

6. United States and local governments are responsible for ownership and control of the highway system. Each state has its own standard specifications and details, special provisions and design manuals. The Federal government sets minimum live load requirements for the design of the Interstate Highway System. Traffic regulations, signal and signs are the responsibility of the state and local governments.

   For very large disasters, Congress can pass legislation and authorise funding which is typically managed by the Federal Emergency Management Agency (FEMA).
    a. Federal Response Plan 9230.1-PL (April 1999)

       The Federal Response Plan (FRP) outlines how the Federal Government implements the Robert T. Stafford Disaster Relief and Emergency Assistance Act, to assist States and local governments when a major disaster or emergency overwhelms their ability to respond effectively to save lives; protect public health, safety, and property; and restore their communities. The FRP, a FEMA publication, is available on the internet at http://fema.gov/r-n-r/frp/
    b. Federal Highway Administration's Emergency Relief Program
       Title 23 – United States Code, Section 125 Emergency Relief, provides for an emergency fund for the Secretary of Transportation to use for repair or reconstruction of highways, roads, and trails that the Secretary finds to have suffered serious damage as a result of natural disasters over a wide area or catastrophic failure from any external cause.
    c. Section 120 Federal Share Payable allows 100 percent of cost for eligible emergency repairs to minimise damage, protect facilities, or restore essential traffic accomplished within 180 days after the actual occurrence of the natural disaster or catastrophic failure.
    d. Title 27 Code of Federal Regulations (Highways), Part 668 – Emergency Relief Program provides program guidance for the administration of emergency funds.

       There are numerous examples of outstanding states' programs. One example is * North Carolina Emergency Operations Plan (NCEOP). The NCEOP may be downloaded in PDF format from the North Carolina Emergency Management web site www.ncem.org.

7. United Kingdom none specific to the management of risk for roads but the legal framework for the organisation is given by the Highways Act 1980 and, to a lesser extent, the Traffic Regulations and General Directions (Highways Agency). The management of the network is contracted out to 14 Managing Agents and their Maintenance Contractors. The guidelines for their work are either contained in the Trunk Roads Maintenance Manual or based upon this document. There is nothing that addresses risk in the way suggested but there is extensive legislation, regulation and advice that governs the work and inevitably has considered relative risk (U.K. Local Road Authorities).

Emergency Manual (Q2)

1. For road management no special emergency manual exists, but there are alarm plans of the police and the fire brigade in Austria.
2. Manual providing prompt information on dangerous substances as required by ADR, SIX. in Hungary.
3. The counter-disaster action plan of MLIT is now on revise because of the last government reform in 2001 in Japan.
4. U.S.A. has "Emergency Relief Manual", Publication No. FHWA-PD-98-054. The Emergency Relief Manual provides program guidance and instructions on the FHWA's emergency relief (ER) program. The manual provides information for FHWA, State, and local transportation agency personnel on policies and procedures for requesting, obtaining, and administering ER funds.

   An example of a state emergency response manual is "North Carolina Department of Transportation Emergency Response and Procedures Manual, 2000 NCDOT". This manual was developed by the state of North Carolina after prolonged flooding resulting from Hurricane Floyd in 1999 caused severe widespread damage to the highway system in the eastern part of the state. The manual provides guidelines for field operations managers and supervisors in responding to emergencies affecting state roads and requiring significant mobilisation and expenditure of resources.

The following link is to the manual:

http://www.doh.dot.state.nc.us/operations/dp_chief_eng/maintenance/road_main/Resources/EmerProManual/emerpromanual.html

5. Nothing specific, though the Agency does have a risk register that contains, to a certain extent, the risks associated with road management. As before, the Trunk Road Maintenance Manual, contains information on the management of risk at a working level. The Agency is currently developing a concept called "Active Traffic Management" that will enhance the incident management capabilities of the organisation (U.K. Highways Agency).

6. There is a very new "Code of Practice for Highway Management" on non-strategic roads. (U.K. Local Road Authorities).

Risk Prevention Methods (Q3)

1. For avalanches a risk zoning is made for mountainous areas in Austria, taking into account the potential hazards. In the red zone no settlements and buildings are allowed, most minor roads are closed in winter, major roads and motorways are protected by tunnels, galleries or avalanche dams. In the

yellow zones building must be constructed and in a specific manner (including protection measures).

2. As a part of the efforts to reduce risks of road (vehicular) traffic, the following monitoring is systematically carried out in Czech Republic:
   - density of traffic – load (summing up);
   - congestion;
   - closure of roads;
   - thermal mapping;

3. Hungary's catastrophe endangerment map is available, presenting the existing danger sources in the territory of the country. More severely than EU legislation, the authority determines the route of the carriage of dangerous substances in Hungary. Course of development is the implementation of the satellite tracking system of motor vehicles carrying dangerous substances.

4. No highway specific mapping or zoning in Japan.

   However, there are several aerial designations and/or plans regarding earthquakes, volcano eruptions and floods. Authorities vary, for instance, national/regional levels and law-regulated/optional.

5. In the United States the Federal Emergency Management Agency (FEMA) maintains extensive flood plain maps to support the federal flood insurance program. The United States Geological Survey (USGS) and others do extensive full time monitoring of the level and flow of most flood prone rivers.

   Coastal areas of hurricane vulnerable states have state government developed evacuation plans. Timely information is provided on the course and location of approaching storms.

   The United States experiences more tornadoes than any other country. In areas where tornadoes are likely to occur, weather conditions that are conducive to the development of tornadoes are monitored and reported immediately to the news media. A tornado alert is then issued.

   The USGS has seismic risk maps for the entire United States and there is an extensive network of stations for monitoring all seismic activity.

6. U.K. Highways Agency has a risk register that has been developed to identify, monitor and manage risks, both to the network and the business.

7. The Environmental Agency issued flood plain maps, in a format that can be used as an overlay on GIS systems. These clearly indicate the roadway liable to flooding (U.K. Local Authorities).

Risk Potential Evaluation Methods (Q4)

1. Most of the risk prevention work is depending on local experience and long term observations (up to 50 or 100 years back) as a basis input for the local avalanche commissions. Nowadays electronic calculation models such as the SAMOS-model supplement these basis data (Austria).

2. Seismic Risk Analysis (SRA) of highway systems is a part of the ongoing research programs the FHWA of U.S.A. has had with the Multidisciplinary Center for Earthquake Engineering Research (MCEER) since shortly after the Loma Prieta Earthquake in 1989. The SRA software estimates post-earthquake damage states for a highway system or regional network, based on various scenario earthquakes. The software computes how the damage will impact the capacity of the local highway network, and then calculates economic losses.
3. The University of Coventry run a postgraduate diploma in Emergency Planning, one of the Units of which is a specific Risk Assessment for potential emergencies. Very high-risk industrial sites are identified and have specific plans including roads (U.K. Local Road Authorities).
4. Hungary: in order to increase the safety of transportations by tankers, the Energy Inspectorate elaborated the risk analysis of gases and liquids. This organisation practices its activity through the Regional Technical Safety Inspectorate.

Evacuation (Q5)

1. In Austria: by surface or helicopter (depending on the location and weather situation).

2. Czech Republic commander of the evacuation decides on the mode of evacuation; in the case of a traffic accident, the evacuation is carried out according to the system used for rescue work in road traffic accidents or, in the case of the occurrence of another extraordinary event, according to the regime of the integrated rescue system.

3. In Hungary: in the accidents of the past years, resulting from the carriage of dangerous substances, the population of the area concerned had not been evacuated. Provisional isolation of those endangered is more common. The necessary plans are available for the order and execution of the evacuation process. General scheme is the following:

Directorate for Catastrophe Prevention (hereinafter: OKF):

- alarms the Fireguard(s), Ambulance, Police;
- notifies the competent Protection Committees;
- operates local civil guards' headquarters;
- provides for the means of transport;
- activates local accommodations.

4. Problems with overturned or wrecked tanker trucks carrying volatile or hazardous chemicals have routinely resulted in the closure of highways and the evacuation of neighbourhoods at risk. With the widespread use of cell phones, calls to 911, a emergency telephone number that is directed to local emergency response centres, can be expected almost immediately after an incident. Initial action would typically be taken by the highway patrol, police, fire marshal or emergency personnel responding to the call (U.S.A.).
5. "Evacuation" is not applicable to the type of incidents for which the Agency is responsible. If evacuation is required, it is the responsibility of the police and local government agencies. The Agency would, however, provides road related expertise, resources and strategic diversions (U.K. Highways Agency).

6. All Emergency Plans include sections on evacuation. These usually features locally available buses and community hall/ schools with permanent or volunteer assistance for feeding (U.K. Local Road Authorities).

Organisation Charts of Risk Management (Q6)

1. The system of rescue work in road traffic accidents can be considered as a specific organisation structure for crisis management on the roads in Czech Republic.
   In addition, an "Integrated Rescue System" exists; nevertheless, this system does not concentrate specifically on traffic only. By law, the integrated rescue system is defined as a coordinated procedure for its components (units) during the preparation for extraordinary events and during the execution of rescue and elimination work.
   The basic components of the integrated rescue system are:
   - fire rescue corps of the Czech Republic;
   - fire prevention units;
   - health care services;
   - the Police of the Czech Republic.

   The other components (units) of the Integrated Rescue System are:
   - the armed forces and the resources of the armed forces dedicated to this system;
   - other armed security corps;
   - other rescue corps;
   - public health bodies;
   - emergency, stand-by, technical and other services, non-profit making organisations and citizens associations which can be used for rescue and elimination work.

2. The chart regarding the emergency management according to Road Law is same as that of usual highway administration in Japan.

3. The Agency's network is divided into 20 geographically based areas, each managed through an area team. The Area Manager is responsible for emergency planning and the management of incidents within his area. The Area Manager reports to A Regional Director who in turn reports the Agency's Board. The Area Managers and the Board are supported by a "Network Security Liaison Officer" who is responsible for the transfer of information on threats and incidents trough the organisation, the development and dissemination of emergency planning policy and liaison with central government (U.K. Highways Agency).

4. Hungary: the Transport Inspectorate, whose responsibility is the management of the road risks on account of its designation, performs the serviceability tests and the examination of the motor vehicles engaged in the carriage of dangerous substances. It is in charge for the organisation of ADR training courses, training of motor vehicle drivers engaged in carrying dangerous substances, issue of certificates, regular training of motor vehicle drivers.

ANTZ (State Service for Pubblic Health and Medical Officers) controls, with regard to the designated route, the issue of activity permissions by the Ministry of Environment.

Traffic Management Methods (Q7)

1. Within the alarm plans the setting of road signs for deviation routes is included. Information about closed roads is forwarded to radio and tv stations in Austria.

2. The increasing rate of traffic accidents in the Czech Republic and, as a consequence, the increasing demand for rescue work created the need to develop conditions for the effective rescue of individuals and property and for the protection of the living environment during road (vehicular) traffic accidents. The system of rescue work during road traffic accidents have been established. The objective of the system is:

- to ensure the coordinated procedure of the rescue units, emergency and other services during the elimination of the consequences of traffic accidents;
- the principles for the implementation of the system;
- the rescue units working as a part of this system maintain an uninterrupted emergency service so that they can assist at any time, at the place of a traffic accident and so that they can start the necessary rescue works within 15 minutes (20 minutes as a maximum) after receiving an emergency call.

The above rescue units are:

- Fire rescue corps of the CR.
- Fire fighting units.
- Medical rescue service.
- The Police of the CR.

The tasks of the rescue units and selected emergency services that form part of the system:

a) The Police of the CR receives emergency calls of a traffic accident on the telephone number 158 and informs the other rescue units, controls, or detours traffic at the place of the traffic accident, prevents unauthorised access to the place of the traffic accident, provides first aid to persons injured in the traffic accident.

b) The Fire rescue corps of the CR and the unit of fire fighting receive emergency calls on the telephone number 150 about a traffic accident and inform other rescue units, take charge of rescuing individuals from crashed vehicles, make sure that dangerous substances affecting the living environment do not leak, ensure that crashed vehicles don't catch fire, fight fire provide first aid help to injured participants in a traffic accident.

c) The medical rescue service receives emergency calls about traffic accidents on the telephone number 155 and informs other rescue units, provides professional, pre-hospital immediate care and transports injured persons to the relevant health care establishment, coordinates the use of air rescue service.

d) Communications administrators are in charge of the elimination work that is related to the state and use of the communications, the clearance of crashed and immobile vehicles and of other obstacles to vehicular traffic, as well as cleaning and repair of the communications after the traffic accident.

3. The management of disasters is the responsibility of the local police who also have the power to stop and direct traffic in U.K. They therefore establish local diversion routes that are usually planned and agreed by the relevant authorities.

4. Local authorities usually liaise with the Police in a formal way to determine and implement diversions and other response (U.K. Local Road Authorities).

5. In Hungary normative requirements are laid down by the ADR Agreement.

Man-made Disasters (Q8)

1. The major road disaster in Austria related to human activities was the Tauern Tunnel fire accident. A report was given by Mr. Eberl from the Austrian Motorway and Expressway Company in a special session at the 1999 World Road Congress in Kuala Lumpur.

2. In the last 10 years, no extraordinary accident caused by the human factor which would have provoked foreign attention has occurred in Czech Republic.

3. In Hungary there was no such industrial or traffic catastrophe as a result of which the population of the relevant area would had been necessary to be evacuated.

4. The tragic fire of the Month Blanc Tunnel is the recent man-made disaster in Italy / France.

5. Nuclear plant accident (Japan)

Time 1999.09.30 - 10:35

Location Ibaraki-ken

Cause Diffusion of a radiation or a radioactive substance caused by the loss of control of the nuclear plant

Risk source Human error

Traffic Highways including an express way was closed because of the settlement of certain forbidden area

Other influences 69 people exposed to neutron radiation, suspension of socio-economic activities, and economic damage due to rumours

6. Train crash in U.S.A.

Place of disaster - downtown Baltimore, Maryland in U.S.A.

Area affected - much of East coast.

Year of occurrence - 2001.

Duration of disaster - several days.

Length and number of interrupted arterial roads - metropolitan area.

7. The effects of the fuel crisis in the autumn of 2000 (U.K. Highways Agency).

Natural Disasters (Q9)

1. The biggest natural disaster in Austria within the past 5 years that attracted international attention was the Galtür avalanche catastrophe, but this catastrophe was not road related. Part of a village in a "safe" area was destroyed, the linking road to the village was closed earlier by a wise decision of the avalanche commission. Caused by this closed road access the evacuation of the people had to be done by helicopter.

2. Population living in the area of the upper section of the river Tisza was in immediate life-danger due to the flood in March 2001. The necessity of immediate evacuation and accommodation of a great number of the population arose (Hungary).

3. Volcano eruption (Japan)

Time 2000.03.31 - 13:07

Location Usu Mt., Hokkaido

Cause Volcano eruption

Evacuation at most 16 thousands of evacuee from 3 municipalities

Traffic Express way closure due to land deformation and deposits appearance of craters on the national highway R230 traffic restriction in the forbidden area

Site address http://www.hkd.mlit.go.jp/topics/info/usuzan/saigai/main.html (Japanese only)

4. Place of disaster - East coast from Florida to Maine (U.S.A.)

Area affected - Thirteen states declared major disaster areas

Year of occurrence - 1999

Duration of disaster – Hurricane days, flooding weeks

Length and number of interrupted arterial roads – unknown

5. Flooding on the Agency's network in the spring of 2001(U.K.).

6. During the last five years, there has been extensive and lengthy flooding leading to some loss of life, much personal hardship and extensive economic dislocation (U.K. Local Road Authorities).

1.5 Comments

The international surveys, although the samples are not extensive allow a better identification and classification of risks; they confirm the previous results from G2 studies related to natural disasters. Some general conclusions:

- the type of incidents may vary according to the social / economic conditions of the country but are generally similar for man-made risks;
- natural risks depend mainly on the location, topography, climate, geological conditions and so on;
- natural disasters become more and more predictable with advanced technologies, while man-made incidents often struck in a surprising way; just remember September 11th, 2001;
- there is considerable, variation among countries, in the agencies responsible for handling incidents;
- the state of preparedness for dealing with incidents shows a wide degree of differences;
- the same is also widely disparate legal framework.

2. CLASSIFICATION OF RISKS

2.1. Identification of risks (natural and man-made)

In case of the natural disasters, the studies carried out by G2 and the present first C18 survey give results which can be summarised as follow:

- the four main natural hazards to roads are: landslides, earthquakes, floods and snow avalanches;
- other hazards include: volcano eruptions (debris flows, rock falls, slope failures), cyclones, snow blizzards, windstorms, forest fire (sometime man-made), tsunami, sand accumulations, storms.

The C18 survey's analysis for man-made risks shows a very broad variety of incidents related to human, social or industrial activities. Impact depend on the location of the roadways: in urban areas or in less populated zones; in delicate environment or not perceived as such.

Apart from the transportation of dangerous goods; where an important legal framework exists, the surveys don't indicate any mayor cause for man-made risks. For a better understanding it is therefore necessary to propose a first classification of the types of man-made risks and incidents.

