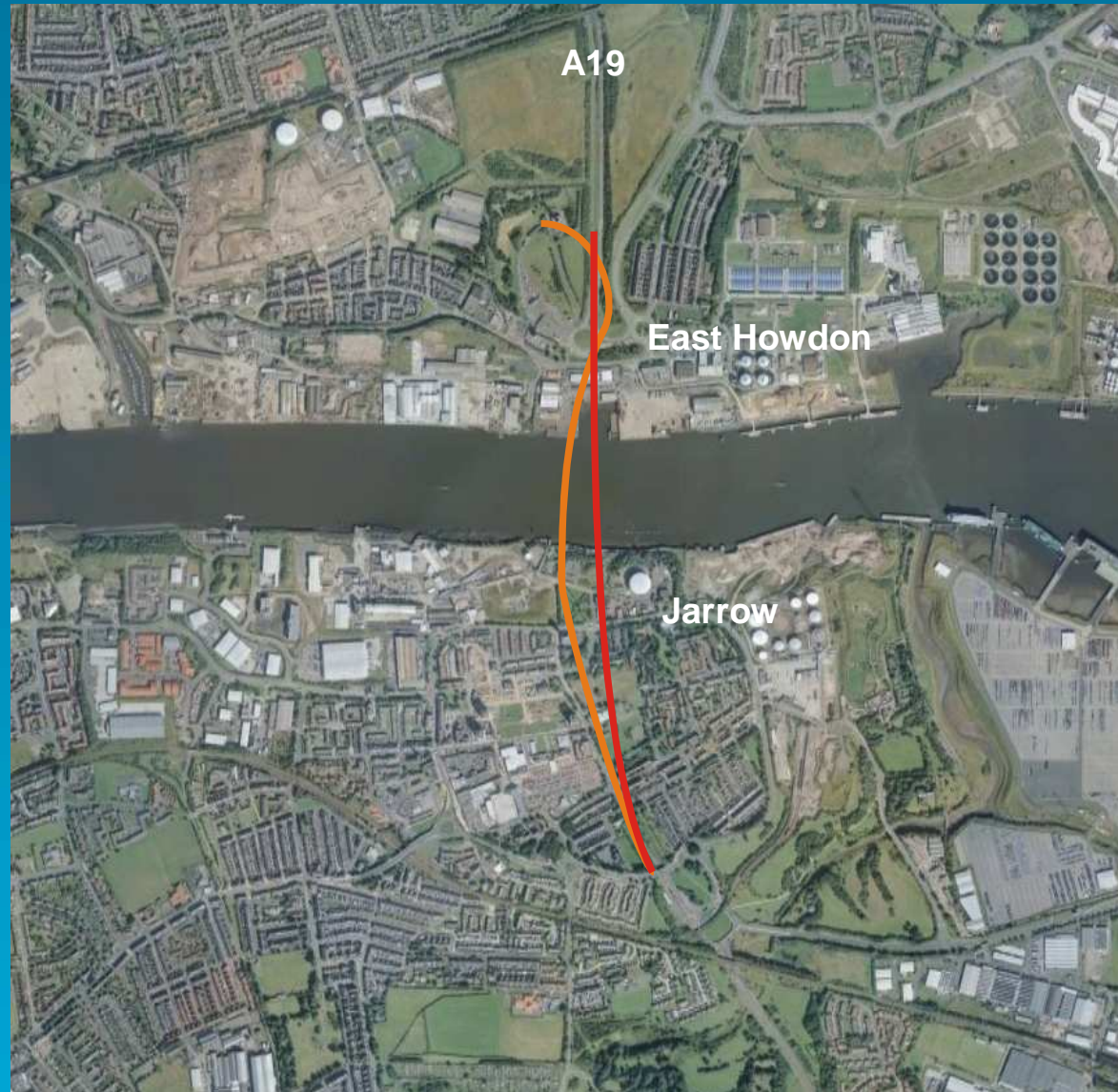


- **Quantitative risk assessment for a fire suppression system in the New Tyne Crossing**

**Dr Fathi Tarada**

- **The brief**
- **Feasibility study**
- **Risk assessment**
- **Cost-benefit analysis**
  - **Primary assumptions**
  - **Risk parameters**
  - **Monte Carlo simulations**
  - **Results**
- **Recommendation**

- **To undertake a risk assessment and a cost-benefit analysis regarding the a fire suppression system in NTC**
- **Make a clear recommendation – yes or no**



