

METRO — Safety in mass transport systems.

Fire protection in transportation

The METRO project is a Swedish research project about infrastructure protection in mass-transport underground rail and metro systems. The focus was on tunnels and subway/metro stations, and both fire and explosion hazards were studied. It is a multidisciplinary project where researchers and PhD students from nine different disciplines cooperate with practitioners with the common goal to make underground rail mass transport systems safer in the future. The METRO project (www.metroproject.se) was a three year undertaking, running from December 2009 to the December of 2012. The main objective of METRO was to create a safer environment for passengers, personnel and first responders in the event of fire or terror attack in underground mass transport systems.



The final report compiles the results from the METRO-project. The different parts of the project; design fires, evacuation, integrated fire control, smoke control, extraordinary strain on constructions and fire- and rescue operations are presented separately.

The most complicated and expensive part of the project was the performance of the large scale fire and explosion tests in the Brunsberg tunnel. The maximum heat release rates measured from the metro carriage was 77 MW. The maximum ceiling gas temperatures was 1118 °C. These values are high, and should be put into a perspective of the situation and the type of carriages used. The project is not recommending the highest values as the design fire, but values reflected in conditions. However, the results from the fire tests in the Brunsberg tunnel are seen as an important indicator.

The egress study confirms that one of the major issues related to fire evacuation in underground transportation systems is that people often are reluctant to initiate an evacuation. New data show that participants moved with an average of 0.9 meters per second in the smoke filled environment (average visibility of 1.5-3.5 meters). A way-finding installation at the emergency exit, which consisted of a loudspeaker, was found to perform particularly well in terms of attracting people to the door.

Two smoke control systems were simulated for a single exit metro station. The systems consisted of a pressurizing supply air system and mechanical exhaust ventilation system with and without platform screen doors. The results show that both the pressurizing supply air system and the mechanical exhaust air

system provide effective smoke control for one exit metro station. The significance of the platform screen doors was shown to be important in relation to smoke control.

Experiments and simulations have provided increased confidence in ability to simulate explosion scenarios to determine the pressure inside and outside a carriage and to be able to study variations of conditions such as carriage geometry and window designs. The explosion test performed show that an explosion with a relatively minor charge can significantly change the conditions for both evacuees and the rescue service. The results show that the conditions for evacuation and rescue operations can change dramatically as a result of a relatively minor explosion. Evaluation of methods and fire and rescue tactics in metros is given. Mapping of IR imaging as a tactical resource at tunnel fires was presented.

The following nine partners participate in the METRO project: Mälardalen University, SP Technical Research Institute of Sweden, Lund University, Swedish Defense Research Agency (FOI), Gävle University, Swedish National Defense College, Swedish Fortifications Agency, Greater Stockholm Fire Brigade and Stockholm Public Transport (SL). □ The total budget of METRO was 19 million SEK. METRO is funded by the following five organizations: Stockholm Public Transport (SL), Swedish Civil Contingencies Agency (MSB), the Swedish Research Council Formas, the Swedish Transport Administration (Trafikverket), the Swedish Fortifications Agency (Fortifikationsverket), and the Swedish Fire Research Board (Brandforsk).

Report and contact

The report can be downloaded at www.brandforsk.se.

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