2.2. Classification of Risks (man-made)

Based on the results of the C18 International survey the following classification / categorisation is suggested:

a) Incidents related to road and vehicles:
   - . major roads accidents;
   - . overloading (weight and height) causing severe damages to the road structures, p. ex.: damage to bridges;
   - . fire / incidents in tunnels;
   - . fallen objects on the highway / roadway;
   - . bad maintenance of vehicles;
   - . bad maintenance of road's structures ex.: collapsing of bridges;

b) Incidents related to transport operations (dangerous goods):
   - . fuel and oil spillage from accidents;
   - . hazardous chemical spillage;
   - . spillage of inert materials;
   - . danger from nuclear materials.

c) Incidents involving other transport modes:
   - . plane crashes onto or close to highways;
   - . train collisions and impacts on structures;
   - . ship / boat impact on structure;

d) Incidents related to property adjacent to the highway / roadway:
   - . explosion and fire in an industrial area close to highways;

. spill of radioactivity from a near nuclear processing facility;
. spill of toxic materials near to highways.

e) Incidents resulting from social disruption:
. road blockages by protestors, strikes, demonstrations;
. terrorist activity, active incidents or threats;
. vandalism, fun ventures, spraying.

f) Others:
. wartime remains: mines, bombs, explosives;
. biological outbreaks.

In analysing these different types of incidents it is important to take into account that they can occur in a deliberate or undeliberate way, making a response far more difficult to plan for.

The study of these types of man-made risks and incidents points out a more complex array of consequential effects and of organisations involved than natural disaster.
Following a first analysis:

Consequential effects:

- major traffic delay and disruption;
- direct damage to road and bridge infrastructure;
- indirect delays to other transport modes;
- environmental threat to watercourses;
- danger to people from chemical / nuclear spillages;
- economic impact on local / regional / national economy;
- direct loss of life and serious injuries;
- social disruption / riots;
- political focus on national / local government policies.

Organisations involved in incidents:

- police Forces;
- fire and Rescue Services;
- ambulance and Medical Services;
- national Government Departments (Transport, Environment, Home Affairs);
- local Highway Authorities;
- emergency Planning Authorities;
- health and Safety Executive;
- road Network Contractors and Consultants;
- coastguard;
- operators of other Transport Modes;
- national or Local Advisory Standing Committees (particularly in regard to hazardous chemicals).

Issues to consider in incident management:

- initial response and assessment of an incident;
- consolidation and recovery of an incident;

- logistics and resources;
- co-ordination of publicity;
- availability of real time information to the public;
- provision of real time information to the public;
- availability of alternative road diversions;
- compliance and protocols and procedures;
- temporary and permanent repair to infrastructure.

Longer term considerations:

- identification of prevention / management measures;
- development of risk strategies;
- indirect social / industrial / economic implications at a regional / national level;
- accident pathology;
- review of performance by participating organisations;
- education of road users;
- training and simulation exercises.

Examples of solutions to deal with results of incidents:

- incident Plans prepared by those directly involved in managing the road network;
- emergency plans for wider participating organisations;
- distribution of advice on best practice;
- development of route strategies for major road links;
- provision of real time information to public;
- national Traffic Control Centre.

Appendix:

1.1. Survey Form (First Survey) - Questionnaire

1.2. Survey Form (Second Survey) - Questionnaire

Appendix 1.1.

SURVEY FORM (FIRST SURVEY)
QUESTIONNAIRE

Information on the types of damages to road traffic which have caused major social and / or economic problems as a result of human, social and industrial disasters as well as natural disasters.

a. Name of the country

_____

b. Name, Organisation, Address and Fax Number and E-mail address of the contact person responsible for completing this questionnaire.

Name	:	_____
Organisation	:	_____
Address	:	_____
Fax	:	_____
E-mail	:	_____
Homepage address	:	_____

Form I Please fill out the following table listing human, social and industrial disasters in your country for last ten years.

Kind of disaster	Year of accurence	Affected area (length, area)	Affected highway structure (kind, length)	Duration blockage (days / hours)	No. of casualties		Other remarks
					death	injury	

Form II Please fill out the following table listing recent major disasters caused by four major natural hazards (landslide, earthquakes, floods and snow avalanche) and other major natural disasters in your country for the last five years.

Kind of disaster	Year of accurence	Affected area (length, area)	Affected highway structure (kind, length)	Duration blockage (days / hours)	No. of casualties		Other remarks
					death	injury	

Form III

Q1. Please list any kind of risks on the roadways in your country related to human, social, or industrial activities other than listed on Form I of this questionnaire.

Q2. Is there a specific organisation that deals solely with the Risk Management Policy beside the Public Works Department or Ministry?

1. Yes
2. Under Planning
3. No

If "Yes", please give us an organisation chart

Q3. Is there an Emergency Manual (or Emergency Procedure) in your Government?

1. Yes
2. Under Planning
3. No

Q4. Is there an Emergency Manual specifically edited for road management in your Government?

1. Yes
2. Under Planning
3. No

If "Yes", please attach one copy.

Q5. Are there any regulations in your government with regard to the following items in order to maintain traffic safety?

A. Transport of hazardous materials
1. Yes
2. Under Planning
3. No

B. Laws imposing penalties or fines for those who release dangerous goods on roads
1. Yes
2. Under planning
3. No

C. Load limits on tires, axles and total vehicle weight
1. Yes
2. Under Planning
3. No

Q6. In relation to Q5, are there any fieldwork manuals that describe dangerous materials, the way to designate routes to be used by vehicles carrying dangerous materials and how to treat such materials once they are spilled on the road surface?

1. Yes
2. Under Planning
3. No

In case of "Yes" please attach one copy of the manual.

Q7. What public agency is responsible to inspect security of loads? Is there any legal punishment for release of materials on roads?

1. Yes
2. Under Planning
3. No

Q8. If there are load restrictions on the wheel, axle or total weight please describe the weights

1. Wheel ( ) ton
2. Axel ( ) ton
3. Total Weight ( ) ton

Q9. At the road planning stage, do you have to consider avoiding any industrial or social facilities in locating the routes from the viewpoint of risk management?

If there are any regulations please describe it.

_____
_____
_____

Please attach copies of newspapers or journals describing one or two major road disasters related to human, social or industrial activities that attracted international or regional attention during last 10 years as examples.

APPENDIX 1.2.

SURVEY FORM (SECOND SURVEY)
QUESTIONNAIRE

Information on the types of damages to road traffic which have caused major social and/or economic problems as a result of human, social and industrial disasters as well as natural disasters.

a. Name of the country

_____

___

b. Name, Organisation, Address and Fax Number and E-mail address of the contact person responsible for completing this questionnaire.

Name : _____

_

Organisation : _____

_

Address : _____

_

Fax : _____

_

E-mail : _____

_

Homepage address :

_____

Q1. Please enumerate the name of laws, regulations, codes or guidelines dealing with risk management for roads and their relationship.

Q2. Please name the emergency manual specifically edited for road management and send a copy of the manual if available.

Q3. Is there any risk prevention methods practiced in your country, such as hazard mapping or risk zoning, etc.? If any, please describe it.

Q4. Are there any risk potential evaluation methods in your country? If any, please describe it or send a copy of the methods.

Q5. How do you evacuate people / drivers from natural hazards or hazards due to human / industrial activities on roads? Please describe examples.

Q6. Please describe organisation charts of risk management for roads.

Q7. Please describe traffic management methods in case of disasters or risks on roads in your country. If there are manuals or guidelines, please send a copy.

Q8. Please describe briefly a major road disaster related to human, social or industrial activities that attracted international or regional attention during last 10 years as an example. The report should be written from risk and crisis management point of view and may include time, location, cause, kind of risks causing disasters, description of traffic, influence to socio-economic activities, countermeasures, evacuation, restoration work and so on. Maps, figures and photos may help describe the disaster.

Q9. Please describe briefly a major natural disaster for road that attracted international or regional attention during last 5 years as an example. The report should be written from risk and crisis management point of view and may include time, location, cause, kind of risks causing disasters, description, restoration work and so on. Maps, figures and photos may help describe the disaster.

ANNEXE 2: EXAMPLES OF MAJOR DISASTERS

2. EXAMPLES OF MAJOR DISASTERS

The first one presents examples of natural disasters and the other some examples of man-made disasters. They are reported following the emergency management process setting out the position before, during and after the disaster. Where it is possible some examples of best practices and the lessons learned are indicated for each example.

2.1. Natural disasters

2.1.1. The 1999 Turkish earthquakes

In 1999, two major earthquakes struck Turkey, resulting in more than 15,000 fatalities and over 30,000 injuries. The first earthquake called the Kocaeli earthquake occurred on August 17 and had a moment magnitude (Mw) of 7.4. It was caused by a right lateral, strike-slip rupture along the main strand of the North Anatolian Fault (NAF) near the town of Golcuk, a province of Kocaeli, which is located 80 km east of Istanbul (Figure 1). The length of the surface fault rupture is estimated at 150 km with an average lateral offset of 3-5 m along most of its length. There were many stations that recorded the Peak Ground Acceleration (PGA) during the earthquake, with results varying from 0.09g in Istanbul to 0.41g in Adapazari. The General Directory of Disaster Affairs operates these recording stations.

The second earthquake, the Duzce earthquake, with a moment magnitude of 7.2 occurred on November 12 along the secondary Duzce fault, a branch of the NAF (Figure 1). Its epicenter was centered near the town of Duzce, in Bolu Province, which has a population of 80,000. This is approximately 140 km east of Golcuk, the epicenter of the earlier Kocaeli earthquake.

Figure 1: Map showing the epicenter of the Kocaeli and the Duzce earthquakes and the approximate location of the NAFZ

The length of the strike-slip surface fault rupture is estimated to be 40 km with an average lateral offset of 4 m along most of its length. According to seismologists, the rupture on November 12 resulted from the stress created by the Kocaeli earthquake. At the Duzce station near the epicenter, a PGA of 0.5g was recorded while the instruments at Bolu, located 30 km east of the epicentre, registered a PGA of 0.8g.

Before

The Republic of Turkey, with its 73 provinces and an estimated 65 million population, provides a bridge between Europe and Asia. In order to achieve its economic development goals, Turkey spends a good third of all public investment on improving its transport infrastructure, by funding capital projects such as building roads and expanding the rail network, especially in the western part of the country.

During the last 10 years, Turkey has built 1,500 km of motorway with the major portion of construction between Ankara and Istanbul, then continuing to Europe, with remaining segments of construction in the west and south. There is also 800 km of motorway under construction from Ankara to the southern city of Adana, a 24 km strip near the town of Bolu, and additional construction in the northeast and southwest. The Trans European Motorway (TEM) from Ankara to Istanbul is designated Route E80. This strip crosses the NAF at a number of locations and includes a number of tunnels, viaducts, and many underpasses as well as overpasses. It represents the major through transportation route for the transport of goods and other commerce from Asia to Europe. The Turkish Road Directorate (KGM) is responsible for the services and maintenance of the entire motorway in Turkey.

Foreign consultants from the United States, France, Germany, Great Britain, and Italy designed most of the viaducts and overpasses along the motorways. However, Turkish contractors did most of the construction. It appears that a combination of the 1983 and 1992 AASHTO Standard Specifications for Highway Bridges and Euro Codes were used for bridge design. However, on some occasions, there was some departure from strict interpretation of the codes. For example, when ductility of the columns was considered in the design process, the lap splices were located in the plastic hinge zones. Overall, an inherently improved seismic design approach was observed for newer bridges that have led to increased seismic resistance along the TEM.

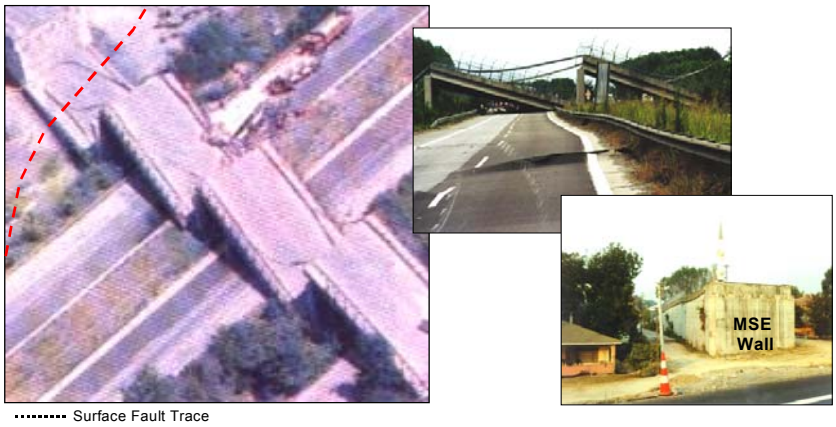
During the disaster

Considering the magnitude of the fault rupture movements and the significant ground shaking, in terms of both accelerations and velocities, the bridges and tunnels along the TEM fared quite well. Several overpasses crossing the TEM sustained minor damage in the form of pier tilting (arising from ground movement), concrete spalling of the decks at expansion joints, and approach fill settlement. Such damage did not impair traffic over the motorway.

Only one overpass (Arifiye) crossing the TEM did collapse (Figure 2). This was not surprising as the fault rupture passed directly beneath the north span. The fault movement exceeded the available seat width causing the span to fall to the ground.

In so doing, it dragged the remaining three spans off their seats. At the same time the MSE walls of the Arifiye overpass performed very well considering the fact that the north wall was only a few meter away from the rupture.

Figure 2



Arifiye Overpass

The extent of damage to the engineered fills on the TEM extended some 10 km to the west and east of the Adapazari area. Settlements ranging from 100 mm to 500 mm were observed. This was evident at most single span bridge and culvert location, resulting in classic bump-at-the-bridge problems. Repair of this damage was swift. Initial repairs, made in the first few days following the earthquake, consisted in placing asphalt ramps and maintaining a 30 mph speed restriction. Within 10 days, more long-term repairs were made.

In general, most of the bridge damage observed along the TEM was due to failure of poorly detailed and constructed reinforced concrete shear keys, permitting excessive transverse movement of the superstructure. The reinforcing cage in most keys was minimal, both in height and percent of steel (Figure 3).

The Duzce earthquake caused considerable damage to Viaduct #1 and to the Bolu tunnel due to the close proximity of the fault rupture (near fault effect). These structures are located along the 24 km segment of the TEM under construction in the Bolu province.

Figure 3

Shear-key Failure

Viaduct 1: Viaduct 1, with its 59 spans and dual 2.3 km structures, was approximately 95% complete and awaiting installation of expansion joints for completion of the project at the time of the earthquake (Figure 4). Its 40 m spans are comprised of 7 lines of simply-supported, prestressed concrete box girders seated on pot bearings with stainless steel PTFE-slider interface. The deck slab is continuous over 10 span segments. The viaduct's piers are single cast-in-place, octagonal hollow-core reinforced concrete columns, 4.5x8.0 meters in plan dimension with heights varying from 10 m to about 49 m. They were designed and detailed to provide ductile behaviour during earthquakes. The viaduct had also incorporated an Energy Dissipation Unit (EDU) system, which is installed on each pier cap to accommodate longitudinal thermal movements and to reduce any seismic forces through energy dissipation during a major event.

Figure 4

Viaduct #1

A surface-fault rupture propagated between two piers and evidence of high-velocity impulses was observed from the earthquake records and at the sites. Significant damage did occur to the EDUs and bearings of Bolu Viaduct 1, from surface rupture displacements and ground shaking; which then caused the girders to translate on top of the piers, narrowly avoiding total collapse. Viaduct 1 was designed for 500 year return period (PGA=0.4g) based on the 1992 AASHTO Standard Specifications for Highway Bridges and the Euro Code for seismic isolation design. However, it is appear that due to close proximity of fault rupture the viaduct experienced a PGA in excess of 0.4g, its design value.

Bolu Tunnel: The Bolu tunnel construction is based on the New Austrian Tunnelling Method (NATM). The tunnel consists of three layers (from outside inwards) of shotcrete, reinforced concrete, and, finally, an unreinforced-concrete layer. The tunnel is about 10 km east of the epicentre and has a total length of about 3.3 km, of which 2 km was completed before the Duzce earthquake. It has a width of 12 m, outer and inner heights of 15.3 m and 8.6 m respectively, and an outside diameter of 17 m. The tunnel portal at the Elmalik site on the east side is shown in Figure 6. The seismic design for the tunnel was based on experience and judgment. An Effective Peak Acceleration (EPA) of 0.4g was used in the design, which corresponds to a return period of about 500 years. From an engineering perspective, the Bolu tunnel represents the most difficult part of the design and construction process for the entire TEM, due to a very complicated tectonic history and varied geological conditions.

The Duzce earthquake caused complete closure of both tunnel bores about 200 to 300 m from the Elmalik portals due to the close proximity of fault rupture. The collapses occurred in a section of tunnel passing through a clay/weak rock zone where a temporary shotcrete lining system was in place. Due to complexity of the site geology, a new alignment is being considered for reconstruction of the collapsed section.

After

In general, the bridges on the TEM performed acceptably. The effect on traffic along the TEM, during both earthquakes, was minimal. That can be greatly credited to good management by KGM which took steps immediately after the Kocaeli earthquake to maintain the traffic flow. The collapsed Arifiye overpass was cleared in a few days while a detour was hastily built to accommodate traffic. At some locations, re-profiling and re-paving of large stretches of the road surface was done very swiftly and the motorway returned to its normal 120km/h operating speed days after the earthquake. In bridges with partial loss of elastomeric pads, temporary wooden blocks were provided.