**Excellent safety regime at Tyne Tunnel to be continued and enhanced:**

- **Escorting of permitted dangerous goods vehicle through the tunnel**
- **Inspection of heavy goods vehicles prior to entry into the tunnel**
- **Tunnel control room manned 24 hours a day, with CCTV and Automatic Incident Detection monitors**
- **Rapid response vehicles with on-board fire-fighting facilities**
- **Tunnel closure barriers, to prevent entry into the tunnel in an emergency**

**Note: 'free flow' traffic tolling regime upon the opening of the two tunnel tubes, with only random inspection of vehicles**

- A separate evacuation passageway in both tunnels, with double leaf doors at approximately 100m intervals
- Tunnel linings protected for two hours to the enhanced hydrocarbon curve

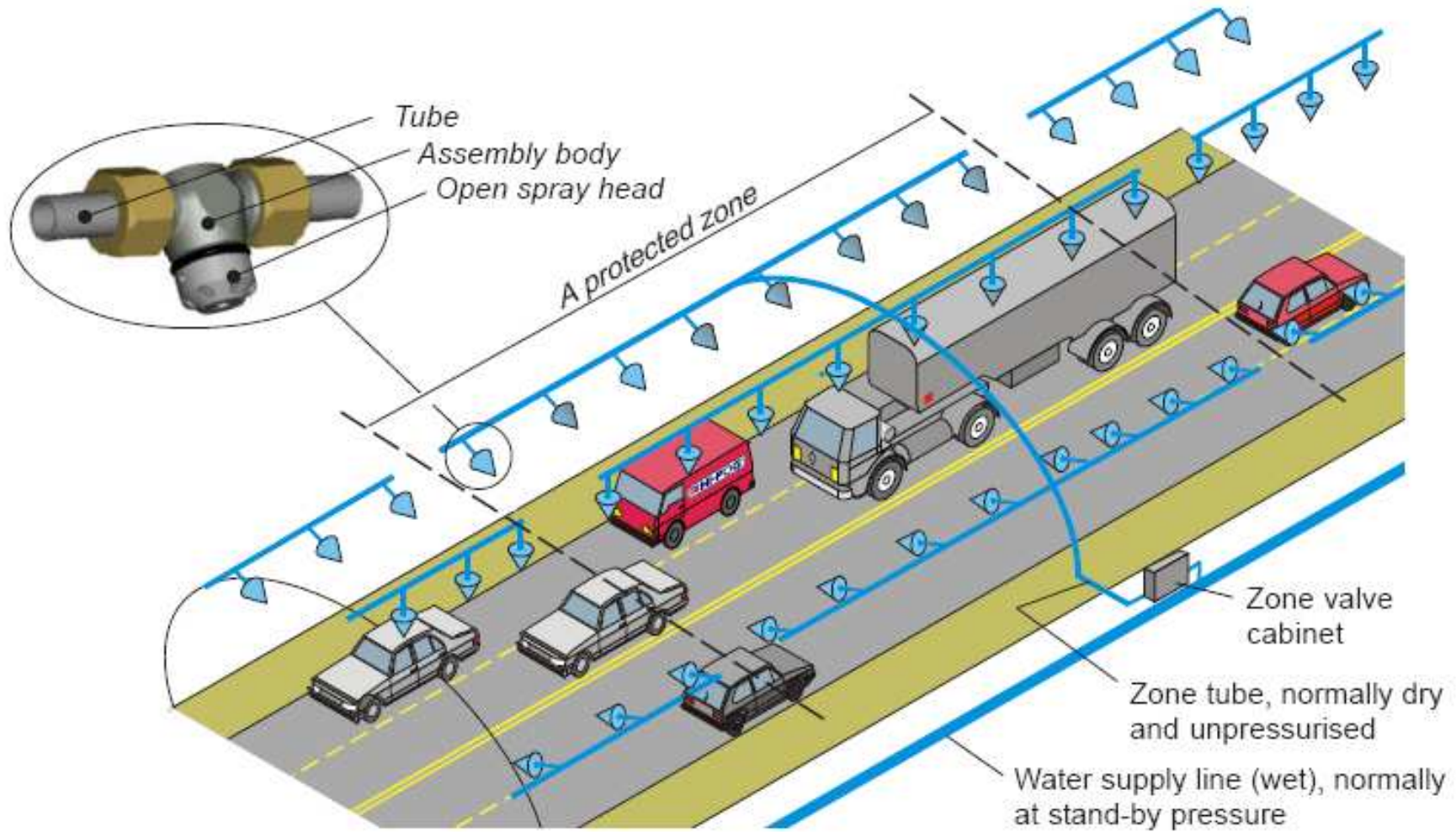
- **Duplicated power supplies**
- **Smoke detection via digital image processing**
- **Public access emergency panels at 50 metre intervals**
- **Locked electrical distribution point panels and Fire Service emergency panels at 50m intervals, including hose reels, hydrants and gate valves**
- **Combustible gas detection equipment system and a foam blanket suppression in the mid-river sump, together with associated alarms.**
- **Comprehensive CCTV coverage of the tunnels and approach roads**

