

Newsletter - December 2011

**Inherently
Secure Blast Resistant
and
Fire Safe Metro Vehicles**

<http://www.securemetro.com>



FP 7 project supported by EC
January 2010 - December 2012



Foreword

This is the first issue of the newsletter that will be sent to keep you informed of the progress of the SECUREMETRO project as work advances into the final year.

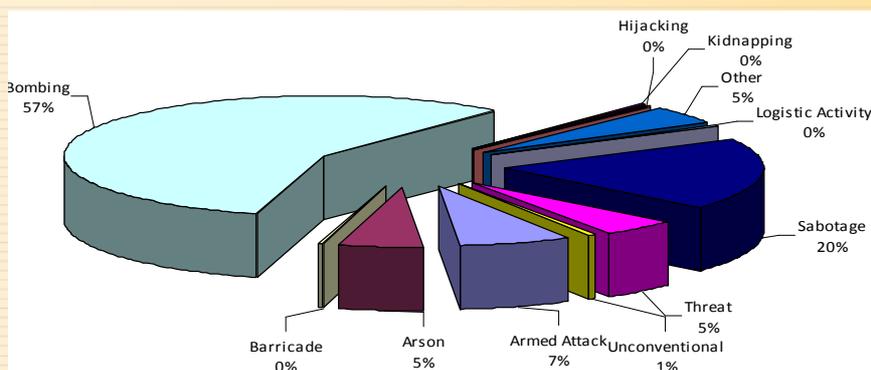
Over the past two years significant progress has been made in understanding the methods used by terrorists against metro targets, which has allowed us to define a series of blast tests which closely match the perceived threat. In addition, preliminary blast simulations have been conducted to better understand the mechanisms behind blast attacks and the potential effects on surrounding structure. Manufacturing of a full-scale metro vehicle prototype is currently underway, which will incorporate our novel materials and designs intended to mitigate the effect of bomb blasts.

This newsletter will keep you informed of the key activities over the next twelve months, which will include:

- Completion of panel tests.
- Completion of full scale tests.
- Validation of simulations.
- Completion of derailment simulations.
- Completion of fire modelling.

Work Package 1 – definition of the attack scenarios

The purpose of WP1 was to understand the types of terrorist threats that metro systems face, and to define a typical attack scenario on which to base the testing and analysis of the SECUREMETRO project. Over 830 attacks worldwide over the past 50 years were analysed and common information was extracted, such as: country, target, tactic, weapon, number of fatalities and injuries, and perpetrators.



In addition, the possibilities of future attacks were also investigated, seeking to determine the future methodologies. A questionnaire was distributed amongst operators throughout Europe to gain an understanding of what the industry perceive to be the likely nature of future attacks. This allowed the project to define a scenario and perform a risk analysis representative of both present and future threats.

WP1 also proposed expected vehicle performance, defining how components such as floors, walls, glazing, bulkheads, seats, etc. should behave in blast. This work assists the other work packages in focusing their design solutions to meet specific goals.

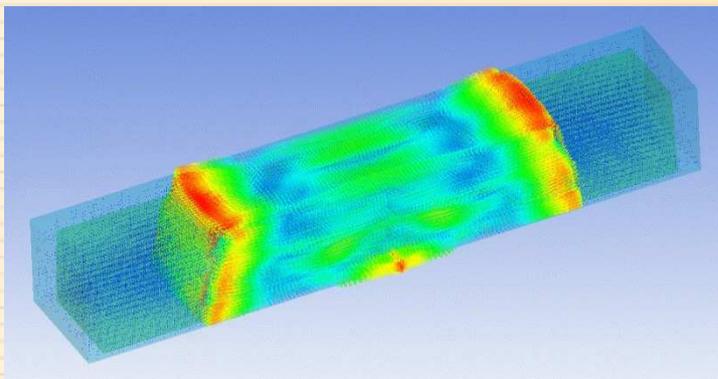
WP1 is now successfully concluded.

Work package 2 – Design solutions for blast

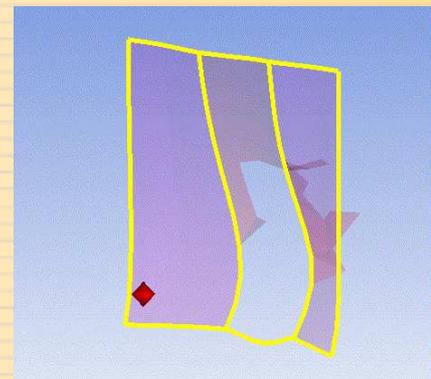
WP2 focused on the analysis of the effects and consequences of blasts, in particular:

- Fragmentation of interior and structural vehicle components, which become projectiles.
- Loss of structural load-carrying capacity, causing vehicle collapse.
- Derailment and/or collision; behaviour of people in blast situations.