Soon after both earthquakes, extensive work was undertaken by the KGM to reconstruct the Arifiye overpass, to replace and reconstruct the damaged shear keys on a number of bridges, to retrofit the Viaduct 1 and to find a simple solution for realigning the Bolu tunnel.

The new Arifiye overpass is being constructed at the same location with the same alignment. The existing foundation is being utilized. The overpass has much wider seat widths and utilizes cable restrainers to accommodate large displacements if subjected to any future near-fault effects. The Viaduct 1 is being retrofitted, by

incorporating Friction Pendulum Isolation bearings, to accommodate a displacement demand of 700 mm.

The KGM, the academicians, the media and especially the public in Turkey are very much aware of the risk and hazard associated with the NAF segment which has the possibility of generating a large earthquake in Istanbul. Government agencies, particularly the KGM, are embarking on an ambitious plan to retrofit critical bridges in Istanbul. Only time will show whether this earthquake preparedness will be in time for the next one.

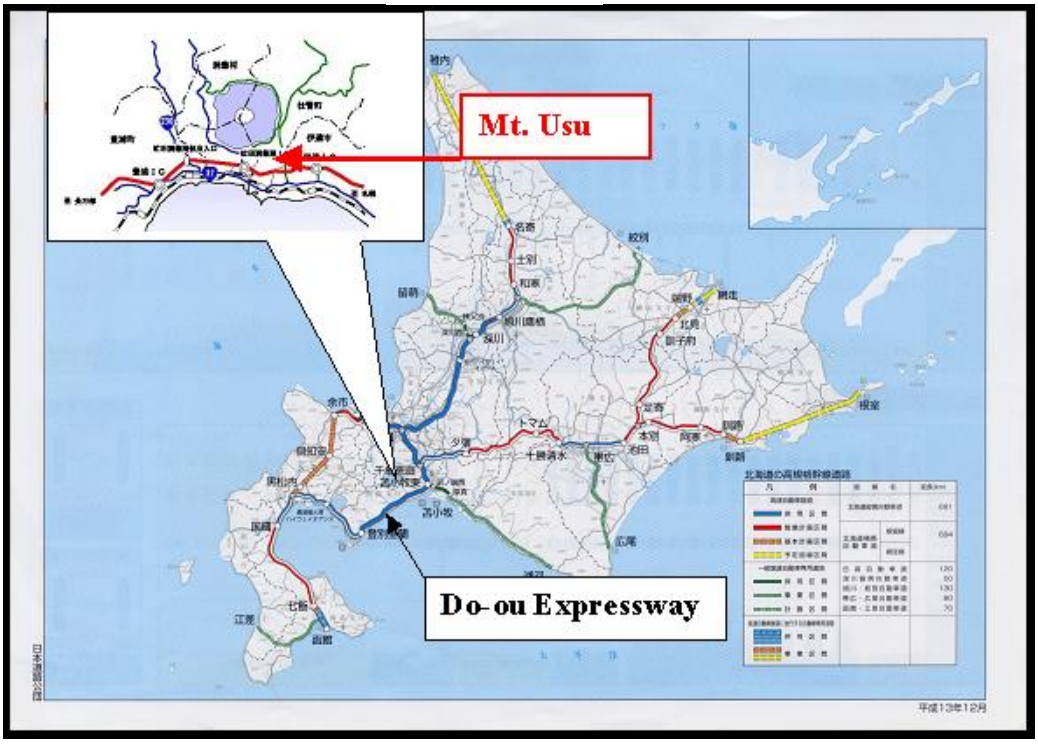
To remember

- Good management by Turkish Road Directorate (KGM) which took steps immediately after the earthquake to maintain the traffic flow.
- Built a detour to accommodate traffic.
- Implement temporary solutions to facilitate the return to the normal traffic.
- Cooperation between partners (KGM, academic's, media, public, government agencies) and preparation for the next one.

2.1.2. The 2000 volcano eruption in Japan

The Do-Ou Expressway of Hokkaido is a part of the National Expressway Networks in Japan and goes from north to the south end of the island. The expressway connects main cities of Hokkaido, such as Oshamanbe, Muroran and Tomakomai, which are the principal cities in South Hokkaido, Chitose, where an international airport is located, Sapporo, which is the largest city in Hokkaido, Asahikawa, which is the second largest city, and Wassamn. Thus the expressway is vital for the economy in Hokkaido (Fig. 1).

Figure 1



Before

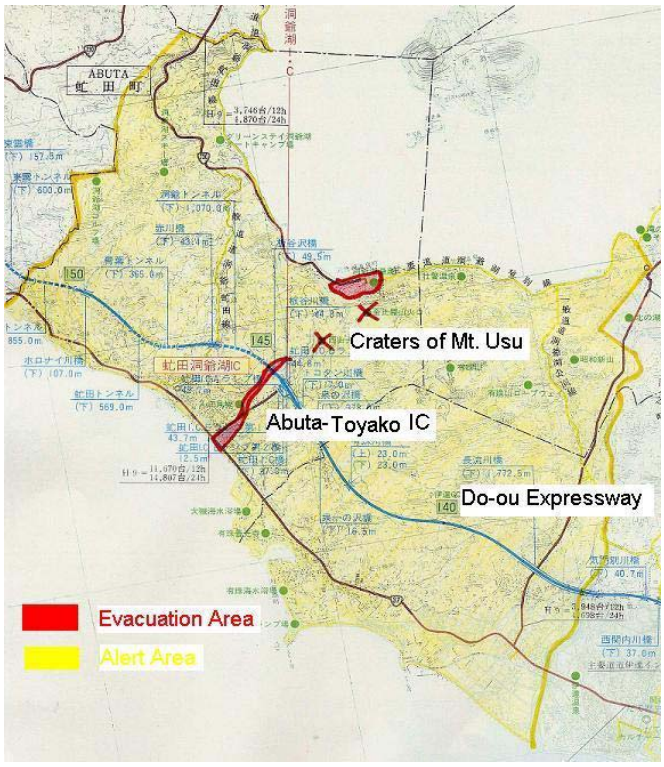
The Hokkaido Branch and the Muroran Operation Office of the Japan Highway Public Corporation (JH) received *a precaution* and emergency message of volcanic eruption on March 28. They immediately *strengthened* their systems for collecting information and contacting related organizations. A vehicle installed with a satellite communication system was positioned at Mt. Usu Rest Area near the volcano. The branch and the office took close contact with disaster prevention offices of other organizations and collected information. JH also warned road users to always listen to highway advisory radio for the information of volcanic activities.

On March 29, an evacuation advice was announced. The section between Toyoura and Date Interchanges was closed. The closure was thereafter expanded to the section between Oshamanbe and Muroran Interchanges due to frequent earthquakes.

During the disaster

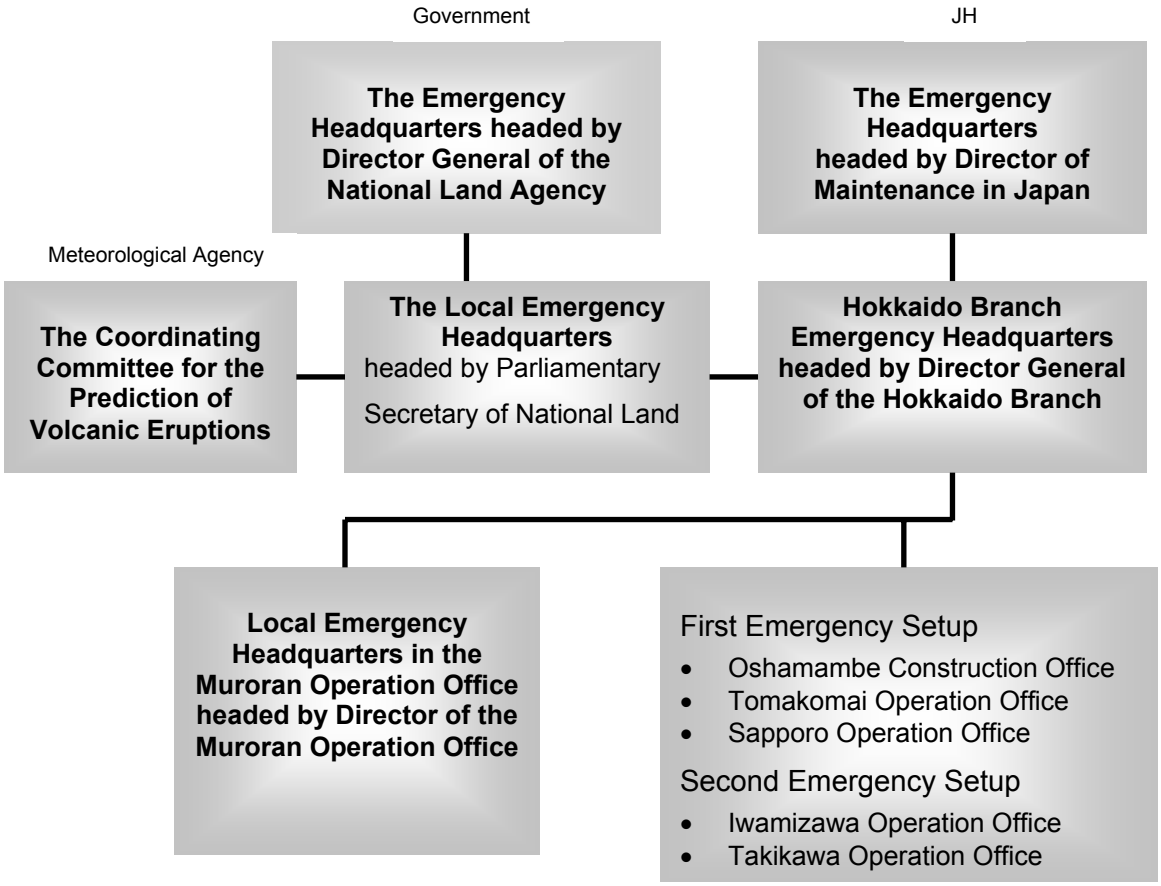
On March 31, at 1:07 PM, Mt. Usu Volcano erupted. The Do-ou Expressway was affected near Abuta-Toyako Interchange, and various road structures and facilities were destroyed. Therefore, a part of the expressway, which was the principal highway in Hokkaido, was closed for a year and three months after March 29, 2000.JH established the Emergency Headquarters of Volcanic Activity of Mt. Usu. The headquarters monitored the states of damage, communicated with related organizations, and collected information (Figs.2 and 3)

Figure 2



Evacuation Area due to Eruption of Mt. Usu

Figure 3



Emergency Service Setup

The damage to the closed section was precisely surveyed using helicopters for those sites that were dangerous to go (Fig.4).

The principal measures taken for residents who had to evacuate and users of the expressway are described below:

(1) Three emergency entrances were constructed so that the residents could use the expressway as an evaluation route.

(2) The closed section was shortened by constructing a temporary entrance approximately 8 km to Oshamanbe from Abuta-Toyako Interchange.

(3) For the refugees to maintain their daily lives, they were allowed to use the expressway free of charge for moving to nearby safe areas based on the order of the Ministers of Transport and Construction. The order was given based on the Article 6 of the enforcement order of the Law Concerning Special Measures for Highway Construction.

(4) Vehicles of the Self Defence Force used for the rescue activities against the Usu volcano eruption were also allowed to use the expressway free of charge.

(5) JH provided meal services for the crew of the emergency activities at the Mt. Usu Rest Area, which is a resting facility, during the period when the section between Oshamanbe and Muroran Interchanges was closed.

(6) A temporary information center was established at Mt. Usu Rest Area. The information center at Wattsu Parking Area prolonged the service hours and provided users with information about the expressway, volcano, and bypasses.

Figure 4

Mt. Usu and the Abuta-Toyako Interchange

After

Survey of damage

On June 7, the evacuation order was removed from the area where the expressway runs through. Precise surveys were conducted and gradually revealed the severe damage near Abuta-Toyako Interchange (Figs.5, 6 and 7).

The ground around the expressway upheaved due to the volcanic activity of Mt. Usu. Surveys at the expressway showed large ground deformation for a section of approximately 10 km. Near Abuta-Toyako Interchange, the expressway moved almost 8 m to the seaside, and was raised for approximately 6 m. Many volcanic cinders were also found on the expressway.

Figure 5

Erupted Stones around Abuta-Toyako Interchange

The deformation and the cinders caused serious damage to road structures, such as bridges and tunnels, and various facilities, such as power stations and communication cables.

Figure 6

Damage of Bridge Joint

Figure 7

Damage of Tunnel Lining

An investigation committee consisting of specialists and professors were established to discuss the restoration methods for bridges, tunnels, and slopes separately.

After the ground movement settles near the expressway, comprehensive restoration works started. Restoration methods decided by the committee were mainly used. To answer the requests of the residents for early opening of the expressway, the restoration works were carried out day and night even during severe winter. The section between Abuta-Toyako and Date Interchanges opened at noon on February 11, 2001. The section between the temporary entrance at Abuta-Toyako and Abuta-Toyako Interchange opened at 9 o'clock in the morning on June 30, 2001. The entire expressway was opened again after the interval of about one year and three months.

To remember

- Cooperation with Japan Highway Public Corporation (JH) and related organizations.
- Rapid restoration of the expressway (day and night).
- No deaths and injuries of road users due to prior actions taken by JH based on precaution by related organizations.

2.1.3. The 2001 floods in Hungary

Before

The flood was the consequence of the immense snow melting and raining that took place on the surrounding watershed area and which is an annually repeating danger. As measures of prevention, the neighbouring countries are required to carry out concerted development of the infrastructure and flood, and water management.

During the disaster

Population living in the area of the upper section of the river Tisza was in immediate life-danger due to the flood in March 2001. The necessity of immediate evacuation and accommodation of a great number of the population arose. Rescue and lifting works of damages were controlled by OKF. Accessibility/inaccessibility of roads was continuously monitored. Police controlled road traffic and if needed the relevant road section was closed. Those participating in the rescue works had priority. In order to save the settlements, main road 41 had to be cut through, the fact that resulted the unfortunate water-flooding of the Ukrainian settlements, too. Economic activity and road traffic were suspended in the flooded areas. Goods transport could only be carried on by a detour of the area (including also the closing of the border crossings at Beregsurány and Barabás).

After

The embankments were protected by catastrophe prevention organizations. The evacuated population was resettled during the reconstruction works. Settlements were decontaminated.

The Government financed the building of new houses instead of the houses which got ruined or dangerous to live in.

“EMERGENCY” was announced in view of the management of the ensued catastrophe.

2.1.4. The 2002 floods in Czech Republic

Before

The exceptional nature of the floods and the extent of damages caused surpasses any floods remembered by generations now living and indeed all available information about similar catastrophes in our country in previous centuries.

During

Over the course of just a few days, from 11th to 17th August 2002, devastating floods changed the character of the country and people's living conditions across an extensive area.

As a result of heavy rainfall, some rivers reached 500 year flow rates, this is equal to the likelihood to a flow rate occurring once every 500 years. It was not possible to master such a volume of water, even on those rivers where water works as protection against floods had been built. The situation was especially complicated by uncontrollable tributaries which had no accumulation reservoirs. On top of this, intensive rainfall progressively fell over a large part of the Czech Republic.

The floods which directly affected the Capital City of Prague, almost all of Bohemia and South Moravia, can be classified into the category of natural disasters for the following reasons:

- the affected areas do not remember a catastrophe of this size during this century;
- the floods were distinctive for the unusual size of the affected area - a total of 43 districts;
- estimated damages total 80 billion CZK;
- the floods claimed 17 human lives;
- the floods affected circa 1.6 million people, either directly or indirectly;
- a total of 200'000 people had to be evacuated;
- the floods caused damages in 446 cities and municipalities.

The exceptional magnitude of the 2002 floods greatly affected the entire transport system of the Czech Republic.
With the oncoming flood wave, areas were progressively flooded, together with the road transport infrastructure. The devastating effect of the flood wave was increased in some areas as the banks of lakes (ponds) bursted. Bridges and surface communications built in close proximity to water courses were exposed to the greatest risk.
Especially in Prague, damaged sewers and the effects of underground water posed the greatest danger as these was undermining many local communications.
Bridges were endangered by objects floating on the water (massive tree trunks, huts, parts of houses) and carried downstream by the raging water. The most important bridges were protected using heavy machinery, which broke up floating objects or, in some cases, pulled them from the water.
However the greatest risk to bridges was posed by large freight boats which had broken their moorings. As water levels rose in some ports due to increasing flow rates, some boats broke their moorings and began an uncontrolled journey down the river.
In view of the fact that there was the risk of serious damage or even the destruction of important bridges on the Labe River, those uncontrollable boats (some with a load of 700 tonnes), which could not be caught and moored, were sunk using explosives or by pumping in water.

After

Transport was completely halted on flooded or directly threatened road sections, respectively, transport was diverted to safe sections. Naturally these capacity restrictions caused traffic congestion, especially in large cities. The biggest transport problems arose in the Capital City of Prague. This is because the floods seriously damaged the city's underground and public transport, which had to be secured by alternative bus and tram transport. In order to ensure the smooth operation of public transport bus routes, reserved lanes were marked out, which, apart from buses, could only be used by police vehicles, rescue and ambulance services.
As far as the provision of public transport bus services is concerned, information for the connections and timetables were published on the internet web site of the national information system and were also available on special telephone numbers.
The floods also seriously affected the operation of freight transport. In view of flooded access communications, some border crossings were closed. This and other transport restrictions for road freight transport were continually updated and presented on the internet.