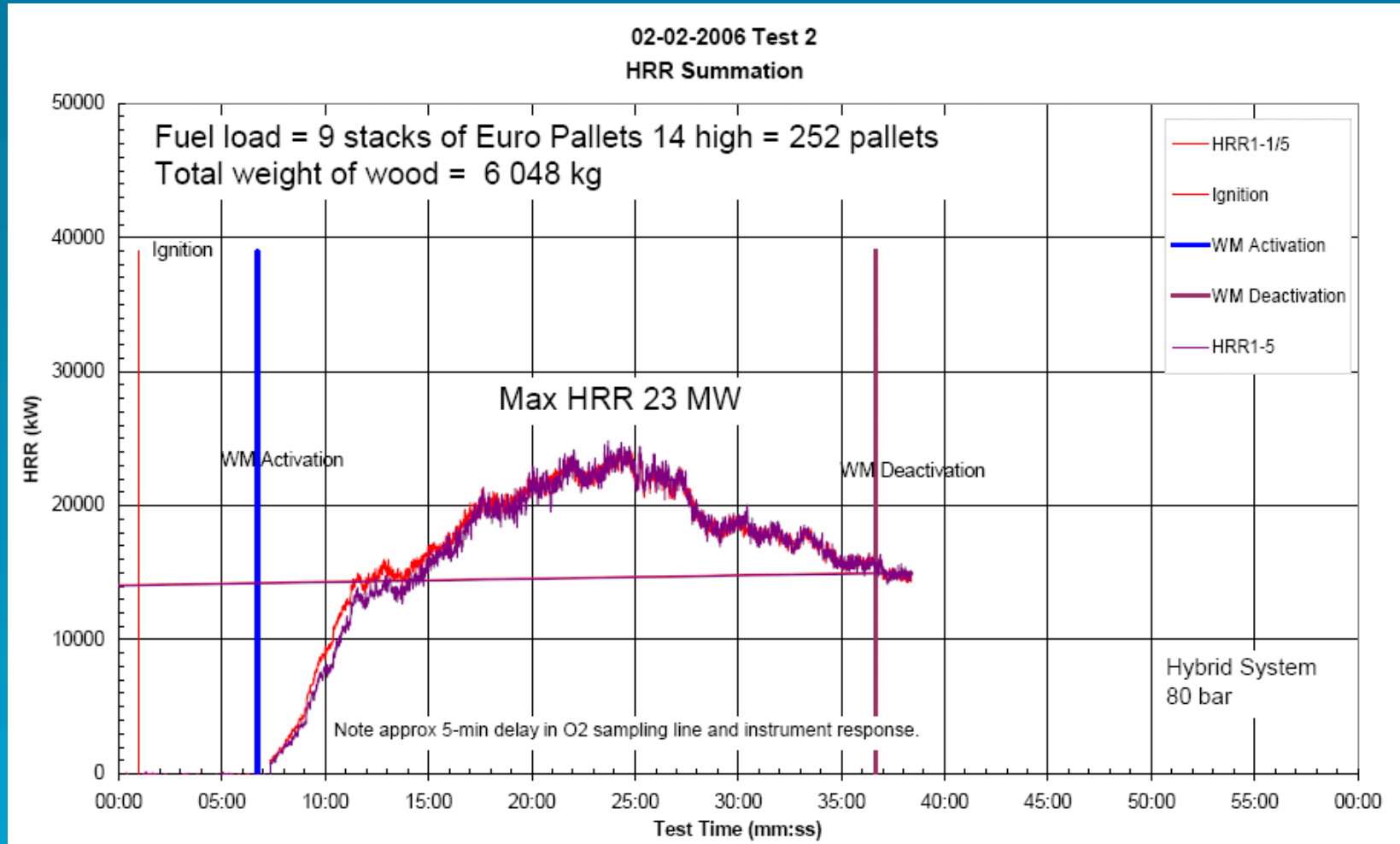
- Longitudinal ventilation system in both tunnel bores, controlled by an environmental control system and smoke panels
- Pressurised evacuation passageways



- **Public use emergency telephones**
- **Emergency radio network with mobile phone support**
- **Radio Re-Broadcast and Interrupt Facilities**
- **A Public Address system with speakers in both the traffic spaces and the evacuation passageway**

