



Upgrading of existing tunnels for fire safety

Database Specification

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Prepared by

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Control Systems

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This report is part of Workpackage 1 Prevention, Detection and Monitoring, Task 1 Categorisation and listing of European tunnels.

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1 Introduction

UPTUN is the acronym for Cost-effective, Sustainable and Innovative Upgrading Methods for Fire Safety in Existing Tunnels; a European RTD-project funded by the European Commission in FP5.

The UPTUN project main objectives are:

To develop innovative technologies where appropriate and where relevant comparing to and the assessment of existing technologies for tunnel application.

Focus is on technologies in the areas of detection and monitoring, mitigating measures, influencing human response, and protection against structural damage.

To develop, demonstrate and promote procedures for rational safety level evaluation, including decision support models and knowledge transfer

2 **Scope**

Within the overall UPTUN project, separate work packages have been created to perform distinct activities. Each work package has subsequently been sub-divided into tasks.

Objectives

The objectives of Work package 1 are as follows:

- a) To categorise tunnels - In order to structure the work of the entire project, a categorisation of existing tunnels is needed.
- b) Identify causes and prevention techniques of accidents and fires
- c) To detail actual systems installed, how reliable these systems are, failure rate, false alarms,
- d) To develop and validate a method to monitor tunnel entrances/portals to prevent a fire before it enters a tunnel. To develop and validate new innovative cost-effective (early) detection systems that withstands fires, or provides details of the migration of fires.
- e) Recommend and implementation of proposed solutions and prototypes

Description of work / tasks

Each objective has been allocated a Task. These tasks are briefly described as follows:

Task 1-0 Interface with DART and FIT projects. To ensure that there is no overlap of effort in all projects, meetings with representatives from these projects will be held.

Task 1-1 Categorisation and listing of European tunnels. There are a lot of categories that should be taken into account, such as road or rail, number of operating tubes, service tubes and cross-bores, etc..

Task 1-2 Causes and prevention of accidents and fires. Review of existing situations and systems, recommendations for prevention

Task 1-3 Existing Detection and monitoring systems. Details of actual detection and monitoring systems installed will be recorded, how reliable these systems are will be evaluated.

Task 1-4 Exploration of alternative or new technology for detection of moving fires, detection of fires outside tunnels, detection of the migration of fires.

Task 1-5 Implementation of proposed solutions and prototypes. Small-scale tests will be performed to evaluate the new systems with regard to reliability, accuracy, fire resistance, etc. Modifications to existing detection and monitoring systems will be made to assess any expected improvements.

Activity description

Within each task, sub-tasks are generated. These sub-tasks are known as activities. Activities for Task 1.1 are described as follows:

- 1.1.1 Definition of a Tunnel,

- 1.1.2 Database of European tunnels to include classification, category, existing detection & monitoring and protection systems,
- 1.1.3 Database of recent accidents and fires

2.1 Purpose of Document

This Document outlines the proposed design criteria for the database for task 1.1.2 of the Uptun project.

As task leaders of Task 1.1, Tyco Control Systems Ltd has undertaken the definition of the database.

This document will be developed to clearly describe the requirements of the database. The requirements of what type of data that is required from the other Work packages needs to be defined and included in the 'questionnaire' shown in appendix A.

This document needs to be agreed upon by the steering board for final development to take place.

2.2 List of Abbreviations

A number of abbreviations have been and will be used in the text of this document and within the database. It is important that abbreviations commonly used in each country are clearly defined and their meaning is clearly understood. A list of abbreviations generally used in the UK, and their meaning is given below. This list of abbreviations will be developed for each country, where necessary: -