A preliminary estimate of damages to roads and motorways after the 2002 floods is 3.9 billion CZK.

ESTIMATED DAMAGE:	***3,9 BILLION CZK***
MOTORWAYS:	***0,06 BILLION CZK***
ROADS OF CLASS I:	***1,02 BILLION CZK***
ROADS OF CLASS II AND III:	***2,78 BILLION CZK***

A total of 256 bridge structures were damaged, of this 70 bridges and passages were completely destroyed. 250 road and motorway sections suffered large damages (landslides, damage to supporting walls, road verges undermined, damaged or washed away, fissures and other damage to road surface construction, even totally destroyed road surfaces).
In order to re-establish the operation of road transport as quick as possible, it was decided to resolve the problem of renewing damaged bridges or communication sections with the use of provisional bridge structures, which the Czech Republic has stored in its national material reserve supplies. This material was provided to communication managers in the form of a free loan for a 3 years period.
By the end of 2002, a total of 68 bridges were repaired using this method.

2.2. Man-made disasters

2.2.1. The Howard street tunnel fire, Baltimore, USA

Before

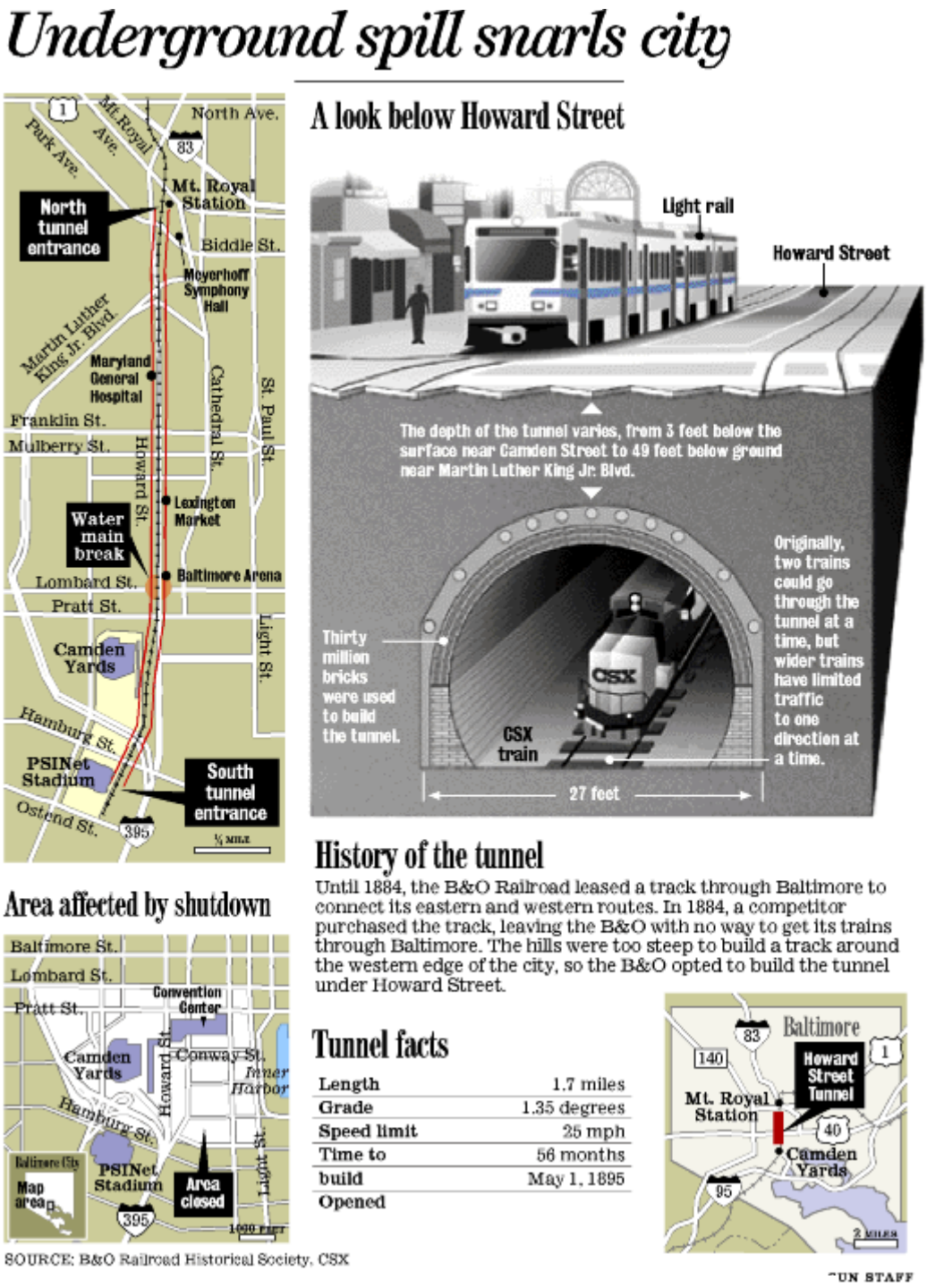
The Howard Street Tunnel is located directly under the heart of Baltimore City's business and cultural districts, and is adjacent to the core of the City's tourist and sports attractions and the Port of Baltimore. As noted in figure 1, incorporated from the Baltimore Sun Newspaper, the south end of the tunnel is located next to the two professional sports stadiums in downtown Baltimore and adjacent to the Inner Harbor and the National Aquarium, the heart of Baltimore's tourist area, and near the Port of Baltimore. The north end of the tunnel, near the Mount Royal light rail station, is located close to the Maryland State Government office complex. The area under which the tunnel runs includes the downtown business and entertainment districts.

The location of the tunnel is also near the end point for the surface transportation systems leading into Baltimore City. These include Interstates 395 (which exits off of Interstate 95 approximately one mile from the south end of the tunnel) and 83, the major north/south interstate routes, and US 40, the major east/west route. These roadways serve passenger traffic, commercial vehicle traffic in transit, and commercial vehicle traffic using the Port of Baltimore. The MARC commuter train service and CSX and other rail freight carriers use the tunnel. In addition, the Maryland Mass Transit Administration's (MTA) light rail system runs over the tunnel (as noted in the graphic) and the streets above the tunnel are used by MTA's bus service. The MTA's subway system is located in a tunnel near the Howard Street tunnel (figs 1,2).

Figure 1

Howard Street Tunnel – Accident Location

Figure 2



Location of the Howard Street Tunnel
Source: The Baltimore Sun Newspaper, July 19, 2001

At 3:07 PM on Wednesday, July 18, 2001 a 60-car CSX freight train derailed in the Howard Street Tunnel in downtown Baltimore. At 3:15 PM, the engineers discovered that a fire had broken out in the vicinity of the derailed cars (fig.3).

Figure 3

Smoke billows from the Howard Street Tunnel with the Baltimore City Skyline, Stadiums, and the Inner Harbor as Backdrop

In response, they decoupled the engines and evacuated the tunnel. Baltimore City firefighters arrived on scene at 3:35 PM and were given a cargo manifest. Following a review of the manifest, it became apparent that the freight train was carrying a number of hazardous materials (including tripropylene and hydrochloric acid) and that several of the cars carrying these materials were on fire (figs.4,5).

Figure 4

Right-Firefighters prepare to enter the tunnel at Mount Royal Station

Figure 5

Hazardous Materials Concerns : CSX workers check a tanker that had contained flammable tripropylene

Emergency response efforts were further complicated when a forty inch water main located on Howard Street almost directly above the site of the derailment broke, spilling water into the tunnel and onto the street (fig.6).

Figure 6

The broken water main above the tunnel on Howard Street

These events occurred as the City of Baltimore was preparing for both the evening rush hour and the first game of a baseball doubleheader at Oriole Park at Camden Yards. The City thus found itself facing a potentially catastrophic environmental situation at peak demand hours for transportation services.

Incident Response

The Baltimore City Fire Department Chief assumed the role of Incident Commander. Additional incident response support was provided by: Baltimore City Police Department; the Maryland Departments of Transportation (MD DOT) and Environment; the Maryland Emergency Management Administration (MEMA); the Environmental Protection agency; and the US Coast Guard.

MD DOT does not have jurisdiction in the City of Baltimore (except for light rail and Metro), and Baltimore City had the lead for incident response and management. The City's concern was extinguishing the fire, while MD DOT and other state agencies (MEMA, MD Department of Environment) were concerned about hazardous materials on the train and ensuring that there was no environmental disaster. MD DOT worked with the Baltimore Department of Public Works (DPW) to establish a plan on how to repair the infrastructure damage once the fire was extinguished (procurement issues – having a contractor in place to do repairs, developing a plan on how repair work would be implemented once the "green light" to proceed would be received, plans for site survey, traffic diversion plan, etc.).

Transportation Impacts
Immediate transportation impacts for Baltimore City included:

A request by the Incident Commander to close the major roadways into the City. MD DOT contacted Maryland State Highway Administration (MD SHA) State Operations Center, which handled road closures for I-83 southbound, I-295 (B/W Parkway) northbound, Rte 40 east (inbound), and I-395 northbound (fig.7). The closures included posting variable message signs (VMS) signs with messages advising in-bound routes to Baltimore closed, as well as highway advisory radio (HAR) messaging. The roadway system was opened to incoming traffic the following morning.

A temporary closing of the METRO subway while the MTA conducted tunnel inspections. The inspections revealed no impacts, and the system resumed operation to help move people out of city. During initial response to the fire, the State Center stop (main stop near fire) was closed and trains simply passed through the station. This continued until a complete damage assessment had been conducted.

The disruption of light rail service in the vicinity of the water main break and MARC commuter rail and Oriole game day service.

The closing of city streets in the vicinity of the tunnel, and the rerouting of passenger, bus, and commercial vehicle traffic. The day of the incident, drivers were trapped for hours on grid locked streets, and people waited at curbs for hours for buses halted on their routes.

The closing of the Inner Harbor to boat traffic by the Coast Guard at 5:00 PM.

The disruption of rail freight movement. Reported delays of 18-24 hours for rail freight from Chicago to Baltimore/Philadelphia, and delays of 24-36 hours for north-south movements resulted from the tunnel being closed due to the fire.

Figure 7

Road Closures Resulting from Tunnel Fire

Baltimore City adjusted traffic lights near the Howard Street corridor and added parking restrictions to improve traffic flow downtown. Per the Baltimore Sun newspaper, a member of the city's emergency planning committee was quoted as saying "They (Baltimore City police and other emergency responders) handled the

evacuation fine," but communication with people driving into the city was less successful. An example of this comes from a report from a journalist with the Baltimore Sun who was driving around the Beltway trying to get back into the city the evening of the incident who reported having to wind through surface streets to make his way home because all major roads into the city were closed.

In the vicinity of Orioles Park at Camden Yards, located at the point where I-395 enters Baltimore City, the vice chairman and chief operating officer of the Orioles estimated that 2500 to 5000 fans were at or around the stadium, along with 2000 employees, all of whom were evacuated. A traffic enforcement officer at Conway and Sharp Streets was assigned to divert traffic and pedestrians away from the stadium.

After

Long Term Transportation Impacts

Monday morning, when city and state employees returned to work (after taking advantage of liberal leave on Thursday and Friday), traffic on I-395 into downtown was backed up more than a mile on northbound I-95. Street closures forced MTA officials to reroute 23 buses. Light rail service continued to rely on buses to transport riders between the Patapsco and North Avenue stops. For five days following the incident, streets in the vicinity of the tunnel and the water main break remained closed, and all vehicle traffic was diverted. On July 24, six days following the incident, nearly all streets were opened to traffic. Only a two-block stretch of Howard Street (around the intersection with Lombard Street) remained closed. The light rail service disruption, including the use of buses to transfer passengers around the closed-off area surrounding the intersection of Howard and Lombard Streets, lasted for nearly seven weeks until all repairs were completed. The intersection of Howard and Lombard Streets was opened to traffic on September 4, and light rail resumed service on September 9.

While high-priority cargo was rerouted around Baltimore's Howard Street Tunnel the day of the fire, ability to move cargo in the East Coast's rail network grew increasingly tight with each day that the major north-south artery remained closed. Freight trains were stalled, cancelled, and diverted hundreds of miles throughout the Middle Atlantic States due to the blocked tunnel. In fact, CSX's entire system along the East Coast and in the Midwest was affected by the bottleneck. The railroad received help from its chief competitor, Norfolk Southern Corp, as some CSX trains were diverted onto Norfolk Southern tracks. Other shipments were sent over alternate CSX tracks. "We cooperate with each other when we have problems like this", said a spokesman for CSX. Delayed trains were scattered throughout several states. At one point, 12 trains were being held, 18 were being diverted, and 3 had been cancelled. MARC commuter rail service was also disrupted during this time. These delays were not alleviated until the tunnel had been cleared, inspected for damage, and reopened to rail traffic on July 24, six days after the incident occurred.

To remember

- Disrupting one mode of transportation can distrupt others.
- Our infrastructures are more fragile than we think.
- Giving information to the population is very important but not necessarily easy.

2.2.2. The Nuclear accident in Japan

Before

The Joban Expressway connects Tokyo, the capital of Japan, and the largest city in Tohoku Area, Sendai. 200 km out of the planned 340 km from Tokyo has been completed the construction and open to traffic. The average traffic volume reaches approximately 40 thousand vehicles a day on the four/six lane section of the expressway. The six-lane sections near Tokyo have even more traffic of over 100 thousand vehicles a day. The expressway is vital for the social and economic activities in *both* Kanto and Tohoku Areas.

Various nuclear power facilities are located in Tokai-mura, which is approximately 100 km from Tokyo along the expressway, such as the Second Tokai *Nuclear* Power Generation Plant of the Japan Atomic Power Co. and Japan Nuclear Cycle Development Institute (Fig.1). Special emergency measures are needed for the expressway in cases of accidents in these facilities.

Figure 1

Location map

During the disaster

Outline of the criticality accident

A criticality accident occurred at 10:35 AM on September 30, 1999, in an uranium processing plant of the JCO Co., in Tokai-mura, Ibaraki Prefecture. Three workers, who were pouring 18.8% uranium solution into a precipitation tank, were exposed. The mayor of Tokai-mura advised people who were within 350 m from the plant to evacuate (39 households). At 10:30 PM, the governor of Ibaraki Prefecture requested

people within 10 km from the plant to shelter indoor (staying inside of the building) since there were possibilities of another criticality.

150 people were exposed to radioactivity during the accident, including the ambulance crew, nearby residents, and workers of the plant.

Measures at the expressway

The Japan Highway Public Corporation (JH) closed the entrance to the Tokai Parking Area, the nearest rest facilities to the nuclear processing plant along the expressway at 23:00 on September 30, which is approximately 700 m from the plant, following the instructions by the Ministry of Land, Infrastructure and Transport.

The Naka and Hitachi-Minami-Ota Interchanges were within the indoor shelter area. Since toll collectors had to be inside of the offices, vehicles were allowed to pass the tollgates free at these interchanges. This toll-free measure was instructed by the Ministry of Land, Infrastructure and Transport.

During this period, traffic regulations were informed through variable message signs, highway advisory radio, post-up signs, and all other possible measures. Toll-free passage of vehicles was the first attempt, and the message had to be newly and manually prepared for both variable message signs and highway advisory radio announcements. The contents of the information are shown in Table 1. Through these actions there were no fatalities and injuries of highway users.

Table 2.2

Medium	Information provided
Variable message signs	Mito IC (Joban) to Hitachi-Minami-ota IC (Joban) "Pass quickly."
Highway advisory radio	"The Tokai Parking Area is closed due to the sheltering order given for 10 km from the site of radioactivity leakage in Tokai-mura. From Mito Interchange to Hitachi-minami-Ota, close the windows, do not get out of your vehicle, and pass quickly."
Post-up sign	Same as the above

Problems

The national and prefecture governments have never considered such a small plant as JCO brings about wide area disasters; in stead they only assumed large-scale nuclear accidents, such as those at nuclear power plants. Therefore, the governments did not investigate the measures against such accidents in advance. That leads to confusion in related organizations.

JH did not assume such an accident either. An emergency headquarter was established at 10:00 PM, which was one hour behind the national government

meeting. The difficulty was mainly attributable to the interrupted telephone lines to the municipal governments of Ibaraki Prefecture and Tokai-mura and related organizations. Therefore, the headquarter had to acquire information from mass communication media. This caused the delay of the initial emergency measures, such as closing and opening the road and information for road users.

After

Reflecting these problems, the national government and the government of Ibaraki Prefecture decided to establish an "Off-site Center" as a center during emergency.

JH prepared manuals for measures during accidents at nuclear power plants and related facilities. JH also constructed systems for collecting and providing information. JH is likely to be able to more quickly respond to an accident like that of JCO.

JH is also improving information devices, such as the signs showing the start points of highway advisory radio sections. The conventional variable message signs with electric bulbs are being replaced by those that use LED.

Unlike torrential rains and earthquakes, nuclear accidents are not visible. Scientific and medical knowledge is required to estimate damages during a nuclear accident and investigate countermeasures. Road administrators cannot themselves judge danger nor take appropriate measures. Administrators of expressways must quickly acquire correct and useful information from the command offices for radiation emergency, in order to communicate the information to users and workers of the expressways and take appropriate measures.