- Provision for 10% of the minimum night time lighting to be supported by UPS equipment, for safe evacuation of the tunnel
- Internally illuminated “running man” signs above each passageway door
- Variable message board signs on the walls and inside the passageway
- ‘Switch on radio’ signs
- Wall mounted direction signs to nearside emergency exits
- “Wig –Wag” signs above the nearside lane activated by the opening of the door





**Expected HRR without fire suppression = 75 MW**

- For minor fires – no effect assumed
- For severe fires – 50% reduction in in fires progressing from minor to severe (for damage & delay), 25% corresponding reduction for injuries
- For very severe and catastrophic fires - 66% reduction in in fires progressing from minor to severe (for damage & delay), 33% corresponding reduction for injuries

Questionnaires sent to, and meetings held with:

- Tyne & Wear Passenger Transport Authority
- Tyne Tunnels
- Bouygues Travaux Publics
- High-Point Rendel
- Highways Agency
- Tyne & Wear Fire & Rescue Service

- **Benefit to Cost Ratio = Relevant Benefits / Relevant Costs**  
  
over the selected assessment period
- **Need to account for the time value of money, via discount rates (HM Treasury's Green Book)**
- **Inflation assumptions are as per the Department for Transport's COBA Manual**

## Possible benefits:

- Reduction in cost of injuries and emergency services attendance
- Reduction in traffic delays
- Reduction in cost of tunnel damage

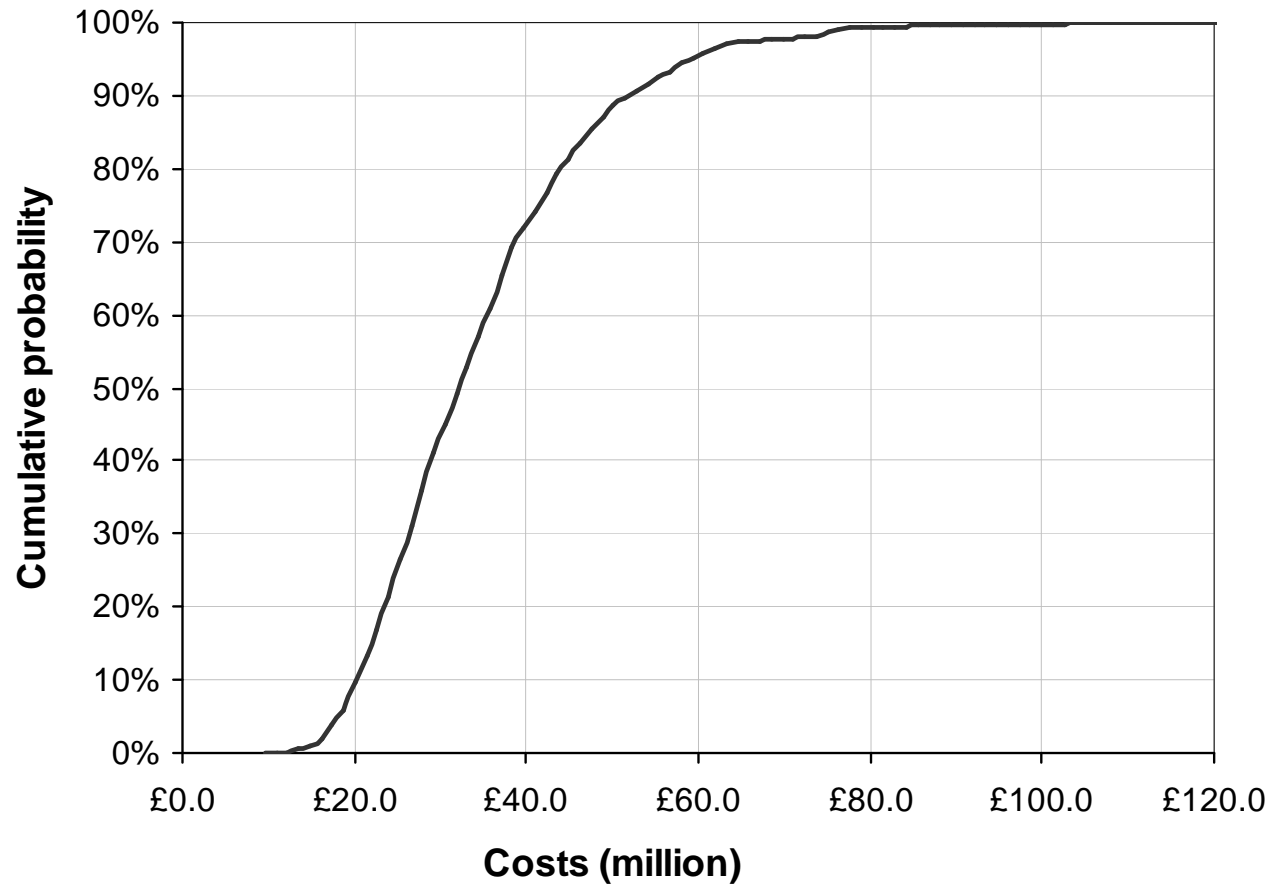
## Costs:

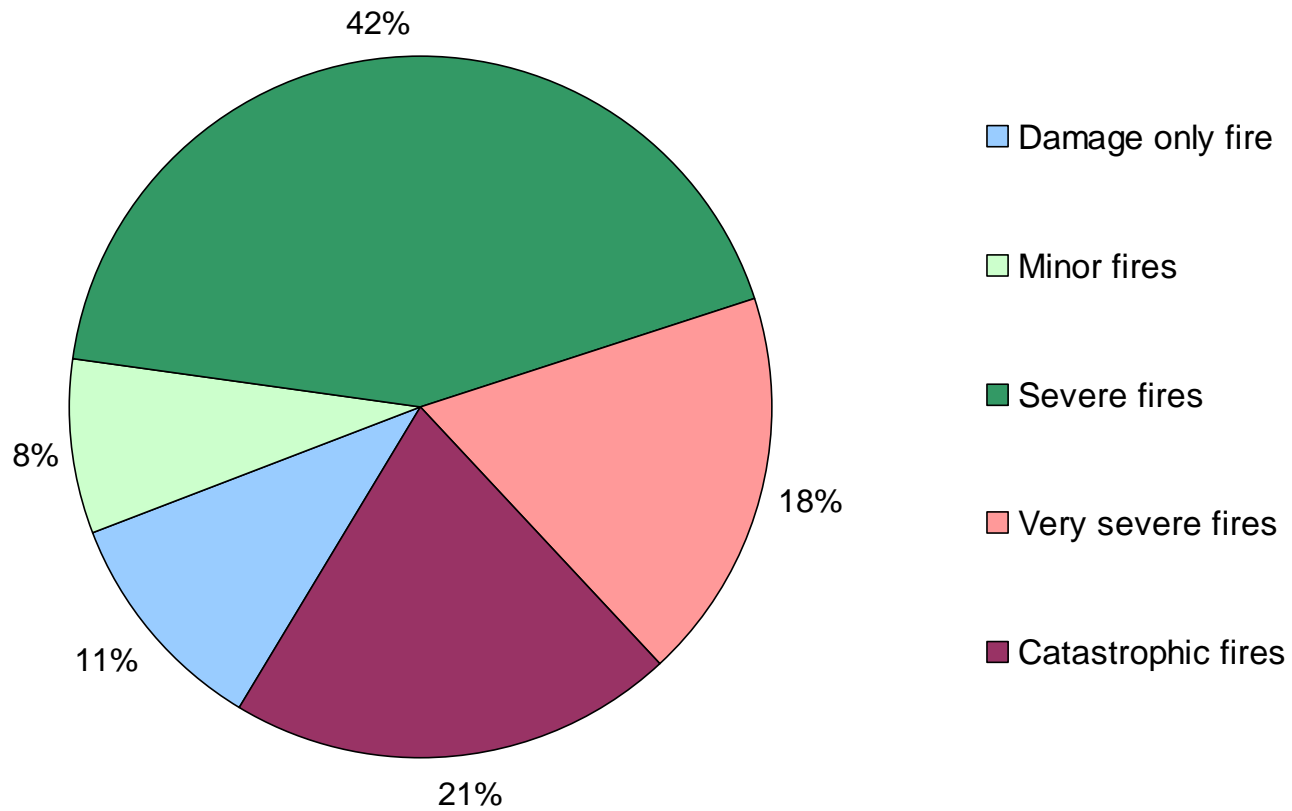
- Capital costs of fire suppression system
- Cost of refurbishment and maintenance for the fire suppression system