ASP	- Active Server Pages
ECS	- Environmental Control System
EDP	- Emergency Distribution Panel
EP	- Emergency Panel
FOCP	- Fire Officers Control Panel
HMI	- Human Machine Interface
HV	- High Voltage
IIS	- Internet Information Server
LAN	- Local Area Network
LCD	- Liquid Crystal Display
LCP	- Local Control Panel
LV	- Low Voltage
MCS	- Monitoring and Control System
MMI	- Man Machine Interface
NOx	- Nitrogen Oxides
PC	- Personal Computer
PLC	- Programmable Logic Controller
RS232	- Data Connection Protocol
SCADA	- Supervisory Control And Data Acquisition
TCP/IP	- Transmission Control Protocol / Internet Protocol
TCS	- Tyco Control Systems
TSB	- Tunnel Services Building
UPS	- Un-interruptible Power Supply
VDU	- Visual Display Unit
VIS	- Visibility Sensor

3 Database Specification Proposal

Tyco Control Systems has a requirement to develop a method of correlating European tunnel information for future analysis.

Tyco Control Systems are proposing to develop a questionnaire that will be generated using Web technologies. The questions will be held within a database and extracted onto web pages for user interaction. There will be more than one questionnaire produced for different types of tunnel i.e. Road and Rail Tunnels.

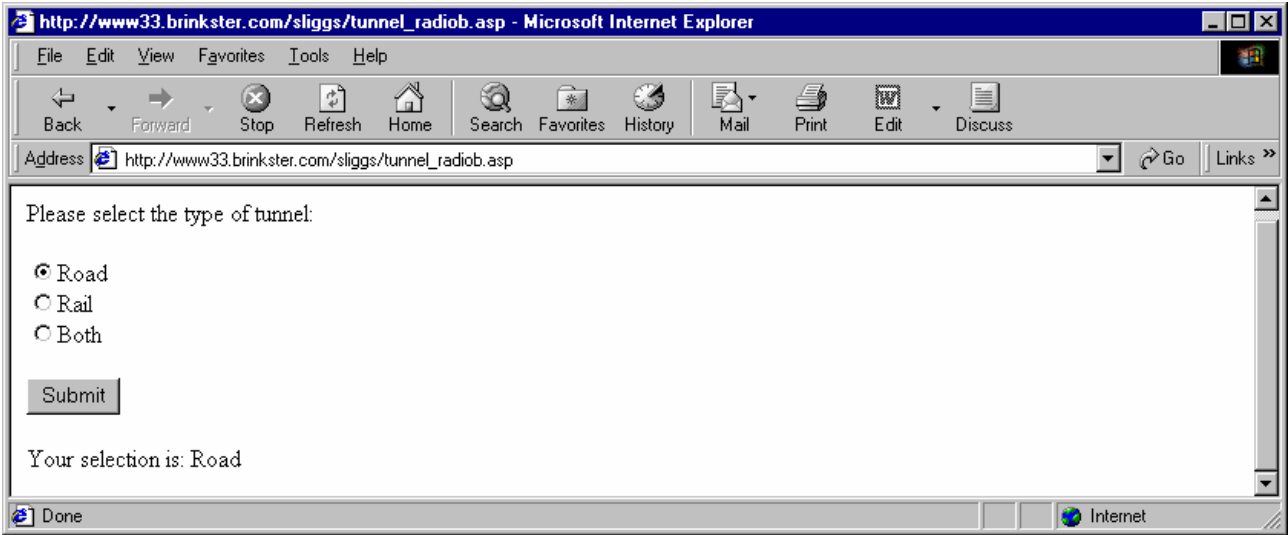
The answers to the questions will be stored in the same database for future analysis. Further web pages will be developed to provide search functions on the gathered tunnel data from the questionnaires.

There are several possible solutions for hosting these web pages.

1. Within the Uptun Server. This would require the web page files and database to be stored on the Uptun web server. A link to these pages would then be required on the Uptun website.
2. Tyco Engineering Website <http://www.tycoengineeringservices.com> is another possibility for hosting the web pages and database.
3. Newly registered website and domain name with a third party web hosting company.

The types of questions that will be asked within the Questionnaires are listed in Appendix A. The Questionnaire will be designed with ease of use in mind. Selection and option criteria will be used throughout the questionnaire to help the user make the correct selection. Only questions relating to a particular response will be displayed for further response.