Communication with other organizations should be enhanced as well as practicing emergency drills, preparing manuals, and constructing software and hardware for collecting and providing information.

To remember

- The establishment of an "Off-site Center" as a center during emergency, the preparation of manuals for measures during nuclear accidents and systems for collecting and providing information are kind of very important actions to be able to rapid respond.
- Improving information devices to be able to use them without electricity (LED technology).
- Nuclear accidents are not visible. Road administrators can't themselves judge danger or take appropriate measures. They must quickly acquire correct and useful information from the command offices for a radiation emergency.
- Communication with other organizations is very important as well as practicing emergency drills, preparing manuals and constructing software and hardware for collecting and providing information.

2.2.3. The fuel crisis in United Kingdom

A significant example with lessons for governmental bodies occurred in the United Kingdom in the autumn of 2000 by a protest affecting all forms of transport using the road network (in a period of days the UK government was faced with widespread public dissent, economic disruption and the possibility of a major breakdown in society), the event and how normality was re-established is now discussed.

Before

Fuel prices in the United Kingdom comprise 3 elements:

- the cost of fuel, distribution and return on capital;
- vehicle excise duty VED[1];
- value added tax applied to both of the former.

For the two decades between the oil crisis of the early 1970's and 1992 fuel costs had remained relatively stable at constant prices as the basic cost had not fluctuated greatly and taxation had only been increased in line with inflation. U.K. fuel costs were in the top quartile of those in Europe but this had been broadly accepted.

Two events then combined to cause a change in taxation policy. Firstly Britain suffered a sharp recession in the late 1980's early 1990's which reduced the taxation base due to unemployment and the taxation returns due to lower company profits etc. Secondly environmental pressure groups pointed to the continuing use of motor vehicles despite the recession[2] by at least 1%/annum. It was suggested that fuel was

[1] In the period from 1986 - 1998 VED on diesel DERV and unleaded petrol was approximately 15% less than that for leaded petrol. In 1999 and 2000 as leaded petrol was phased out, DERV VED was 6% dearer than unleaded petrol VED.

[2] All motor vehicles thousand million vehicle/km :

1985	309.8
1990	410.9

too cheap as demand was inelastic. Professor David Pearce of University College, London, advocated 'green' taxes on fuel as an advisor to government in 1989.

In response to these pressures the Chancellor of the Exchequer introduced a 'Fuel Escalator' in March 1993. This escalator committed the government to increase duties by at least 3% each year in real terms. A further budget in November 1993 increased the escalator to 5%. It was further increased to 6% from July 1997. These measures altered the balanced situation which previously obtained.

The effect of these cumulative changes can be seen in Table 1. In a period of relatively low inflation the price of fuel rose disproportionately with other costs. The effect on industry was mitigated by the fact that other energy costs were stable or falling.

Table 2.3

	VED pence/litre	
	Unleaded Petrol	**DERV Diesel**
March 1991	22.4	21.9
March 1992	23.4	22.9
March 1993	25.8	25.1
November 1993	28.3	27.7
November 1994	31.3	31.3
November 1995	34.3	34.3
November 1996	36.9	36.9
June 1997	40.3	40.3
March 1998	44.0	45.0
March 1999	47.2	50.2
March 2000	48.8	48.8*

*Rate for ultra low fuel diesel

During the 1990's lobbying organisations involved in road transport were concerned. This concern focused on the growing disparity between government spending on road maintenance and improvement and the revenue from all road taxation shown in Table 2. There appeared to be a general acceptance of the high price of fuel with the exception of those representing the road haulage industry. In fact there was a serious debate about raising the escalator to 10% but this was not accepted.

The two organizations representing hauliers RHA (Road Haulage Association) and FTA (Freight Transport Association) were not part of this consensus. They repeatedly lobbied against continued increases in all forms of taxation which affected their members many of whom were owner/drivers.

1995 430.9

Table 2.4

Road User Taxation and Road Expenditure (£bn)		
	Expenditure	**Taxation**
1989/90	4.5	18.3
1990/91	5.2	19.0
1991/92	5.4	19.2
1992/93	5.8	19.6
1993/94	6.1	21.3
1994/95	6.1	23.7
1995/96	5.8	25.7
1996/97	5.3	28.3
1997/98	5.0	32.0
1998/99		35.5

The fuse for the events of Autumn 2000 was lit in 1999 when world fuel prices, which had been as low as $10/barrel, started rising steeply to over $30/barrel. The retail price of petrol, which had been about 63 pence/gallon in January 1999, had jumped to 75 pence/gallon by January 2000 and over 80 pence/gallon by July of that year. An increase of one third in 18 months. The fact that fuel was now some 70% above the price obtaining in Europe was a further source of resentment.

In the budget of April 2000 the Chancellor made some response to this situation in deciding not to use the Escalator for that year, but the assumption was that it would be applied in future budgets, and fuel duty was increased to reflect inflation. Modest changes were also made on the duties affecting hauliers. Annual car tax was reduced for vehicles under 1100 cc.

In the summer of 2000 as fuel prices rose steadily so did public anger. The media took the issue up and every petrol increase was given headline treatment. It was pointed out that the overall incidence of VAT was increasing taxation beyond any forward revenue estimates and calls were made for a cut in duty to at least reflect this. Calls for cuts in the duty were rejected by the government pointing to the fact that for each 2p/litre cut in fuel duty £1bn would have to be found from other sources of taxation. In addition the oil companies were accused of increasing their margins and so profiteering.

At this stage it is important to consider the position of hauliers. As we have seen the tax on diesel was somewhat lower than that on petrol until 1998 when a further environmental policy was introduced to make diesel DERV duty slightly higher than that of unleaded petrol in order to encourage drivers to switch to cleaner fuels. This bore heavily on hauliers.

Hauliers were also concerned that the cost of DERV in Europe was generally lower and in some cases markedly so. The U.K. excise duty on diesel which had been about one third above that of the EU average in the early 1990's was more than

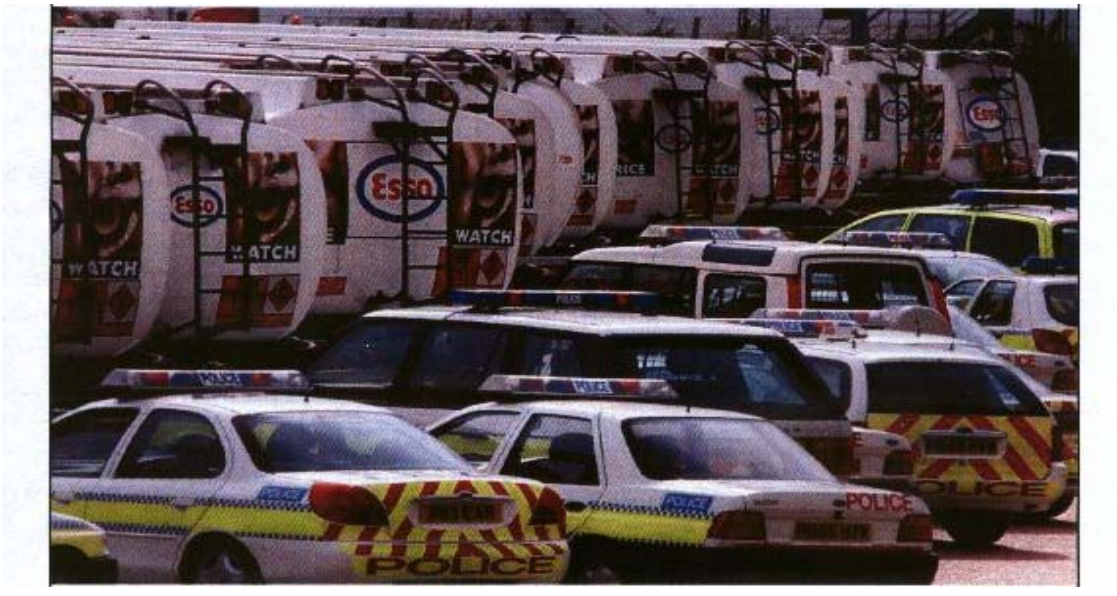
double by 2000. There are substantial lorry born imports and exports between the U.K. and Europe and U.K. hauliers perceived that competition which they had always believed was unfair was now grossly so. Between 1990 and 2000 the U.K. share of cross-channel road haulage reduced from 48% to 32%. In addition vehicle licence duty in the U.K. was particularly heavy on the basis of the road damage factor imposed by those vehicles.

Their lobbying organisations the RHA and PTA again pleaded with government to lower tax rates, by introducing a Fuel Duty Rebate FDR for commercial vehicles equivalent to the difference between the U.K. price and the average of the nearest European neighbours. Farmers were also involved in lobbying. Although they are exempt from duty on DERV used within their farms they were bruised due to falling farm incomes and any increases in their costs were perceived as unfair. Another category expressing concern was rural motorists who did not have the alternative of using public transport.

During the disaster

On Wednesday 5th September 2000 it was announced that fuel prices were to rise again following a further rise in the price of crude oil. The next day the Channel Tunnel was blockaded in protest. On Friday 7th September lorry drivers, many of whom were individuals owning their own lorries, started picketing the Shell refinery at Stanlow near Manchester. The protests spread very rapidly, encouraged by media coverage and communication by broad band radio between hauliers and mobile telephones. More refineries were blockaded on 8th September and by the 10th September protests had closed Britain's largest inland oil terminal at Kingsbury near Birmingham. Nationwide panic buying had begun on September 9th with huge queues forming at any garages with fuel. Garages normally carry stocks for 3 - 5 days. These were often exhausted within hours.

Figure 1



Petrol shortage
Brian Smith / Daily Telegraph

The question posed by government was why didn't the tankers leave the depots when picketing was predominantly peaceful. Three reasons were given:

That the tanker drivers were like 90% of the general public[3] in full sympathy with the protest. After all they are all private drivers.

That threats were made against drivers who came out. There were some suggestions of this but such allegations were never proved.

That the oil companies were keen for taxes to be reduced so they colluded in the protest and did not apply any pressure. The major companies denied this and stated that for safety reasons their tankers should not be on the streets in a volatile situation due to their hazardous loads.

The government also inferred that there was some conspiracy and pointed to the use of mobile phones etc., as they facilitated orchestration of the protest.

Here the position is unclear. Leaders of the protest emerged from both the trucking and farming communities and although supported by RHA, FTA, NFU (National Farmers Union) in their aims these bodies in no way organised the protest.

The government which won power by an enormous majority in the 1997 general election was overtaken by the opposition in opinion polls for the first and only time between then and 2001 when they were returned to power equally convincingly. At first the government showed resolve. On September 11th Tony Blair, U.K. Prime Minister, made it clear that it would not change its policy because of blockades and pickets. "That is not the way to make policy in Britain and as far as I am concerned it never will be".

The crisis deepened by September 12th, protestors had blocked off 6 of Britain's 8 refineries and over half of the country's filling stations were shut. There was concern about supplies to hospitals etc., and pickets allowed smaller tankers to deliver on the basis that fuel taken out was only to be used by emergency services etc.

On September 13th, protestors switched tactics, lorries, farm vehicles and taxis converged on London, Manchester and the motorways (fig.2). In London police closed Park Lane and cars queued 15 miles from the Blackwall tunnel. There were long delays on the M40, M5 and M1.

The Prime Minister held daily emergency meetings at 10 Downing Street calling on oil executives to take steps to get fuel moving, insisting that the police move the pickets well away from the depot gates and appealing to other representative bodies. An emergency task force was set up under the chairmanship of the Home Secretary, Jack Straw, comprising ministers, police chiefs and oil company executives. As the position worsened major industrial lay offs were signalled. At this point everyday life was being severely disrupted.

[3] 157,489 listeners contacted a BBC telephone poll and 91% supported the direct action.

Figure 2

Lorry drivers protest against high fuel prices on the M25 Motorway near London
Rob Bodman / Daily Telegraph

By September 14th traffic on motorways was down 39% and 25% on major roads.(5) September 14th was the fulcrum of the crisis, the government's actions were now resulting in some tankers leaving the refineries and depots. That day hauliers and farmers called off their demonstration at the main distribution terminals although pockets of resistance remained. Organisers stated that they wanted to end the action while they retained public support. They also perceived that whilst the British motorist hated high fuel prices his freedom of movement was ever more sacred.

The government also struck a more conciliatory tone towards the protestors. The Prime Minister ruled out an emergency budget but accepted that they had a "genuine sincerely held grievance". Ministers would meet them if they wished and hints were given about taxation changes to help motorists and hauliers.

In calling off the action the protestors made it clear that unless the government made a commitment within 60 days to cut fuel taxes it could be resumed.

After

The speed with which life returned to normal was similar to that of the disruption taking effect. In 2 weeks the country was back to its usual pattern. Road traffic in the 3rd quarter of 2000 was reduced by 2% as a result of the protest. Afterwards it appeared that secret changes were made to safety regulations to allow truck drivers to remain at the wheel longer each day. European regulations were suspended for one month. There continued to be waves of panic buying of petrol as rumours of

further action were circulated. One particularly severe instance arose out of a statement made from a local radio station in South Wales.

The dialogue with government continued and the Chancellor signalled the following measures in his pre budget statement on November 7th.

Fuel Duty to be frozen until April 2002 and beyond if crude oil prices remain high. It was in fact frozen again in April 2002.

Vehicle Excise Duty on lorries to be widely reformed producing an average reduction of more than 50% or £715/annum.

A 'British disc' to be introduced requiring lorries registered overseas to pay to use British roads. This had not yet occurred but is promised.

Car duty at the lower rate to apply to cars up to 1500 cc. The lower limit then was 1100 cc.

In the April 2002 budget the government scrapped the fuel escalator entirely, 9 years after its introduction. Professor David Pearce sees these events as the death of energy taxes for some years to come.

To remember

- **The need for governments to carry out 'risk assessment' of their policies to cover events of high consequence and infrequent occurrence.**
- **That changes in relative prices of staple products such as fuel have to be managed sensitively and over a very long period.**
- **The speed with which action to disrupt transport could, if unchecked, undermine the whole economy of a nation state. This is a matter of days not weeks.**
- **The need for governments to have emergency planning mechanisms in place to deal with disruption in transport caused by civil unrest.**

2.2.4. Explosion During Transport of Blasting Explosives that occurred in Walden, Ontario, Canada on August 5, 1998

Before

In the early evening of Wednesday, August 5, 1998, a Transport truck (tractor trailer combination) loaded with 18,000 kg of blasting explosives set out to deliver its shipment from Coniston, Ontario, to a manufacturing/distribution site in the Hemlo gold mines area. The distance between the two sites is approximately 670 kilometres.

Making up the 18,000 kg load were quantities of three different blasting explosives. Each is a stable explosive, meaning that under normal conditions they will not

explode on their own. The three different blasting explosives were 4,471 kg of Aquamex, a TNT-sensitized water-based gel or slurry explosive, 669 kg of RXL 511, a detonator-sensitive emulsion explosive, and 13,052 kg of AMEX II, an ammonium nitrate fuel oil mixture (ANFO).

At about 6:00 pm, August 5, 1998, employees finished loading the trailer, sealed its rear doors, and parked it in a lot behind the plant. The driver arrived at the Coniston site between 7:00 pm and 7:15 pm, accepted the shipment, signed the shipping document and left the site between 7:30 pm and 7:45 pm.

During the disaster

The truck (tractor-trailer) left the highway at approximately 90 kph. The beginning of the tire marks through the gravel on the side of the road was approximately 50 m from the final location of the truck.

Several witnesses described extensive damage to the front of the trailer. The front end was broken open, either from contact with the rock cut, from the effect of the jack-knife, or from the load moving through the front wall of the trailer due to an abrupt stop. The back end of the trailer was still intact.

The tractor unit sustained severe damage. The passenger door of the tractor was jammed and bent into the frame. The hood had buckled or had been torn off and the engine compartment was exposed. There appears to have been damage to at least one of the diesel fuel tanks. Witnesses noted the smell of diesel fuel or referred to a ruptured diesel fuel tank.

A fire started but its exact origin is not clear. The locations identified were in the engine compartment, near the engine compartment, and beside the cab on the driver's side of the truck. In the initial stage witnesses described low flames and black smoke. Smoke was reported as being in or near the cab of the tractor.

The driver reported that the accident threw him upside down in the cab, towards the back, tangling him in webbing. He untangled himself and tried to force his way out the passenger side door as the driver's door was buckled and blocked by fire. However, the passenger side door was also jammed.

Two westbound cars stopped almost immediately after the accident happened. The driver of the first car and the passenger in the second car called 911 using cell phones. The passenger in the second car ran toward the cab to help the driver. Two large trucks (also tractor-trailer configurations) transporting bread stopped on the wider left shoulder of the westbound lanes, the first nearly opposite the accident site. To the south, several eastbound cars and trucks stopped.

From witness reports, the placards on the truck were recognized early as indicating that the trailer contained explosives.

The two men trying to assist the driver found the passenger door jammed and bent into the cab frame. Together they pulled and pried the door open while the driver kicked at the door from the inside. Finally the door opened and the men helped the driver out of the damaged truck. The driver urgently warned that there were

explosives on board, that they had to leave the area, and that they had to close the highway.

By about 8:20 pm, only a few minutes after the accident, several other cars and trucks had slowed or stopped on the westbound and eastbound lanes.