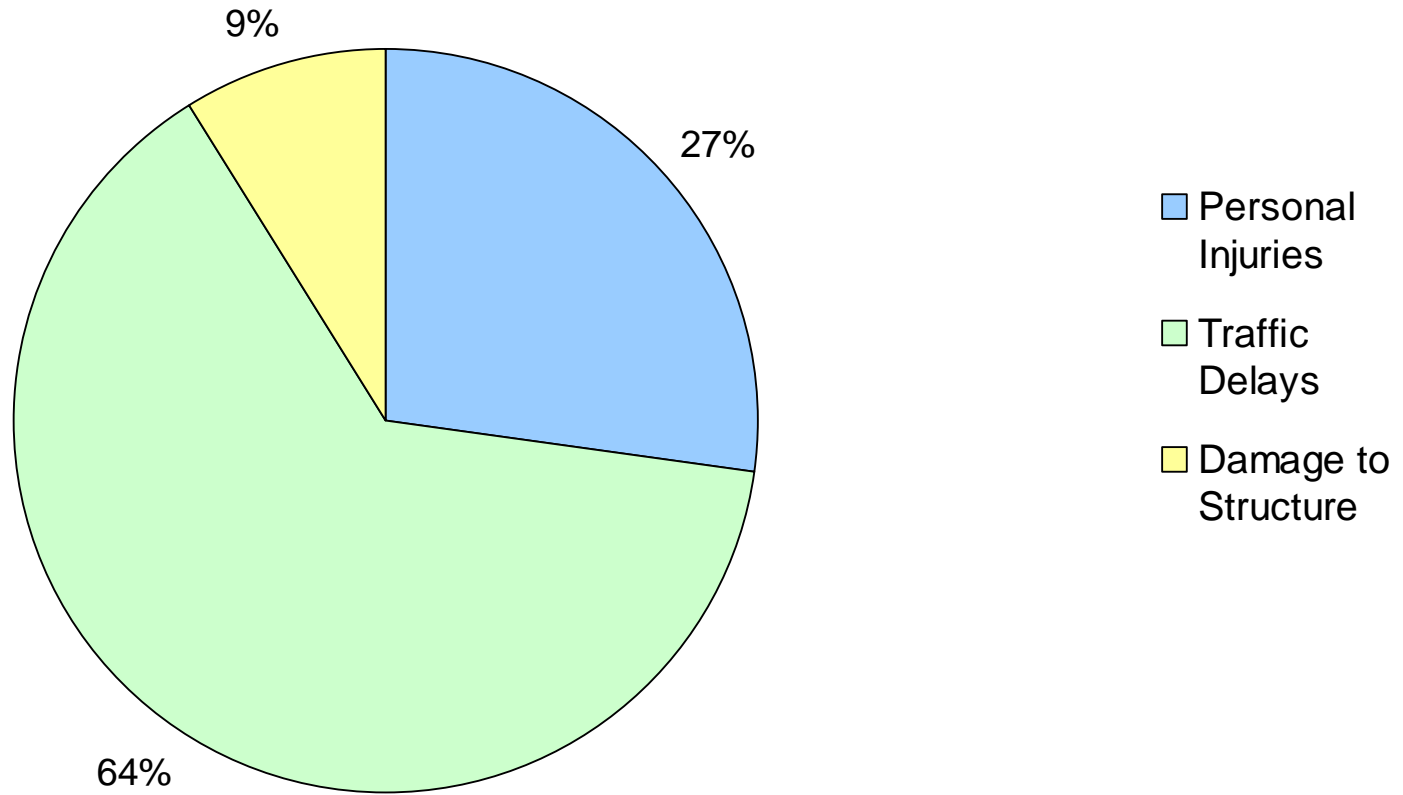


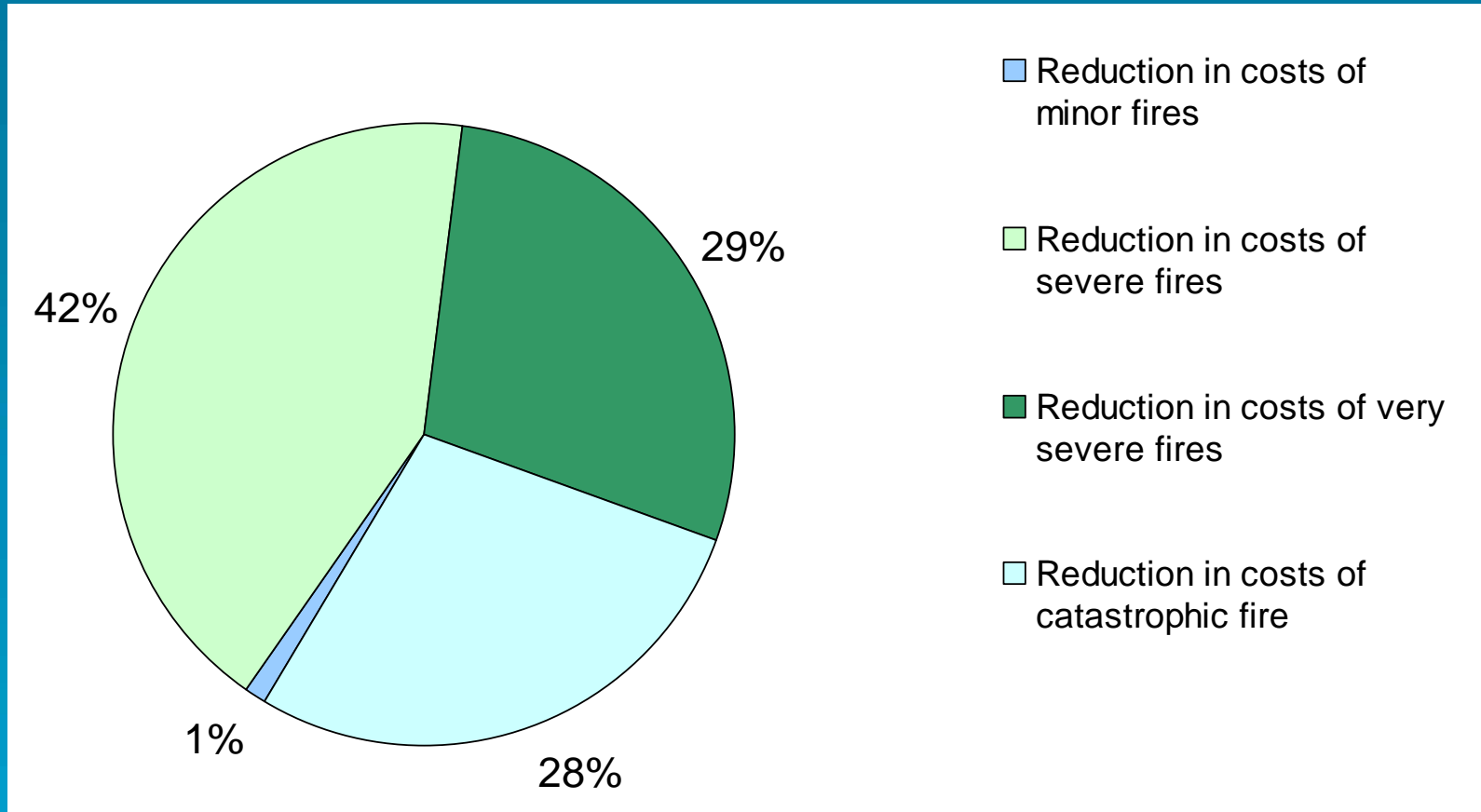
Year	Project Phase	Traffic flow management	Is fire suppression system an option in the operating tunnel?