E.g.



3.1 Software

3.1.1 Database

The database is being developed in Microsoft access 2000 because of ease of use. This could easily be upgraded to Microsoft SQL Server if required.

3.1.2 Web Pages

The web pages will be developed using ASP (Active Server Pages).

Note an ASP server engine or the Microsoft IIS web server will need to be available on the hosting web server to enable these pages to run.

3.2 Security

Details relating to a secure web server will be investigated with the company that will host the new web pages.

3.3 Data required from other Work Packages

Part of the reason for the database is to feed information into other Work packages as input to their tasks. The data from other work packages will be detailed in Appendix A, as and when the required information becomes known from the other work packages.

The data required from WP3 is shown in appendix D, and has been included in the list in Appendix A.

APPENDIX A – Questionnaire in Excel

Tunnel Database Criteria

Question?

Answers!

Tunnel Location & Details

Country of Origin
Postal Code / Zip Code (Operating Address)
Tunnel Name
Road or Rail Tunnel
National Road Number
Rail Track Number / Name
Current Status (In Operation or Under Construction)
Date of Construction
Year of Opening
Urban Tunnel
Operating Authority
Ownership
Management Staff Total
Contact Name
Postal Address of Contact
E-Mail Address of Contact
Is Tunnel Maintenance carried out?

Enter Country Code eg. UK
Unique Location Reference
Enter text (max 20 characters)
Road / Rail
Enter text (max 10 characters)
Enter text (max 20 characters)
Enter text (max 20 characters)
Enter date (DD/MM/YYYY)
Enter date (DD/MM/YYYY)
Yes / No
Enter text (max 30 characters)
Enter text (max 30 characters)
Enter number (max 99)
Enter text (max 20 characters)
Enter text (max 30 characters)
Enter text (max 30 characters)
Monthly / Quarterly / Yearly / Other / None

DATA ENTRY EXAMPLE
UK
LL32 8HB
Conwy Tunnel
Road
A55
N/A
In Operation
1991
1991
Yes
TNSG
National Assembly For Wales
17
Andy Evans
TNSG, Morfa, Conwy
anyone@...com
Quarterly

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Tunnel Maintenance Contractor	Enter text (max 30 characters)	TYCO
Tunnel Maintenance Expiry Date	Enter date (DD/MM/YYYY)	xx/xx/xx
Toll Tunnel	Yes / No	No
Operating Time of Tunnel	Enter text (max 20 characters)	24 Hours
Average Daily Traffic/Train Volume	Enter value	N/A
Annual Average Traffic/Train Volume	Enter value	N/A
Passenger Trains (% of AADT Above)	Enter value	N/A
Heavy Goods Vehicles (% of AADT above)	Enter value	N/A
Vehicles with Dangerous Goods (% of AADT above)	Enter value	N/A
Year of Traffic Censor (AADT)	Enter date (DD/MM/YYYY)	N/A

Tunnel Construction Details

Is the tunnel under water \ through rock	Enter Water or Rock	Water
Authorised Gauge (Rail Tunnel Only)	Enter text (max 20 charaters)	N/A
Number of Operating tubes/bores	Enter number (max 9)	2
Name of Operating tubes/bores if different from Tunnel Name	Enter text (max 30 characters)	
Number of Operating Lanes/Tracks in a bore	Enter number (max 9)	2
Number of Operating Lanes/Tracks Outside a bore	Enter number (max 9)	2
Are all lanes open for all traffic i.e. trucks	Yes / No	Yes
Is there merging traffic within the tunnel from another bore or from another source	Yes / No	No
Two-way traffic flow / Contraflow / Tidal in Normal Operation	Yes / No	No
Two-way traffic flow / Contraflow Available	Yes / No	Yes
Over Height Detection of Traffic	Yes / No	No
Elevation of Tunnel	Enter value	
Maximum Gradient within Tunnel (%)	Enter value	
Maximum Length of bore (Km)	Enter number (max 999)	0.9
Tunnel Diameter / Width (metres) Cross-Section	Enter number (max 999)	8
Construction / Composition	Enter text - or Option select?	Immersed with Cut and Covered
Tunnel Cladding / Lining present	Yes / No	

