Mitigating the Effects of Firebomb and Blast Attacks on Metro Systems.

Conor O’Neill (NewRail)
3½ year EU project – Jan 2010 to Jun 2013

11 partners in 4 countries
To increase metro vehicle resilience to terrorist bomb blast through selection of vehicle materials and structural design.

To increase security against a firebomb attack through design of fire barriers and fire suppression technology.

To increase the resilience of vehicles to blasts in order to speed up recovery following attack to return to normal operation.

To reduce the attractiveness of metro systems as a target for attack by reducing deaths and injuries and increased resilience.
Review of previous blast and incendiary attacks on metro systems.

Analysis of potential future threats, risks and potential trends.

Threat and attack scenarios to provide design approach.

1960-2010
Subway systems.

<table>
<thead>
<tr>
<th></th>
<th>Total Attacks</th>
<th>Attacks on Vehicles</th>
<th>% of Total</th>
<th>Fatalities on Vehicles</th>
<th>Injuries on Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subway</td>
<td>82</td>
<td>29</td>
<td>35%</td>
<td>90%</td>
<td>67%</td>
</tr>
<tr>
<td>Subway EU</td>
<td>35</td>
<td>11</td>
<td>31%</td>
<td>100%</td>
<td>92%</td>
</tr>
</tbody>
</table>

Future Threats.

<table>
<thead>
<tr>
<th>Question posed</th>
<th>Highest ranking response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most severe threat</td>
<td>Explosive device</td>
</tr>
<tr>
<td>Most probable threat</td>
<td>Explosive device</td>
</tr>
<tr>
<td>Most vulnerable target</td>
<td>Multi-modal terminals</td>
</tr>
<tr>
<td>Primary aim of attack</td>
<td>Loss of life</td>
</tr>
<tr>
<td>Device type</td>
<td>Improvised explosive device</td>
</tr>
<tr>
<td>Attack type</td>
<td>Multiple targets</td>
</tr>
</tbody>
</table>
Finite element modelling and simulation of blast conditions.

Study of blast mechanics related to rail metro vehicles and systems.

Small/large scale blast testing (correlation) components and vehicle.

Evaluation of range of potential vehicle design improvements.
Panel tests June 2012:

- Driver cabin panels.
- Carriage wall panels.
- Floor and ceiling panels.
- Windows (glazing).
- Material assessment tests (32 individual materials tested).
Full-scale test Aug 2012:

- Decommissioned Metro de Madrid vehicle.
- Tested at HSL (UK) for NewRail.
- Evaluation of structural and equipment response.
Delivery of metro!
AREAS OF INTEREST - Reduce Damage and Injury

- Glass fragmentation
- Door retention
- Structural deformation
- Equipment retention
- Vehicle derailment

- Interior components (floor/roof)
- Critical system protection
- Driver Protection
- Evacuation & egress
- Recovery (injured & system)
A blast resilient prototype incorporating:

- Glazing protection.
- “Tethering” systems for internal panels.
- Energy absorbing materials.
- Flexible coatings.
- Longitudinal and transverse seat arrangements.
A blast resilient prototype incorporating:

- Reduction in glazing debris.
- Reduction in debris in gangway.
- Tethering held dislodged panels.
RESEARCH OUTPUT

- Appraisal of State-of-Art design practices (techniques).
- Specification of the desired vehicle performance.
- Design specification for blast and firebomb mitigation.
- Recommendations for future international standards.
THANK YOU!

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