2007 to 2011	1	Bi-directional	No
2011 to 2012	2	Bi-directional	Yes
After 2012	3 &4	Uni-directional	Yes

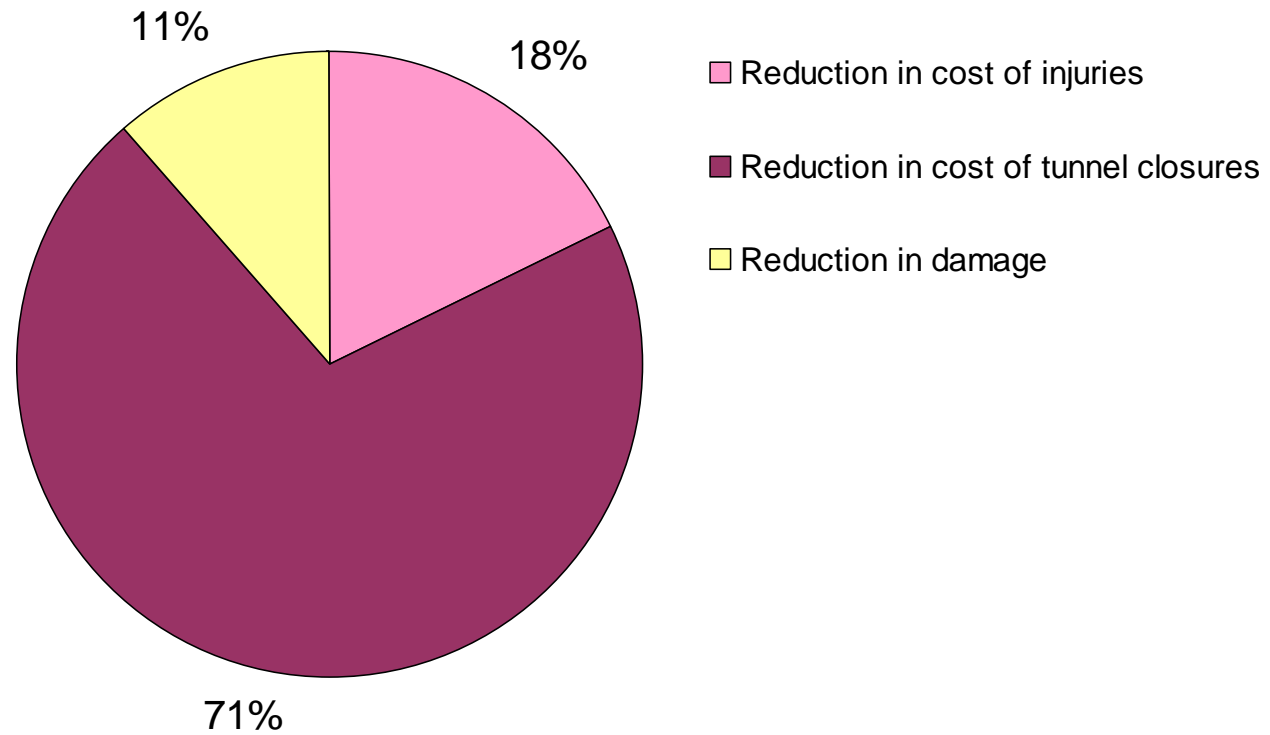
Cumulative Probability Profile for Fire Costs (Case 1)



