



U.S. Department  
of Transportation  
**Federal Railroad  
Administration**



**RR 11-23 | November 2011**

---

## **PASSENGER RAIL CAR EGRESS – TRB WORKSHOP**

### **SUMMARY**

The Federal Railroad Administration's (FRA) Office of Railroad Policy and Development is exploring how to enhance regulations that address the safe, timely, and effective emergency evacuation of occupants from passenger rail vehicles in various emergency scenarios. Several evacuation concepts, strategies, and techniques are currently being investigated and evaluated for applicability to U.S. passenger rail cars.

FRA sponsored a Human Factors Workshop related to passenger train emergency egress on January 9, 2010, as part of the Transportation Research Board (TRB) Annual Meeting, in Washington, DC. The workshop featured two areas: 1) findings from recent research regarding emergency evacuation from transportation vehicles; and 2) a field trip for participants to experience the challenges of egress for an overturned commuter rail car and a crash-damaged rail transit car in a subway tunnel environment.

A Roll-Over Rig (ROR) Simulator was used to demonstrate commuter rail car egress during the TRB Workshop.

FRA funded the construction of the ROR, which is located at the Washington Metropolitan Area Transit Authority (WMATA) Carmen E. Turner Maintenance and Training Facility in Landover, MD. The ROR Simulator is capable of "rolling" a rail car "over," in place, at various angles to simulate rail car positions after derailments or other rail accidents. The ROR Simulator is used as a training tool by WMATA for emergency response organizations and has been used to demonstrate different types of emergency evacuation-related equipment to government agencies and industry groups.



Passenger Rail Car ROR Rig



Subway Tunnel

**Figure 1. WMATA Emergency Evacuation  
Training Facility**



## BACKGROUND

FRA sponsored a Transportation Research Board (TRB) Human Factors Workshop, which allowed participants to explore strategies and new technologies that may reduce injuries and fatalities in public transportation emergencies.

At the morning session, individuals from FRA, the Federal Aviation Administration (FAA), the John A. Volpe National Transportation Systems Center (Volpe Center), and the University of Greenwich (United Kingdom) provided technical presentations and other reference information relating to FAA and FRA regulations, as well as ongoing research conducted by FRA, FAA, the Volpe Center, and the University of Greenwich.

During the afternoon session, participants traveled to the WMATA facility, where WMATA officials provided a briefing about the agency's extensive emergency-management planning and capabilities as well as its leading role in training emergency responders. Participants then experienced the unique challenges of egress from the Roll-Over Rig (ROR) Simulator commuter rail car and a crash-damaged subway car in a tunnel environment.

## ROR EGRESS DEMONSTRATIONS

### *Participant Information*

Nineteen persons who registered for the TRB Workshop participated in the ROR rail car egress demonstrations:

- 14 males and 5 females\*
- Age groups:
  - 20–30 years, 6 persons;
  - 30–50 years, 7 persons;
  - Over 50 years, 7 persons.

\* One female participated only in the upright demo.

Five persons stated that they had previously exited from a rail car when it was not upright.

### *Car Information*

The ROR rail car is a single-level commuter rail car that was donated by New Jersey Transit. The car is 85 feet long, with “three and two” seating for 135 people (Figure 2). The center aisle is 20.5 in (3.2 m) wide between armrests.



Figure 2. ROR Simulator Car Interior

### *Demonstrations*

Volpe Center staff first pointed out emergency systems required by FRA regulations on the exterior and the interior of the rail car. These systems include the emergency exit type and location, as well as emergency exit and rescue access identification and instructions.

Egress demonstrations were then conducted at different angles.

#### ROR Egress Demonstrations

DEMO	TYPE	ANGLE
1	Individual	Upright
2	Individual	10°
3	Individual	20°
4	Group	15°

For each demonstration, participants started at one end and then walked along the length of the car, exiting the vestibule door and using the side-door stairway steps onto a wooden platform (Figure 3). (Both the vestibule and side doors were open.)