Database Specification

Tunnel Cladding / Lining Material or Method	Enter text (max 50 characters)	
Number of Ventilation Fans	Enter number (max 99)	36
Number of Ventilation Shafts	Enter number (max 99)	0
Maximum Operation Speed of Transport (Km/h)	Enter number (max 999)	80
Number of Vehicle Cross Passages	Enter number (max 99)	0
Number of Pedestrian Cross Passages	Enter number (max 99)	4
Length of Pedestrian Cross Passage (metres)	Enter number (max 999)	0
Pedestrian Access / Thoroughfare	Yes / No	No
Pedestrian Walkway/Pavement/Gantry	Yes / No	Yes
Pedestrian Walkway/Pavement/Gantry Location	Single Side / Both Sides / middle / None	Both
Number of Vehicle Lay-by or Emergency stop zones	Enter number (max 99)	0
Length and Width of Lay-by or Emergency Zones	Enter value	N/A
Emergency Hard Shoulder (Road Tunnel)	Yes / No	No
Length and Width of Hard Shoulder	Enter value	N/A
Number of Emergency Exits other than Tunnel Portals	Enter number (max 99)	0
Maximum Operating Voltage within Tunnel (Volts)	Enter number (max 999)	415
Dual Power Supplies	Yes / No	Yes
Diesel Generator Backup or similar	Yes / No	Yes
Access via sub-tunnel	Yes / No	No
Secondary adjacent/parallel escape tunnel / tube	Yes / No	No
Emergency Shelters present	Yes / No	No
Dimensions of Emergency Shelters	Enter value	N/A
Distance Apart of Emergency Shelters	Enter value	N/A
Construction of Emergency Shelters	Enter text (max 30 characters)	N/A
Are Emergency Shelters Fire-Proof	Yes / No	N/A

Detection & Control Details

Environmental Control System present (SCADA/DCS/PLC)	Yes / No	Yes
Operating ECS Name and Version	Enter text (max 30 characters)	FactoryLink 7++
Dedicated Manned Tunnel Control Centre / Local control room /HQ etc	Yes / No --- specify?	Yes – central control room for 3 tunnels
How many tunnels is the operator controlling	Enter number (max 99)	3

Q. Are these supported by UPS?

Database Specification

Emergency Services / Remote Monitoring (Police, Fire etc)	Police / Fire / Rescue / Other / None	Police
Automatic Fire Detection System	Interior / Exterior / Both / None	None
Automatic Fire Detection System Method/Type	Infra-red CCTV, Optical, Linear Heat Ring etc / None	None
Fire Detection in Tunnel	Temperature / Smoke / Flame / None	None
Manual Fire Alarm Pushbuttons	Yes / No	No
Traffic Incident Detection System	Interior / Exterior / Both / None	None
Traffic Incident Detection System Method/Type	Road Loops, CCTV etc / None	None
CCTV System	Interior / Exterior / Both / None	Both
Lighting Control System	Yes / No	Yes
Lighting Maximum Brightness (lumens)	Enter value	
Number of Lighting Stages	Enter number (max 99)	8
Ventilation Control System	Yes / No	Yes
Ventilation Type	Natural / Longitudinal / Semi-Transverse / Transverse	Longitudinal
Ventilation Method	Enter text (max 20 characters)	Jet Fans
Ventilation Capacity	Enter value	
Ventilation Temperature Resistance (deg C)	Enter value	
Variable Message Sign System (Traffic Control)	Yes / No	Yes
Safety Information Sign i.e. Toll Tunnel	Yes / No	No
Lane Control Signs	Yes / No	Yes
Portal Entrance Signs	Yes / No	Yes
Traffic Speed Control Signs	Yes / No	Yes
Traffic Speed Control Signs within Tunnel	Yes / No	No
Traffic Speed Control Signs on Approach Only	Yes / No	Yes
PA / Voice Annunciation (Pedestrian Control)	Yes / No	No
Radio Rebroadcasting (Human-Vehicle Control)	Yes / No	No
Tunnels own specific radio station and sign for drivers	Yes / No	No
Radio Message Breakin Facility	Yes / No	No
FM Radio Rebroadcast and sign for drivers	Yes / No	No
AM Radio Rebroadcast and sign for drivers	Yes / No	No
Frequency Rebroadcast Channels	Fire Service, Police, Ambulance, Bus, Cellphone etc. / None	Fire. Police, ambulance, maintenance channels