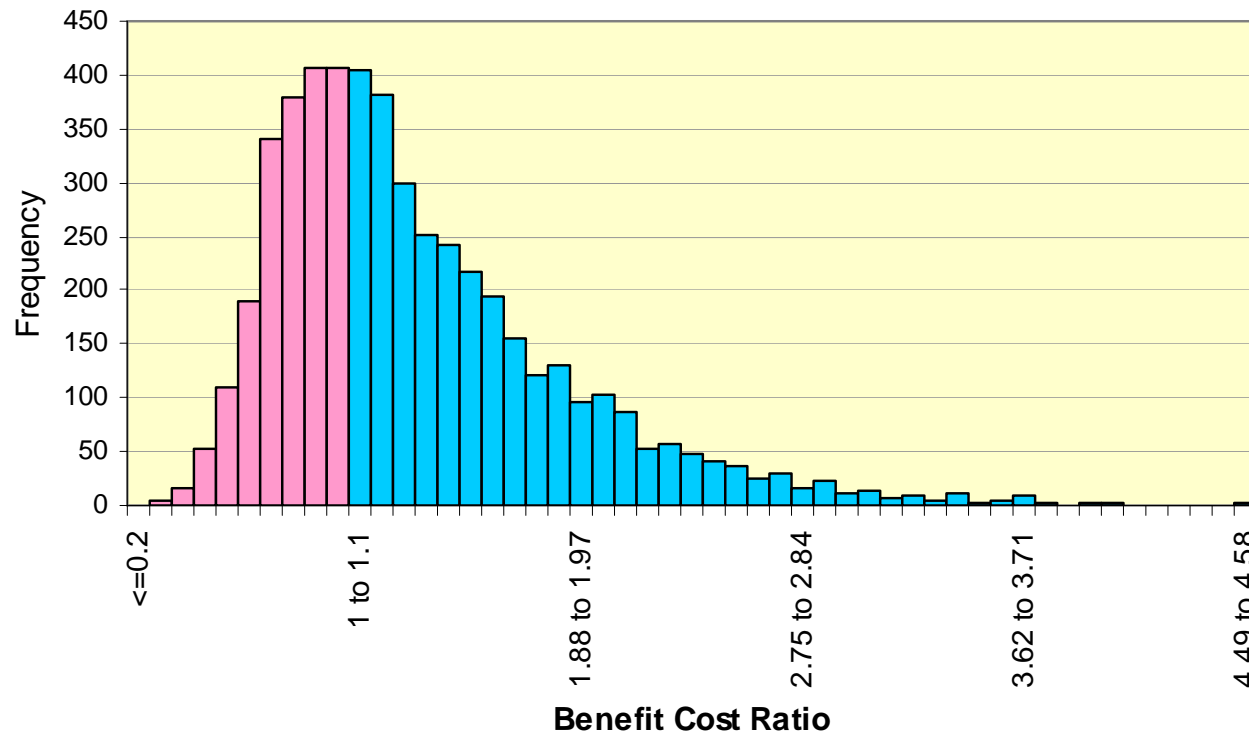








### BCR of Fire Suppression System (Case 1)



Average BCR = 1.27

- **Installation of fixed fire suppression system recommended**
- **Recommendation was approved by TDSCG and TWPTA**



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