The driver or passenger in one car in the eastbound lanes also called 911. They then drove back west on the eastbound lanes to stop traffic. Another drove farther east, then crossed over to the westbound lanes to stop traffic at the crossover road that is about 700 m from the site of the explosion.

An off-duty Police officer arrived at the scene on the westbound lanes. The officer radioed in an emergency call and took a brief report from one of the bread truck drivers. He began to get cars in the westbound lanes to turn around and leave the scene. The officer assessed the condition of the driver, now sheltered at one of the vehicles on the eastbound lanes. From one of the stopped trucks, the officer called on citizen band radio (CB) to trucks to the west to block the eastbound lanes in the area of the Vermillion River bridge. This was successful but as this was about 5 km from the accident site there was still the traffic caught within that 5 km to deal with.

There were two road closure points near to the accident site. One was about 400 m west of the site in an area sheltered by an elevation in the ground between the east and west bound lanes of the highway. The second was located at the crossover road about 700 m to the east of the accident site.

With a cell phone, the fire fighters called the transport company. They discussed the accident and reported that the driver was okay. They asked for information about the explosives on board and for help in planning a response strategy. At 8:49 pm, the OPP Dangerous Goods Unit and the Sudbury Fire Department reported the incident to CANUTEC, Transport Canada's emergency response information centre in Ottawa. Isolation distances were discussed for such an incident.

The rapid action of the OPP in clearing the highway during the immediate response phase prevented loss of life. Their outstanding work in the presence of a burning load of 18,000 kg of explosives is highly praised.

The explosion occurred at 8:52 pm (time determined from seismic readings), approximately 32-37 minutes after the accident (Figure 1).

Figure 1

Police officers at the highway closure 700 m east of the site said the effect of the explosion was strong enough to throw them off balance. The blast was followed by a reverse effect, like the air being sucked back toward the scene. They saw and heard debris flying through the air.

A plume of blackened smoke was seen from 20 km away. Three houses were temporarily evacuated. Crews from the fire department remained on stand-by at the site until the next morning when the area could be assessed more clearly. A fire department presence was maintained during the clean-up period.

One of the bread trucks that stopped in the westbound lanes was not moved away, owing to its proximity to the burning Christie truck. It was destroyed in the explosion by the effects of the blast (Figure 2)

Figure 2

After

At 9:20 pm on August 5, Orica Canada Inc. put their Emergency Response Assistance Plan into effect. This plan had been established to satisfy government regulations.

Two supervisors drove overnight to arrive at the accident site early on the morning of August 6. Orica hired support personnel from Philip Services, Ceda Reactor and Drain-all to help with the clean-up by picking through the rubble and scouring the bush around the blast site. Approximately 2% of the RXL 511 and 11% of the Aquamex, about 500 kg, was recovered. No AMEX II was found.

The clean-up began on the morning of Thursday, August 6, 1998 and continued for 10 days. During this time traffic along the affected stretch of the Trans-Canada Highway was re-routed to Regional Road 55. (Figure 3)

Representatives of Transport Canada, Natural Resources Canada, Ministry of Transportation of Ontario, the Walden Fire Department and the Ontario Provincial Police were on-site to ensure that the clean-up proceeded properly and that all the explosives were recovered.

Figure 3

A full copy of the report is available from Transport Canada, “Report of an investigation into the explosion during transport of blasting explosives that occurred in Walden, Ontario on August 5, 1998” Report number TP13383 E. Transport Canada may be contacted through the following web site address: http://www.tc.gc.ca/tdg/menu.htm

Conclusion

In light of these examples and after the 9-11 tragedy, it appears that it is difficult to prevent these kinds of disasters and be prepared to confront them. Natural disasters such as floods or volcanic eruptions are becoming easier to mitigate with the use of technologies and by reference to historical data.

For natural and man-made disasters it seems that preparation and partnership particularly with the media and related organisations are two essential conditions in emergency situations. Indeed from plans and manuals it will be seen that variable elements influence the context and the situation. For example in the fuel crisis the unfolding of events was particularly surprising and rapid. In nuclear accidents each minute becomes very precious.

The importance of roadways emerges from the impacts of a disaster. The restoration of roadways is always one of the first actions to be taken by authorities in an emergency situation. It is necessary to have plans to identify strategic infrastructures and roadways and plans for diverting of traffic.

APPENDIX

2.1. List of Related Accidents and Associated Web Sites

APPENDIX 2.1.

LIST OF RELATED ACCIDENTS AND ASSOCIATED WEB SITES

Incident type	Incident summary	Web site address
Bridge collapse	Bridge hit by barges, Webbers Falls, Oklahoma, May 26, 2002	http://edition.cnn.com/2002/US/05/26/barge.bridge/index.html http://news.bbc.co.uk/1/hi/world/americas/2014481.stm http://edition.cnn.com/2002/US/05/28/bridge.collapse/index.html http://www.swtimes.com/Includes/BridgeCollapse/PhotoGallery/index.html
Bridge collapse	Sunshine Skyway: Tampa Bay, Florida, May 9, 1980: In the midst of passing through Tampa Bay, the Liberian registered freighter Summit Venture was trapped in a sudden, blinding rain squall. The ship drifted out of the correct channel and tragedy followed. Death toll: 35	http://www.rushw.com/skyway.html http://www.rushw.com/skyway/sky4.html
Bridge collapse	Queen Isabella Causeway (between South Padre Island and Port Isabel, Texas): On September 15, 2001, a string of barges collided into the Queen Isabella Causeway, the only road linking South Padre Island, Texas with the mainland.	http://members.aol.com/wagneko2/queen1.html http://pages.sbcglobal.net/bcalz/causeway.html http://www.stexasbiz.com/TXBIZ/COLLAPSE/collapse.html http://www.gsl.net/ae5r/causeway.html
Fog related accident	Long Beach CA (Nov 3, 2002): -- As many as 100 vehicles crashed on a fogbound Long Beach freeway early Sunday, injuring dozens of people and closing the highway for hours. The accident occurred on Interstate 710. Some cars were buried under others, and some of the injured had to be cut from their vehicles	http://www.cnn.com/2002/US/West/11/03/highway.pileup.ap/index.html http://www.dailynews.com/Stories/0,1413,200%257E20954%257E968499,00.html

Fog related accident	Chambly, QC (Sept 26, 2002): 40 involved in a massive pileup east of Montreal on Thursday that killed one man and injured 17 other people, including one seriously.	http://ca.news.yahoo.com/020926/6/p77j.html http://www.cyberpresse.ca/nouvelliste/actualites/0209/act_502090140906.html
Tank truck fire on highway	Detroit, May 28, 2000: A tanker hauling 13,000 gallons of gasoline exploded as it barrelled past Comerica Park on northbound I-75 around 10 a.m. Driver burned in I-75 tanker truck blast. Gas in sewers forces cancellation of holiday parade.	http://www.detnews.com/2000/metro/0005/28/c01-64371.html
Tank truck fire on highway	Yonkers, New York, Oct 09, 1997: NTSB Report: truck tractor pulling a cargo tank semitrailer was going under an overpass of the New York State Thruway when it was struck by a sedan. The car hit the right side of the cargo tank in the area of the tank's external loading/unloading lines, releasing the gasoline they contained. The ensuing fire destroyed both vehicles and the overpass; the thruway remained closed for approximately 6 months. The driver of the car was killed; the driver of the truck was not injured. Property damage was estimated at $7 million.	http://www.ntsb.gov/publictn/1998/HAR9802S.pdf http://www.nyu.edu/icis/work/ICCreport.pdf
Tank truck fire on highway	Gasoline truck fire in New Jersey: A gas tanker carrying 3,000 gallons of gas caught fire on Route 80 in New Jersey Friday, causing a massive explosion and the closing of the highway.	http://server.firehouse.com/hotshots/photostories/2001/june/25_nj.html http://www.firehouse.com/hotshots/photostories/2001/june.html
Accident Database	General database on accidents	http://www.dct.tudelft.nl/part/explosion/acdata.html
Accident Database	Disasters by date	http://www.uneptie.org/pc/apell/disasters/lists/disasterdate.html

ANNEXE 3 : ORGANISATIONS AND DATA

3. ROAD DISASTER INFORMATION AND RELATED ORGANISATIONS

3.1. Introduction

Road management staff of PIARC member countries may necessitate appropriate risk management procedures for roads when disastrous events happen to occur to their managing roads. This Chapter first presents effective procedures for the reader to obtain how to search for the information and data on road disasters worldwide. Specifically, the reader may wish to search for the information and data on road disasters, in terms of 1) nations or countries, 2) kinds of disastrous events (such as floods, landslides, earthquakes, snow avalanches, volcanoes, fires, etc.), and 3) varieties of structures consisting of roads (such as pavements, fills, slopes, bridges, and tunnels).

This Chapter will next provide information on manuals of emergency response procedures of some countries leading in disaster reduction efforts. It will also present specific requirements or regulations of dangerous substance and hazardous wastes deposited inside roads and rights-of-way.

When referring to this Chapter the road management staff could obtain information and data that are applicable to deciding their disaster mitigation policies to roads in their respective countries. It may also be possible from the information given in this Chapter to transfer and exchange advanced technologies and know-hows among different countries.

Chapter 2 gives a possible classification of risk related to road disasters. Mainly they can be classified into two categories, namely natural disasters and human (or man-made) disasters.

Firstly, natural disasters to roads are defined as those triggered by natural events such as:

1. Floods.
2. Landslides.
3. Earthquakes.
4. Snow Avalanches.
5. Others Volcanoes, Forest and Bush Fires, Blizzards, Heavy Snows, Strong Winds, Storm Surges, Tsunamis, Droughts, Sand Accumulations, Ground Subsidence, etc.

Secondly, human (or man-made) disasters to roads include those caused by:

1. Fires and Arsons in and near Roads (including Tunnel Fires).
2. Collisions of Vehicles and Ships, Explosions, and Attacks to Roads and Bridges.

3. Leakage of Dangerous Substances (Combustible, Inflammable, Nuclear, etc.).
4. Dump of Hazardous Wastes (including Abandoned Vehicles) on Highway Rights-of-Way.
5. Others (Construction Incidents, Structural Corrosions, etc.)

This chapter will discuss and illustrate on the procedures for searching the information and data relating to some of the above road disasters occurred or to be occurring in different countries in the world.

These lists cannot be exhaustive and the definition of Internet / websites are subject to continual change.

3.2 International Organizations Releasing General Disaster Information of Various Countries

There are several international organisations that quickly and periodically release comprehensive disaster information and data of various countries in wide regions. However, those international organisations are releasing material not exclusively for road-related disasters, but general disasters including all aspects of natural disasters and human (or man-made) disasters. Names, home pages (or websites), and typical characters (scopes of areas covering, information contents, disaster preparedness database, human resources database, etc.) of such international organisations are described in the following:

INT-1) United Nations Office for the Coordination of Humanitarian Affairs (OCHA) – New York, U.S.A.
Home Page: www.reliefweb.int
Characters: Relief Web is a project of the United Nations Office for the Coordination of Humanitarian Affairs (OCHA). It provides the latest updates of complex emergencies and natural disasters. It also provides disaster statistics worldwide, disaster maps, and international cooperative programs, and a directory of disaster management resources available for humanitarian assistance.

INT-2) United Nations Office for the Coordination of Humanitarian Affairs (OCHA) – Geneva, Switzerland
Home Page: www.reliefweb.int
Characters: Same as the above.

INT-3) United Nations Office for the Coordination of Humanitarian Affairs (OCHA) – Kobe, Japan
Home Page: www.reliefweb.int
Characters: Same as the above.

Home page www.reliefweb.int is commonly used among the above 3 organisations on the 24-hour basis throughout the year.

INT-4) Asia Disaster Reduction Center (ADRC)
Home Page: http://www.adrc.or.jp
Characters: ADRC covers comprehensive information and data on natural disasters occurring in Asian countries. It also includes worldwide disaster information and various database such as a human resources network. Disaster statistics worldwide, international cooperative programs, and multi-lingual terms related to disaster reduction are also provided.

INT-5) Center for Research on the Epidemiology of Disasters (CRED)
Home Page: http://www.cred.be
Characters: CRED provides a complete coverage of international disaster database (EMDAT) and disaster statistics for long years, and describes international cooperative programs on disaster reduction. It also provides maps, glossary, guidelines, other useful links, and additional information relating to disasters.

INT-6) World Road Association (WRA or PIARC)
Home Page: http://www.piarc.org
Characters: The World Road Association (WRA or PIARC), founded in 1909, is an international organisation dealing with road infrastructure planning, design, construction, maintenance and operation. The home page covers its aims and activities, technical committees, publications, international relations, WIN, etc, in English and French. Especially, click the WIN (World Interchange Network), a service of PIARC that facilitates the contact between people and experts.

INT-7) International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE)
Home Page: http://www.issmge.org
Characters: ISSMGE releases professional information for experts and engineers working in the fields of geotechnical engineering, soil mechanics, and foundation engineering. It also provides information on international seminars on various fields of geotechnical engineering.

INT-8) TrafficLinq
Home Page: http://www.trafficlinq.com, or webmaster@trafficlinq.com
Characters: TrafficLinq is a web site directory for traffic and transportation engineers. They recently added a few new options including: 1) a large section on books on traffic and transportation, and 2) a new search option. One can scan all transportation sites with one query. However, road disasters (natural or human) are not dealt as a key item.

These lists cannot be exhaustive and the definition of Internet / websites are subject to continual change.

3.3 National Organisations Providing Road Disaster Information of Respective Countries

This section provides names, home pages (or web sites), and typical characters (scopes of areas covering) of road management organisations and related institutes of various countries, especially, disaster-prone countries such as the countries having PIARC C18 members, if they are providing their road disaster information. Similar information of meteorological agencies and disaster-oriented organisations of the respective countries will be also presented. Sub-sections of this section appear on the country basis in the alphabetical order. Some countries are providing their information only in their own languages, not in English or other widely used languages.

3.3.1 Australia (AU)

AU-1 Roads and Traffic Authority (RTA), NSW
Home Page: http://www.rta.nsw.gov.au
Characters: RTA is the state governmental agency responsible for main road, motor vehicles and road users in New South Wales, Australia. The home page provides the general information and advice on many issues managed by RTA, as well as several online transactions.

AU-2 Department of Infrastructure, Energy and Resources (DIER), Tasmania
Home Page: http://www.dier.tas.gov.au
Characters: DIER is the state governmental department responsible for energy planning and conservation, transport infrastructure and regulation, and other areas. The home page provides the general information on DIER's organisation and activities.

3.3.2. Canada (CA)

CA-1 Department of National Defence
Office of critical infrastructure protection and emergency preparedness (OCIPEP)
Home page: http://www.ocipep-bpiepc.gc.ca
Characters: OCIPEP has the mission to enhance the safety and security of Canadians in their physical and cyber environments.
The home page provides full information of OCIPEP in English and French and its overall activities.

CA-2 Ministère des Transports, Québec (MTQ), Canada
Home page: http://www.mtq.gouv.qc.ca
Characters: MTQ is the governmental organisation responsible for road and railways in Quebec, Canada. The home page provides the general information of MTQ in English and in French. The page covers road conditions, R&D project, and many other topics.

3.3.3 France (FR)

FR-1 Ministry of Equipment, Transport and Lodgement
Home page: http://www.equipement.gouv.fr
Characters: The home page provides the general information of the Ministry of Equipment, Transport and Lodgement in France.

FR-2 Laboratoire de Ponts et Chaussées (LCPC)
Home page: http://www.lcpc.fr
Characters: LCPC, set up in 1851, is a state research organisation in civil engineering, transport, urban engineering and environment. The home page provides the overall activities in English and French.

3.3.4. Japan (JP)

JP-1) Road Emergency Management Office, Road Bureau, Ministry of Land, Infrastructure, and Transport (MLIT)
Home page: http://www.mlit.go.jp/road/bosai/bosai.html (in Japanese)
Characters: MLIT is the central organisation in charge of construction and management of most of important roads and highways throughout Japan.

JP-2) National Institute for Land and Infrastructure Management (NILIM), MLIT
Home page: http://www.nilim.go.jp
Characters: NILIM has the Research Center for Disaster Risk Management (DRM), under which Erosion and Sediment Control Division, Flood Disaster Prevention Division, and Earthquake Disaster Prevention Division conduct research works in respective areas.

JP-3) Public Works Research Institute (PWRI), Independent Institution
Home page: http://www.pwri.go.jp
Characters: PWRI has the Earthquake Disaster Prevention Research Group (Ground Vibration Team, and Earthquake Engineering Team), and Erosion and Sediment Control Research Group (Volcano and Debris Flow Team, and Landslide Team), which conduct research on earthquakes, and erosion and sediment control, respectively.

JP-4) Japan Highway Public Corporation（JH）
Home page: http://www.jhnet.go.jp
Characters: JH has English pages that include an Annual Report describing various activities in the past year. When large disasters like the Kobe Earthquake of 1995 occur, the Annual Report in the following year will state the characteristics.

JP-5) Metropolitan Expressway Public Corporation (MEX)
Home page: http://www.mex.go.jp (in Japanese)
Characters: MEX has Japanese pages on Disasters and Countermeasures that have the following 4 Questions and the Answers: 1) Are MEX expressways safe when a

large earthquake happens? 2) What kinds of measures are taken inside tunnels against fires?
3) How emergency exits are installed on MEX expressways? 4) How should the users behave when they come across a large earthquake on a MEX expressway?