Emergency Systems Details

Fire Control System (FCP / Smoke Panels etc)	Yes / No	Yes
Emergency Phones / Help Points	Interior / Exterior / Both / None	Interior
Number of Emergency Phones / Help Points	Enter number (max 999)	9 each bore
Location of Emergency Phones / Help Points	Single Side / Both Sides / None	Single Side
Distance Apart of Emergency Phones / Help Points	Enter value (metres)	150
Emergency Panels with Fire Fighting Equipment	Interior / Exterior / Both / None	Interior
Portable Extinguisher(s) within Emergency Panels	Yes / No	Yes
Water Supply (Fire Fighting) Access	General Public / Emergency Services Only	Public
Water Hose(s) with Emergency Panels	Yes / No	Yes
Capacity of Hoses	Enter value	
Water Hydrants present	Yes / No	No
Capacity of Hydrants	Enter value	N/A
Number of Emergency Panels with Fire Fighting Equipment	Enter number (max 999)	6
Location of Emergency Panels with Fire Fighting Equipment	Single Side / Both Sides / None	Single Side
Extinguishant / Fire Fighting Methods	Enter text (max 50 characters)	Pressurised bottle Extinguishers & water Hoses
Extinguishant / Fire Fighting Types	Enter text (max 50 characters) Foam / Sprinkler / Fog / Mist / Other	Nitrogen Foam & Water in tunnel water sumps
Orientation / Exit Direction Lighting	Yes / No	No
Emergency Lighting	Yes / No	Yes
Are there hand rails to follow in the event of poor visibility	Yes / No	No
Illuminated Emergency Exit Signs	Yes / No	Yes
Tunnel Rescue Services On-Site	Yes / No	No
Tunnel Medical / Paramedic Services On-Site	Yes / No	No
Tunnel Fire Brigade On-Site	Yes / No	No

Fire Brigade response time attending an incident \ accident	Enter number (mins)	20
Tunnel Closure Method	Signs / Barriers / Other	Signs
If Any Door to Exit the Tunnel is Locked, who or what unlocks them	Automatic / Manual / Other	Signs
Is the traffic informed about an incident \ accident?		No

Drainage & Sumps

Number of sumps	Enter number (max 99)	6
Fire Detection within Sumps	Yes / No	Yes
Fire Suppression within Sumps	Yes / No	Yes
Gas Detection within Sumps	Yes / No	Yes
Number of Pumps	Enter number (max 99)	4
Monitoring of sump information	Yes / No	Yes
Control of sump equipment	Yes / No	Yes
Sump Fans / Ventilation	Yes / No	Yes

Historical Data Details

Frequency of Incident Rehearsal / Simulation (months)	Enter number (max 99)	N/A
Date of last Incident Rehearsal / Simulation	Enter date (DD/MM/YYYY)	N/A
Number of Fires Detected / Occurred within tunnel	Enter number (max 99)	0
Date of Fire Detection / Occurrence 1	Enter date (DD/MM/YYYY)	N/A
Date of Fire Detection / Occurrence 2	Enter date (DD/MM/YYYY)	N/A
Date of Fire Detection / Occurrence 3	Enter date (DD/MM/YYYY)	N/A
Date of Fire Detection / Occurrence 4	Enter date (DD/MM/YYYY)	N/A
Date of Fire Detection / Occurrence 5	Enter date (DD/MM/YYYY)	N/A
Number of Traffic Accidents Detected / Occurred within tunnel	Enter number (max 99)	0
Date of Traffic Accident / Occurrence 1	Enter date (DD/MM/YYYY)	N/A
Date of Traffic Accident / Occurrence 2	Enter date (DD/MM/YYYY)	N/A