These served as inputs to define the blast simulation scenarios and the key areas of improvement, together with the identification of the blast resistance criteria. Simulations were carried out to identify a prototype design for the full-size trials, investigating several parameters: length, size and shape of venting holes. Based on the simulation results, the partners agreed on a 15 m long vehicle for the full-scale blast trials.



Simulation of a blast wave inside a 15 m long metro vehicle.

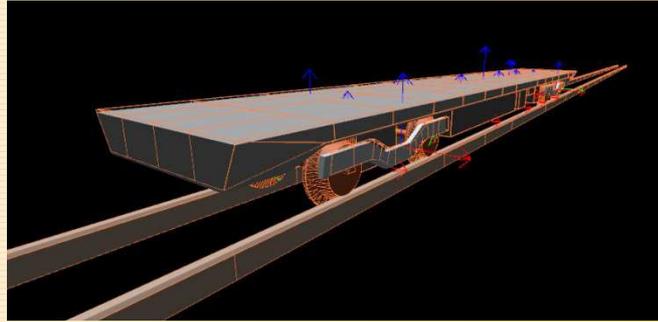
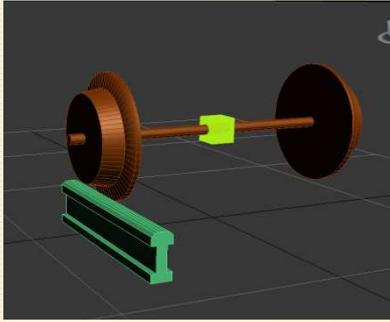


Blast simulation of a multilayer glazing unit.

The preliminary simulations, together with the information available from the London and Madrid bombings, gave indications for the SECUREMETRO design. In particular, the key areas to be improved in order to minimize the effect of a blast to the train structure were identified, for instance the windows, doors, walls, floor, ceiling, seats, joinings. Preliminary simulations of single components were also performed.

The next step will be the blast simulation of the SECUREMETRO design, in order to analyse the behaviour of the structure, identify and test structural improvements. Blast simulation of single components will run in parallel, in order to build realistic finite element models of each, based on the results of the small-scale blast tests in the first months of 2012. These models will be then used for the final design of the metro vehicle which will be validated in WP4.

Newrail is working to develop real-time simulations to understand the effects of bomb blast on overall train stability. The goal is to simulate a metro vehicle running on a track in order to see the effects of explosions and test for probabilities of derailment. These simulations are intended to provide an alternative to the Finite Element Analysis simulations currently used.



We are currently looking at some of the physics simulation technology developed by the video games industry, which can closely mimic the reactions of structures in real-life. We have produced a model of the undercarriage of a metro vehicle running along a curved, sloped track, and render information about the rigid bodies that make up the simulation as well as some of the forces acting on it. The next steps will be to attach engines and to allow the user to customise various parameters, such as the speed of the train or the size of the blast load, to determine the probability of derailment.

Work Package 4 – Pilot tests

WP4 is finalising the design of the test vehicle for the SECUREMETRO explosive test program. A 15m long full-scale vehicle is currently under construction at the Sunsendegui site.

This test vehicle will include key components standard to rail vehicles – seating, internal panelling, doors, windows, access door to driver cabin and flooring. All these will be assessed during the vehicle test, using a combination of sensors (pressure, acceleration, deflection) and high speed video cameras.



SECUREMETRO test vehicle as of end Nov 2011 - side view and driver bulkhead view.

The test vehicle will serve to assess the effects of an internal blast on the existing (unprotected) components, as well as several modified components using protective systems to minimise the effects on both the structure and passengers. These systems will ideally minimise the secondary fragments, to reduce the risk of injury and damage outside of the immediate blast zone.

Several protective systems are currently under evaluation using high speed impact tests to determine their resistance to fragment penetration. Following these tests, the selected systems will also be assessed in a series of blast tests against vehicle subcomponents and material assessment panels. These tests will assess the energy absorption, fragment reduction and key structural joint performances (particularly for ceiling panels to ensure they do not detach and fall onto passengers) of the selected solutions.

The data from these tests will be used to determine the most suitable systems to be installed in the SECUREMETRO test vehicle for testing later in the year. The subcomponent and full scale blast tests will take place respectively in Q1 and Q2 2012.

More information will be posted to the web site, and in the next newsletters, as the trials are being organised.

Forthcoming events

SECUREMETRO will be present at the **TRA 2012 conference**, which will be held in Athens (Greece) on April 23-26. More information is available here:

<http://securemetro.inrets.fr/fileadmin/adminfiles/tra2012.pdf> .

The next **Exploitation Group meeting** is expected to take place in Quarter 3 of 2012 and will be a great opportunity to see the results of the blast tests and simulations of the SECUREMETRO designs. The exact location and date will be announced via email.

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