JP-6) Hanshin Expressway Public Cooperation (HEPC)
Home page: http://www.hepc.go.jp
Characters: HEPC has English pages that include two disaster-related issues, Seismic Control (seismic design of bridges), and DIMS (Disaster Information Management System), in the recent version (as of February 1st, 2002). After experiencing the Kobe Earthquake of 1995, HEPC installs DIMS which enables to take prompt and effective actions during natural disasters and other emergency situations. Several photographs are shown.

JP-7) Honshu-Shikoku Bridge Authority (HSBA)
Home page: http://www.hsba.go.jp
Characters: HSBA has English pages that include articles on the effects of natural events on infrastructures such as long-span bridges. In the recent version (as of February 1, 2002) an article on some damages to Honshu-Shikoku bridges caused by the Geiyo Earthquake of 2001 (Magnitude of 6.4, and 30 km to the nearest long bridge) is provided.

JP-8) Disaster Management Department of the Prime Ministry
Home page: http://www.bousai.go.jp (in Japanese)
Characters: The home page of the Disaster Management Department (DMD) of the Prime Ministry provides the governmental official disaster information throught Japan. The page includes the documents released (in Japanese) the press, the responses to recent disasters, the organisation chart of DMD, the disaster-related systems, and detailed information on recent natural and man-made disasters. Only limited information is provided in English.

JP-9) Fire and Disaster Management Agency (FDMA)
Home page http://www.fdma.go.jp(in Japanese)
Characters: The home page of the Fire and Disaster Management Agency (FDMA) releases information on major natural and man-made disasters recently occurred in Japan. The page also covers the database on the Hanshin-Awaji (Kobe) Earthquake of 1995.

JP-10) Meteorological Agency
Home page: http://tenki.jp (in Japanese)
Characters: The home page covers (in Japanese) the preliminary warring and the emergency warning, information on earthquakes, tsunamis, typhoons, and volcanoes, as wall as daily weather forecasts.

JP-11) Kyodo Tushin News Co. English Page
Home page: http://www.home.kyodo.co.jp

Characters: The home page Kyodo Tushin News, one of the newspaper sources in Japan, releases daily news including those of major natural and man-made disasters, in English, Chinese, and Japanese.

JP-12) Japan Society of Civil Engineers (JSCE)
Home page: http://www.jsce.or.jp
Characters: JSCE provides information on the effects of natural disasters (such as the Kobe Earthquake of 1995) on civil engineering structures including roads and bridges. It may also introduce information on national and international cooperative programs on civil engineering research.

JP-13) Japanese Geotechnical Society (JGS)
Home page: http://www.jiban.or.jp
Characters: JGS provides information on the effects of natural disasters (such as the Kobe Earthquake of 1995) on earth fills, slopes, grounds (including soil liquefaction), and structural foundations. It may also provide information on national and international cooperative programs on geotechnical engineering research.

JP-14) Geographical Survey Institute (GSI), MLIT
Home page: http://www.gsi.go.jo
Characters: GSI, established in 1869, is the national surveying and mapping organisation of the Ministry of Land, Infrastructure and Transport (MLIT). The home page provides information how GSI copes with natural disasters such as volcanic eruptions and earthquakes.

JP-15) Japan Road Association (JRA)
Home page: http://www.road.or.jp
Characters: JRA is a no profit association to investigate road policies, disseminate finding on roads, and enhance the progress of road and traffic policies. The home page provides the general information on various activities of JRA in Japanese.

3.3.5. New Zealand (NZ)

NZ-1 Transit New Zealand (TNZ)
Home page: http://www.transit.govt.nz
Characters: TNZ is a crown entity created in 1989. It is responsible for the maintenance and improvement of the state highway system. The home page covers the general information of TNZ.

3.3.6. Norway (NO)

NO-1 Norwegian Public Roads Administration, (NPRA or Vegvesen)
Home page: http://www.vegvesen.no
Characters: The home page provide (in Norwegian) the general information of the Norwegian Public Roads Administration (NPRA or Vegvesen), responsible for the maintenance and improvement of public roads in Norway.

3.3.7. Portugal (PT)

PT-1 Direccao Geral de Transportes Terrestres (DGTT)
Home page: http://www.dgtt.pt
Characters: DGTT is the government organisation responsible for roads in Portugal. The home page provides (in Portugal) the general information of DGTT.

3.3.8 Spain (ES)

ES-1 Ministerio de Fomento Paso de la Castellana (MFOM)
Home page: http://www.mfom.es
Characters: MFOM is the Spanish Ministry of Infrastructures. The home page provides the general information of MFOM in Spanish.

ES-2 Centro de Estudios y Experimentacion de Obras Publicas (CEDEX)
Home page: http://www.cedex.es
Characters: CEDEX is the national research institute to perform technical assistance, research and development, and technical transfer in civil engineering and related environment. The home page provides (in Spanish) the general information of CEDEX, including research activities of the Geotechnical Laboratory.

3.3.9. Switzerland (CH)

CH-1 Swiss Federal Roads Authority (FEDRO or OFROU)
Home Page: http://www.astra.admin.ch
Characters: The home page provides the general information of the Swiss Federal Roads Authority (FEDRO or OFROU) in English, French, Germany, and Italian.

CH-2 Davos
Home Page: http://www.davos.ch/emergency
Characters: Davos provides useful information on climate, transportation, accommodations, etc. mostly for winter tourists and skiers in Switzerland and European countries. It also has information on snow avalanche studies.

CH-3 Research Center on Alpine Environment (CREALP)
Home Page: http:www.crealp.ch
Characters: CREALP is a public research center on Alpine Environments with emphasis on studying rockfall problems, hydrology, etc. in Alpine regions. The home page provides its general information, glossary relating to rockslope instability (in French and Italian).

CH-4 Swiss Renisurance Company
Home Page: http:www.swissre.com
Characters: The company periodically releases on web the sigma publication, including the newest edition sigma No. 2 /2001 “Natural catastrophes and man-made

disaster in 2000: Fewer insured losses despite huge floods". The edition has overall disaster information including world-wide damage figures in terms of victims and losses in 2000 and 1970-2000, and briefly stating road/rail disasters and collapse of buildings/bridges.

3.3.10. U.S.A. (US)

US-1 Federal Highway Administration (FHWA)
Home Page: http:www.fhwa.dot.gov
Characters: FHWA is a part of the US Department of Transportation (DOT), and provides technical expertise to States and customers in areas such as roadway and bridge design, construction, maintenance, and many other related issues. The home page provides a comprehensive coverage of FHWA's organisation and activities.

US-2 Transportation Research Board (TRB)
Home Page: http:www.nationalacademies.org/trb
Characters: TRB is a unit of the National Research Council, a private, nonprofit institution. Its mission is to promote innovation and progress in transportation. The home page covers the comprehensive research activities. In light of the September 11th attacks, TRB and the National Academies have generated Transportation System Security Website:
http:www4.trb.org/trb/homepage/nsf/web/security

US-3 American Association of State Highway and Transport Official (AASHTO)
Home Page: http:www.aashto.org
Characters: AASHTO is a nonprofit, nonpartisan association representing highway and transportation departments in the 50 States, District of Columbia and Puerto Rico. The home page provides its comprehensive activities, including organisation, committees, news, and so forth. It also covers AASHTO/TRB Security and Emergency Response Survey and AASHTO Task Force Information.

US-4 California Department of Transportation (Caltrans)
Home Page: http:www.dot.ca.gov
Caltans is responsible for the design, construction, maintenance, and operation of the California State Highway system, as wall as the Interstate Highway System within the state's boundaries, and the railway system. The home page provides the comprehensive information of Caltrans.

These lists cannot be exhaustive and the definition of Internet / websites are subject to continual change.

3.4. Road Disaster Information Depending on Disaster Kinds

This Section lists names (by Organisation numbers shown in 4.2 and 4.3), and addresses of home pages (or web sites) of organisations providing disaster information, depending on disaster kinds, such as floods, landslides, earthquakes, snow avalanches, other natural disasters, and human or man-made disasters.

Type of disasters	Ref.	Addresses
3.4.1. Floods	INT-1-3 INT-1□4 INT-1□5 JP-1 JP-2 JP-3 US-1	www.reliefweb.int www.adrc.or.jp www.cred.be www.mlit.go.jp/road/bosai/bosai.html (in Japanese only) www.nilim.go.jp www.pwri.go.jp www.fhwa.dot.gov/bridge/ (click Hydraulics for scouring effects, etc.)
3.4.2. Landslides	INT-1-3 INT-4 INT-5 INT-6 JP-1 JP-2 JP-3 JP-14 CH-3 NO-1	www.reliefweb.int www.adrc.or.jp www.cred.be www.issmge.org www.mlit.go.jp/road/bosai/bosai.html (in Japanese only) www.nilim.go.jp www.pwri.go.jp www.jiban.or.jp www.crealp.ch www.vegvesen.no
3.4.3. Earthquakes	INT-1-3 INT-4 INT-5 INT-6 JP-1 JP-2 JP-3 JP-4 JP-5 JP-6 JP-7 JP-12 JP-13 JP-14 US-4	www.reliefweb.int www.adrc.or.jp www.cred.be www.hepc.go.jp www.mlit.go.jp/road/bosai/bosai.html (in Japanese only) www.nilim.go.jp www.pwri.go.jp www.jhnet.go.jp (in Japanese only) www.mex.go (in Japanese only) www.hepc.go.jp www.hsba.go.jp www.home.kyodo.co.jp www.jsce.or.jp www.jiban.or.jp www.dot.ca.gov/hq/esc/ (click Structural Earthquake Engineering & Design Support)

3.4.4. Snow Avalanches	INT-1-3 INT-4 INT-5 CH-1 JP-1 JP-2 JP-3	www.reliefweb.int www.adrc.or.jp www.cred.be www.davos.ch/emergency www.mlit.go.jp/road/bosai/bosai.html (in Japanese only) www.nilim.go.jp www.pwri.go.jp
3.4.5. Other Natural Disasters Other natural disasters include disastrous events caused by volcanoes, forest and bush fires by natural phenomena, blizzards, heavy snows, strong winds, storm surges, tsunamis, droughts, sand accumulations, and ground subsidences.	INT-1-3 INT-4 INT-5 CH-1 JP-1 JP-2 JP-3	www.reliefweb.int www.adrc.or.jp www.cred.be www.davos.ch/emergency www.mlit.go.jp/road/bosai.html (in Japanese only) www.nilim.go.jp www.pwri.go.jp
3.4.6. Human (or Man-made) Disasters Human (or Man-made) disasters include road disasters caused by fires and arsons, collisions, explosions, attacks, leakage of dangerous substances, and dump of hazardous wastes.	INT-1-3 INT-4 INT-5 CH-4 US-2	www.reliefweb.int www.adrc.or.jp www.cred.be www.swissre.com http:www.nationalacademies.org/trb, and http:www4.trb.org/trb/homepage/nsf/web/security

These lists cannot be exhaustive and the definition of Internet / websites are subject to continual change.

3.5. Road Disaster Information depending on Structural Types

This Section indicates names (by Organisation numbers shown in 6.2 6.3), and addresses of home pages (or web sites) of organisations disaster-information providing disaster information, depending on structural types, such as pavements (road surfaces), fills and slopes, bridges, and tunnels.

Type of structures	Ref.	Addresses
3.5.1. Pavements (Road Surfaces)	INT-6 JP-3	www.piarc.fr (attention to Committee C7/8 “Road Pavements”) www.pwri.go.jp (attention to Pavement Division)
3.5.2. Fills and Slopes	INT-6 JP-2 JP-3	www.piarc.org (attention to Committees C12 “Earthworks, Drainage and Subgrade,” and C18 “Risk Management for Roads”) www.nilim.go.jp www.pwri.go.jp
3.5.3. Bridges	INT-6 JP-2 JP-3 JP-6 JP-7 J-13 US-1 US-4	www.piarc.org (attention to Committee C11 “Roads Bridges and Other Structures,” and C18 “Risk Management for Roads”) www.nilim.go.jp www.pwri.go.jp www.hepc.go.jp www.hsba.go.jp www.jsce.or.jp www.fhwa.dot.gov/bridge/ www.dot.ca.gov/hq/esc/
3.5.4. Tunnels	INT-6 JP-3	www.piarc.org (attention to Committee C5 “Road Tunnel Operation,” and C18 “Risk Management for Roads”) www.pwri.go.jp

These lists cannot be exhaustive and the definition of Internet / websites are subject to continual change.

3.6 Information on Manuals of Emergency Responses

This Section briefly explains some typical examples of emergency response manuals which were prepared exclusively for road management organisations of four countries.

3.6.1. Australia

A) The Network and Road Safety Branch of RTA (Roads and Traffic Authority) Sydney Region, NSW (New South Wales), Australia has issued in September, 1995 the Emergency Response and Incident Management Plan (Document No. NRS-EMP-01) in accordance with RTA's responsibilities under the State DISPLAN. This Plan contains major incident procedures consisting of 6 Parts (Introduction, Preparedness, Roles and Responsibilities of Staff, Control and Coordination, Emergency Response, and Incident Response, and 3 Appendices (Emergency Contact List and Zone Maps, Emergency Resource List, and Emergency Media Guidelines).

B) RPTD (Roads and Public Transportation Division), Department of Infrastructure, Energy and Resources, Tasmania, Australia has published in October, 1998 the Emergency Procedures with the aim to detail arrangements for the management of emergencies affecting roads, traffic signals and other civil engineering structures under the jurisdiction of the RPTD. The Procedures cover 10 Chapters (Introduction, Definitions and Abbreviations, RPTD Assets, Identified Hazards, Control and Coordination, Warning and Alert Procedures, Communications, Administration and Finance, Emergency Planning, and Miscellaneous), and 20 Appendices. Since the Tasmanian RPTD experienced the serious collapse of the Tasman Bridge caused by a ship collision in 1975, the Emergency Procedures are very comprehensive covering natural and man-made disasters, and has a lot of useful detailed descriptions.

C) VicRoads of Victoria, Australia has prepared in 1996 the Emergency Management Manual, which fully details the Roads Corporation's emergency management responsibilities, procedures, and plans. The Manual has 7 Parts: Introduction to Emergency Management in Victoria, VicRoads Emergency Management, Transport, Engineering & Services Support (TESS) Emergency Management, Specialist Area Emergency Management, Business Area Emergency Management, Information Sheets, and Emergency Management Forms.

3.6.2. Japan

A) The Central Council for Disaster Prevention, National Land Agency (now the Disaster Management Department of the Prime Ministry) has published in 1997 the Basic Plan for Disaster Prevention (in Japanese). Part 9 "Road Disaster Prevention" of the Plan has 3 Chapters, consisting of Disaster Prevention, Emergency Measures, and Repair Works.

(http://www.mlit.go.jp/road/bosai/bosai.html). (in Japanesse)

B) In view of the fatal damage to roads and bridges caused by the Kobe Earthquake of 1995, the Japan Road Association has issued in 1996, Part 3 Post-Earthquake Measures, the Guideline for Earthquake Disaster Measures of Roads (in Japanese). The Measures may be effectively utilized for road maintenance staff to promptly and properly respond to disasters. The Measures have 8 Chapters which include Seismic Disaster Preparedness, Emergency Repair Plan, and Management of Post-Earthquake Information. It has many figures and tables. As an example Table 4.3 shows information items necessary for road management in case of an earthquake (simplified). (http://www.road.or.jp) (in Japanese).

3.6.3. New Zealand

A) The Auckland Region of Transit New Zealand (TNZ) has issued in September, 1999 the State Highway Emergency Procedures Manual (1999/2000). The Manual sets out the role and responsibilities for all organizations in the Auckland Region 2. In the Auckland region an emergency event may occur as a result of slips (or landslides), floods, spillage of hazardous substances and accidents. The Manual has 3 Chapters (Scope, Duties, and Specific Requirements), and 7 Appendices (including a notification format of road closure report, emergency Bailey bridges, hazardous substances procedures, 6 different report forms for emergency procedures, etc.). (http://www.transit.govt.nz)

B) The Dunedin Region of TNZ has published in March, 1999 the Contingent Plans – Instructions and Advice in the Event of an Emergency. The Plans incorporate three Sections, namely, Section 1 Staff Safety Plan, Section 2 Business Reinstatement Plan, and Section 3 Operational Emergency Response Plan. Section 1 states Emergency Procedures for the Attention of All Staff in the Main Office, and has 7 subjects (including Evacuation Routes and Assembly Area, Emergency Evacuation Procedures, Fires, Bomb Threats, Earthquakes, Summary of Emergency Procedures, etc.). Section 2 describes Contingent Plan for Recovery from Disaster, and has 3 subjects (Introduction, Model Contingency Plan for Disaster Recovery, and Bomb and Arson Threats Plan). Section 3 describes detailed Plans to Minimise after an Emergency Event the Risk and Delay for State Highway Network Users and to make sure the Efficient Restoration of the State Highway Network Operations. The Plans are very unique and noteworthy, because they include the Section for securing the safety of staff members working in the office, from various kinds of natural and man-made disasters and the Section for quickly recovering the functions of the Dunedin Region's main office. (http://www.transit.govt.nz)

3.6.4. U.S.A.

A) The Office of Engineering, Federal-Aid and Design Division, Federal Highway Administration (FHWA) has issued in September, 1998 the Emergency Relief Manual, Federal-Aid Highways (Publication No. FHWA-PD-98-054). The purpose of this Manual is to provide guidance and instructions on FHWA's emergency relief (ER) program. The manual provides information for FHWA, State, and local transportation agency personnel on policies and procedures for requesting,

obtaining, and administrating ER funds. Congress authorised in Title 23, United States Code, Section 125 (refer to 23 CFR Part 668 - Emergency Relief Program), as a special program from the Highway Trust Funds for the repair and reconstruction of Federal-aid highways and roads on Federal lands which have suffered serious damage as a result
of (1) natural disasters or (2) catastrophic failure from an external cause. Examples of natural disasters include floods, hurricanes, earthquakes, tornadoes, tidal waves, severe storms, or landslides. A catastrophic failure is defined as the sudden and complete failure of a major element or segment of the highway system that causes a disastrous impact on transportation services. The Manual has 6 Chapters (Introduction, Eligibility of Damage Repair Work, ER Application Process, Preliminary Steps, Disaster Assessment and Field Report, and Project Procedures and Requirements), and 6 Appendices (including four Sample Letters, Sample Governor's Proclamation, and Detailed Damage Inspection Report Form). The Manual states useful techniques to accelerate repair or reconstruction projects including Force Account methods as emergency repairs. (http://www.fhwa.gov).