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Date of Traffic Accident / Occurrence 3	Enter date (DD/MM/YYYY)	N/A
Date of Traffic Accident / Occurrence 4	Enter date (DD/MM/YYYY)	N/A
Date of Traffic Accident / Occurrence 5	Enter date (DD/MM/YYYY)	N/A
Number of Control System / Detection System Failures resulting in closure	Enter number (max 99)	0
Date of System Failure / Tunnel Closure 1	Enter FROM and TO date (DD/MM/YYYY)	N/A
Date of System Failure / Tunnel Closure 2	Enter FROM and TO date (DD/MM/YYYY)	N/A
Date of System Failure / Tunnel Closure 3	Enter FROM and TO date (DD/MM/YYYY)	N/A
Date of System Failure / Tunnel Closure 4	Enter FROM and TO date (DD/MM/YYYY)	N/A
Date of System Failure / Tunnel Closure 5	Enter FROM and TO date (DD/MM/YYYY)	N/A

APPENDIX B – Database Schema

Table Information

TUNNEL

This table will store the General tunnel Information

TUNNEL_METADATA

This table will store the answers generated from the Questionnaire.

TUNNEL_TYPE

This table will be used to store the different types of tunnel i.e. Road, Rail, or both types. The function of this table is to allow the correct loading of questions pertaining to a specific type of tunnel.

TUNNEL_TYPE_METADATA

This table will store all the questions to be loaded into the web page questionnaires

METADATA_OPTIONS

This table will store option data for specific questions.

E.g.

Question

What type of system installed. Please select one or more of the following options

- *NONE*
- *SCADA*
- *PLC*
- *DCS*
- *OTHER*

These options will be stored in this table and will pertain to a particular TUNNEL_TYPE_METADATA question.

Note. The above is for information only and is not finalised at this time

APPENDIX C – Sample Database Data

APPENDIX D – INFORMATION REQUIRED FOR WP3

1. Number of tubes in every direction (uni or bi-directional)
2. Are there pedestrian connections between tubes? If yes what is the distance between them.
3. Is there a separate pedestrian tube in the middle?
4. What types of signs are used to indicate escape routes? Where are they located? (E.g. distance to the nearest escape door)
5. Are the tunnels being monitored with cameras?
6. How many tunnels is the operator controlling?
7. Are there loudspeakers in the tunnel?
8. Are there fire extinguishers in the tunnel?
9. Are there telephones to the operator in the tunnel?
10. Are there a number of lay-by? Every xx meters
11. Are there emergency lanes? What are the width of the emergency lanes
12. Is the tunnel under water / in rock / as level
13. Can they close the tunnel? With physical barriers / with traffic lights
14. Is there traffic signaling in the tunnel?
15. Is there lighting in the tunnel? Width and number of lanes?
16. Is there a sign for drivers before they enter the tunnel to switch to a certain radio station?
17. For Rail Tunnels: are there doors to another tube? If yes, how many meters apart. (Same questions as above. Is there a high walking platform for pedestrians
18. Are there handrails for pedestrians to follow if there is smoke?
19. Is there special emergency lighting
20. If there are locked doors to exit the tunnel who or what unlocks them? Automatically after a period of time?
21. Is the traffic informed about an incident / accident? In what way? Is there also information for traffic in the other tube?
22. What is the length of the tunnel?
23. Are there exits and/or entries inside the tunnel? I.e. merging traffic within the tunnel

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24. Lanes open for all traffic? i.e. for trucks
25. Is there information available before people enter the tunnel about safety i.e. toll tunnel
26. Is there a central control room and \ or local control room \ none.
27. What is the response rate of the fire brigade attending an incident \ accident.