B) Damage to highway facilities that are neither Federal-aid highways nor roads on Federal land may be eligible for other Federal funds authorised by the Stafford Act, P. L. 93-288, and administrated by the Federal Emergency Management Agency (FEMA). The FEMA publication Public Assistance Guide, September, 1996, presents a brief overview of FEMA programs. (http://www.fema.gov)

C) California DOT (Caltrans) has released in January, 2001 the Emergency Operations Plan, which establish and maintain guidelines for Headquarters and Districts in order to respond to emergency events, and describe how to respond to and manage emergencies resulting from natural or man-made disasters, technological incidents or nuclear related operations. The Plan has 4 Chapters (Introduction, Response, Communication, and Responsibility), and 9 Appendices (Executive Order, Administrative Order, EOC/SEMS Organisation Chart Examples, Emergency Operation Center, Auxiliary Radio System (CARS), Call-out Procedure, Fan-out Alert Procedure, etc.). Since Caltrans often experiences severe road disasters of various kinds, the Plan covers comprehensive aspects in responding to road emergency situations, and provide a lot of useful information for road management organisations. For example, procedures for incorporating occupational injury, illness or death of Caltrans staff are provided. The Plan also has the responsibility of the press secretary, which is very important in avoiding possible risks of a road management office. (http://www.dot.ca.gov)

3.6.5. PIARC G2 Reports

PIARC Working Group 2 (G2) on "Natural Disaster Reduction for Roads" has published two reports, namely Comprehensive Report (1995), and Final Report (1999).

(A) Comprehensive Report on Natural Disaster Reduction for Roads was published in 1995 to submit to the 20th World Road Congress, Montreal, Canada. The Report contains the following chapters: 1. Introduction, 2. International Survey of

Road Disasters, 3. Landslides, 4. Earthquakes, 5. Floods, 6. Snow Avalanches, 7. Repair Methods, 8. Disaster Preparedness and Emergency Management, and 9. Summary and Conclusions. (http://www.piarc.org)

(B) Final Report on Natural Disaster Reduction for Roads was published in 1999 to present at the 21st World Road Congress, Kuala Lumpur, Malaysia. The Report has the following chapters:

1. Introduction.
2. International Survey of Road Disasters.
3. Examples of Major Natural Disasters.
4. Hazard Potential Evaluation.
5. Seismic Codes and Guidelines for Bridges in Various Countries.
6. Retrofit Methods.
7. Repair Methods.
8. Emergency Planning and Management.
9. Summary and Conclusions. (http://www.piarc.org).

These lists cannot be exhaustive and the definition of Internet / websites are subject to continual change.

3.7. Road Hazard Maps

3.7.1. New Zealand (Dunedin Region)

As described in 4.6.3 B), Dunedin Regional Office of Transit New Zealand (TNZ) has prepared Contingent Plans□Instruction and Advice in the Event of an Emergency. Section 3 “Operational Emergency Response Plan” of the Contingent Plans provides plans to minimise (after an emergency event) risk and delay for State Highway Network users and to attempt the efficient restoration of the State Highway Network Operation. Appendix 6 “Locations of Possible Major Disruption to Road Users through Road Closure ” illustrates a hazard map (Fig.3.1), probably prepared in view of the previous disastrous events, for Region 13 Central Otago near Dunedin City in the South Island of New Zealand. Possible road disruption locations caused by flooding, snow/ice, and landslip are indicated by triangles, circles, and squares, respectively. A list of possible disruption locations (Reference No., State Highway No., kilo-post, location name, and disruption cause), and an identified event summary sheet (general information and actions required) for each location are clearly shown. The information is obviously quite useful to reopen the closure locations as quickly as possible.

3.7.2. Switzerland (CREALP)

The Research Center of Alpine Environment (CREALP) has published in 1998 “Pentes instables dans le Pennique valaisan ”. The proposed MATTEROCK program presents a diagnosis methodology for determining the danger generated by cliff hazards. Fig.3.2 shows an example of the cliff hazard map to a road, obtained from the analysis at Stägjitschugge, cantonal route Illas□St. Niklaus, Mattertal, Switzerland. Red colour denotes high risk rise sections

3.8. Requirements of Dangerous Substances and Hazardous Wastes

Specific treatments are necessary for dangerous substances (such as explosives and combustible chemicals) transporting on roads, and hazardous wastes on highway rights-of-way. Laws for such treatments in Canada, New Zealand, and U.S.A. will be summarised. Also, examples of labels, posters, and placards to put up on vehicles will be illustrated in colour.

3.8.1. Canada

Recommendations on the Transport of Dangerous Goods Model Regulations

The Recommendations on the Transport of Dangerous Goods are addressed to governments and to the international organisations concerned with safety in the transport of dangerous goods. They are prepared by the United Nations Economic and Social Council's Committee of experts on the Transport of Dangerous Goods.

These recommendations are developed with the objective of ensuring the safety of people, property and the environment. They are addressed to governments and international organisations concerned with the regulation of the transport of dangerous goods.

The recommendations are presented in the form of "Model Regulations on the Transport of Dangerous Goods" to allow for uniform development of national and international regulations for various modes of transport. It is then possible for governments, intergovernmental organisations and other international organisations to develop regulations for which they are responsible that will conform to the principles contained in the Model Regulations thus contributing to worldwide harmonisation in the transport of dangerous goods field.

The Model Regulations cover principles of classification and definition of classes, listing of the dangerous goods, testing procedures, safety marks and transport documents

The Transportation of Dangerous Goods in Canada

Each year more and more dangerous goods are moved across Canada by road, rail, water and air. These shipments range from industrial chemicals to manufactured goods and, while indispensable to our modern way of life, they can pose a threat if not handled safely.

The transportation of such products by air, marine, rail and road is regulated under the federal Transportation of Dangerous Goods Act, 1992. The Transportation of Dangerous Goods Regulations, adopted by all provinces and territories, establishes the safety requirements for the transportation of dangerous goods. Their complete web site is available at the following address:
http://www.tc.gc.ca/tdg/menu.html

Federal and provincial legislation provide for the regulation of an extensive list of products, substances or organisms classified as dangerous. The products fall into one of nine classes, a system of diamond-shaped placards and labels is used to

identify dangerous goods. Different colours and symbols, such as a flame for flammables or a skull and crossbones for poisons, depict the dangers peculiar to each regulated product. These symbols are international and can be seen in the New Zealand section of this chapter.

TRANSPORT DANGEROUS GOODS DIRECTORATE

Transport Canada is the focal point for the national program to promote public safety during the transportation of dangerous goods. The department's Transport Dangerous Goods Directorate serves as the major source of regulatory development, information and guidance on dangerous goods transport for the public, industry and government employees. Through its various components, the Directorate works closely with other federal and provincial agencies to implement the safety program.

The Regulatory Affairs Branch is responsible for the administration, development and amendment of the federal Transportation of Dangerous Goods Act and Regulations.

Branch personnel represent Canada on international organisations responsible for establishing uniform international requirements for classification, labeling and marking of means of containment, transport documentation and safety marks for vehicles carrying dangerous goods. These organisations include the United Nations Committee of Experts on the Transport of Dangerous Goods, Association of American Railroads (AAR) Tankcar Committee and International Civil Aviation Organisation (ICAO) Dangerous Goods Panel.

The Branch has initiated the development of standards for all types of means of containment used in the transportation of dangerous goods. The Branch also issues permits when exceptions to the regulations are warranted.

The Research, Evaluation and Systems Branch makes recommendations and implements decisions and directives to minimise the adverse effects of accidental losses to people, property and the environment associated with the transportation of dangerous goods. The Branch applies risk management techniques in a regulatory framework targeted toward a highly diverse and competitive sector of the Canadian transportation system. These techniques reduce the uncertainty surrounding the potential for accident-related losses by estimating the likelihood and severity of losses, and by taking action to reduce the probability and severity of these losses.

The Compliance and Response Branch, with the assistance of five regional offices across Canada, ensures that consignors, federal carriers and consignees are complying with the regulations through a national inspection, investigation and enforcement program and coordinates the activities of all dangerous goods inspection agencies. The regional offices also provide an information and advisory service to industry and the public.

Remedial Measures Specialists within the Branch review industry emergency response assistance plans registered with the Directorate and conduct investigation on the use of the plans to ensure these can be activated to respond effectively to dangerous goods transportation accidents.

The Branch is responsible for the development of training programs for all federal and some provincial inspectors. The Branch provides general education and awareness programs for industry and the public and manages the explosives vehicle certificate program.

CANUTEC (Canadian Transport Emergency Centre) provides 24-hour-a-day bilingual emergency advisory and regulatory information service. CANUTEC's experienced professional chemists assist emergency responders in the event of a dangerous goods accident. The 2000 Emergency Response Guide was developed jointly by CANUTEC, the U.S. Department of Transportation, and the Secretariat of Communications and

Transportation of Mexico. The Guide is an initial reference source of information on the hazards of the chemicals and recommended responses to accidents involving dangerous goods. It is intended to be used to determine immediate and general on-site response to an accident involving specific dangerous goods. It has been translated in several languages including Polish, Hungarian, Hebrew, Italian, Korean, English, French and Spanish. A database version is available for free in English, French and Spanish from the CANUTEC web site. The complete web site is available at the following address: http://www.tc.gc.ca/canutec/en/menu.html

The Administrative Unit plans the Directorate's budget as well as coordinates the development and distribution of numerous publications promoting the TDG program. These publications are available upon request. The Dangerous Goods Newsletter is published quarterly by the Directorate. It includes information on accident flows and trends, regulatory interpretations, reports on national and international events, regulatory and compliance requirements and activities, risk management and assessment techniques, emergency response and data compilation and reports. It is available upon request and distributed free of charge to more than 23,000 readers in Canada and abroad.

3.8.2. New Zealand

The Emergency Procedures Manual of Auckland Region of TNZ has the specific Section 3.3 and the Appendix V, which regulate Hazardous Substances Procedures. The details of the Procedures (Class Labels for the Transport of Hazardous Substances) are illustrated in chapter 3 (Fig. 3.3).

3.8.3. U.S.A.

The Committee on Hazardous Wastes in Rights-of-way, Transportation Research Board, National Research Council has published in 1993 NCHRP Report 351, “Hazardous Wastes in Highway Rights-of-Way,” as a result of NCHRP Project 20-28. The Report contains information on the need and efficacy of programs to deal with the discovery of hazardous wastes in highway rights-of-way. The elements of a suitable response, recommended guidance on the development of a program for managing the hazardous waste problem, and the identification of resource material are presented in this report for those involved in right-of-way acquisition, project development, and construction. The Report has 8 Chapters:

1. Overview.
2. Environmental Laws, Regulations, and Related Materials.
3. Characteristics of the Hazardous Waste Problem.
4. Dealing with Hazardous Waste in Highway Project Development, Approaches, Policies, and Procedures.

5. Developing a Cooperative Relationship with the State Environmental Regulatory Agency.
6. Petroleum Contamination Problems.
7. Technology for Remediating Sites.
8. Findings and Recommendations.

The study was conducted by examining a number of case studies of problems encountered by state departments of transportation. Drawing on these findings and the experience and expertise of the committee members, the Report provides guidance to road maintenance staff on managing hazardous waste-site problems.
The Committee found that there appears to be a need to improve or establish awareness training concerning the potential problems with hazardous waste. Table 3.1 contains the Committee's recommendation for the topics that should be covered in the training course for top management officials.

Table 3.1 Training for Top DOT Officials on Hazardous Wastes

Need for Awareness of Hazardous Waste Rights-of-Way Issues
A. Liability Issues
1. Civil: Agency
2. Criminal : Personal
B. Cost Savings
C. Time Savings
D. Helps Planning of Alignments
Process
A. Contact SRA (State Environmental Regulatory Agency)
B. Develop MOU (Memorandum of Understanding)
C. Train Staff
D. Legal Requirements
E. Procedures
Environmental Issues
A. Type of Problems
1. Early Detection (during planning)
2. Late Detection (after construction begins)
3. Partial or Whole Sites
4. DOT-Generated Problems (maintenance facilities, labs, etc.)
B. Types of Cleanups
C. How Cleanups Fit Into ROW (Right-of-Way) Planning

3.9. Quick Reporting Procedures on Road Disasters and Information Items

Some examples of immediate reporting procedures on roads disasters will be indicated in this Section.

3.9.1. Emergency Response Reporting, VicRoads Emergency Management Manual, Australia

It is essential to keep written records of all emergency situations which need to include an activity record of events, plus resource and emergency status during the emergency. Standard reporting/recording sheets are provided in Part G Emergency Management Forms.

3.9.2. Japan (Japan Road Association)

Part 3 Post-Earthquake Measures, the Guideline for Earthquake Disaster Measures of Roads (JRA, 1996) has shown Table 6.3 Information Items Necessary for Road Management in case of an earthquake. The contents in the Table are simplified. In preparing a quick report, information items listed in Table 3.2 should be included as appropriate.

Table 3.2. Information Items Necessary for Road Management (In Case of an Earthquake)

Information Items	Contents
Event (Earthquake) and Tsunamis	Event Name Occurrence Time Maximum Seismic Intensity Epicenter Charactes (In-Land, Near-Coast or Far-Coast) Seismic Intensity Distribution Information Sources Tsunamis Warning Aftershocks
Road Traffic	Passable Roads Closed Roads Unconfirmed Roads
Damage Features	Outline of Damages
	Closed Roads and Retours
	Structural Data
Repair	Road Information Emergency Relief Road Emergency Route Road Quick Recovery Routes/Repair Plan
	Repair Works
	Related Organisations
Supporting Teams	Requests, Acceptance, and Application of Supporting Teams
Callout for Staff Members	Callout Situations
Activities	Disaster Preparedness
	Organisational Activities

3.9.3. Alert Bulletin Procedure in the U.S. FHWA Order

To rapidly advise the Federal Highway Administrator, the Office of the Secretary of Transportation, and the appropriate Regional Emergency Transportation Coordinator of important matters, major occurrences, and catastrophes of local, regional, or national significance to FHWA programs, and to provide the followup reports, FHWA has established an FHWA Alert Bulletin procedure as the FHWA Order 5180· 1E (March 3rd, 1997). As an attachment of the Order, Alert Bulletin Form is shown in Table 3.3. In the Order 7 types of events to be reported immediately to the Washington Headquarters are clearly defined. One of the types is an accident involving a school bus that results in fatalities and/or disabling injuries.
(http://www.fhwa.dot.gov)

Table 3.3 Alert Bulletin, Federal Highway Administration, U.S. DOT

1. DESCRIPTION OF INCIDENT (Accident, Flood, Road Closure, etc.);
2. LOCATION (State/City/County/Route/Milepost/Railroad/River, etc.);
3. DATE / TIME OF INCIDENT;
4. WEATHER AND ROAD CONDITIONS;
5. DESCRIPTION OF VEHICLES INVOLVED;
6. NUMBER OF FATALITIES / INJURIES;
7. TYPE OF HAZARDOUS MATERIALS (if applicable);
8. DESCRIPTION OF FACILITIES DAMAGED;
9. DATE / TIME FACILITIES ARE EXPECTED TO RETURN TO NORMAL;
10. REPORTED BY (name / office / telephone / date / time).

3.10. Summary and Conclusions

This chapter first defines various kinds of natural disasters and human (or man-made) disasters, and then presents procedures of search for the information and data on road disaster worldwide. It also provides manuals on emergency response procedures, and requirements for dangerous substances and hazardous wastes in rights-of-way. Finally it briefly describes quick reporting procedures on road disasters and information items. From this Chapter one can obtain information and data that may be applicable when making decisions of road management policies to mitigate the effects of disasters on road traffic. In view of the importance and usefulness of the information and data shown in this Chapter, it is recommended that PIARC home page (http://www.piarc.org) covers the
principal contents of this Section. It is also recommended that the contents should be updated at least annually. To attain this each member of PIARC Committee C-18 should send the new disaster-related information of his (her) respective country to the PIARC Central Office. The information should include relevant items such as resources and research programs relating to natural disasters and human (or man-made) disasters to roads.

Appendix 3.1.

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