Figure 3. Upright ROR Car (side view)

The demonstrations were conducted when the commuter rail car was upright and after the car was tilted to three other angles (Figure 4). Three egress demonstrations were conducted with approximately 15 seconds between individuals. The final demonstration was conducted with all individuals proceeding as a group.



a) Upright      b) 20° angle

Figure 4. ROR Car Egress

### ROR Summary

Information obtained as a result of the preliminary review of video and participant questionnaires provided the following insights:

- With the car at an angle:
  - Participants held onto the seats to help them walk along the aisle, and
  - The majority of participants used the handrails to exit the car.
- Participants appeared to experience few or no difficulties in moving through the car at 10°.
- With the car at 20°:
  - Participants appeared to experience greater difficulty in moving through the car, and
  - A few participants exited the car in a backward position.

### RAIL TRANSIT TRAIN – SUBWAY TUNNEL

WMATA staff provided participants with an extensive tour of the WMATA training facility, including the ROR Simulator operation and a crash-damaged subway transit train in a simulated tunnel environment. WMATA staff also described various emergency egress-related features, including transit car exit door markings and emergency releases, as well as car and tunnel emergency lighting (Figure 5). In addition, Volpe Center staff demonstrated emergency exit signs and low-location exit path markings using different letter sizes and several types of photoluminescent material.



Figure 5. WMATA Vestibule End-Door and Side-Door Exit Signs



## RELATED RESEARCH

The Volpe Center has completed research relating to a survey of computer-egress models and description of single-level commuter rail egress experiments under normal and emergency lighting. These experiments included egress from an upright car.

The Volpe Center has also conducted egress demonstrations with the ROR Simulator under darkness conditions with FRA and railroad-industry participants, which included 90° angles and smoke conditions. These other demonstrations showed the advantages of high-performance photoluminescent (HPPL) emergency exit signs.

See also Research Results RR06-06 and RR06-07.

## ACKNOWLEDGMENTS

Several individuals and organizations, in coordination with FRA's Office of Railroad Policy and Development, contributed to the success of the TRB Workshop.

### **Logistical Support**

The rail car egress demonstrations were conducted with the cooperation of WMATA officials who provided extensive advance planning assistance to Volpe Center staff, transportation to the Landover facility from the TRB meeting hotel, as well as extensive staffing for the facility tour and demonstrations.

Stephen M. Popkin, Volpe Center, provided Workshop coordination with TRB and Mike Flanagan, Federal Transit Administration, assisted in coordinating arrangements for bus transportation to the WMATA facility.

TRB provided registration services, arranged for the morning presentation room and equipment, and provided box lunches for speakers and participants.

## Speakers

Brenda M. Moscoso, FRA  
Garnet A. (Mac) McLean, FAA  
Stephanie H. Markos and John K. Pollard,  
Volpe Center  
Peter G. LaPorte, WMATA  
Edwin (Ed) R. Galea, University of Greenwich,  
United Kingdom

## REFERENCES

- [1] Markos, S.H.; and Pollard, J.K. *Passenger Train Emergency Systems; Single-Level Commuter Rail Car Egress Experiments*. Prepared by Volpe Center for FRA/USDOT. Interim report. Report no. DOT/FRA/ORD-11/XX. In FRA report approval process.
- [2] Kelly, A.; Lattimer, B.; Ringwelski, B.; Rosenbaum, E.R.; Markos, S.H.; and Pollard, J.K. *Passenger Train Emergency Systems: Review of Egress Variables and Computer Models*. Prepared by Volpe Center for FRA/USDOT. Interim report. Report no. DOT/FRA/ORD-11/XX. In FRA report approval process.

## CONTACT

### **Melissa Shurland**

Federal Railroad Administration  
Office of Railroad Policy and Development  
1200 New Jersey Avenue, SE – Mail Stop 20  
Washington, DC 20590  
Tel: (202) 493-1316  
[Melissa.Shurland@dot.gov](mailto:Melissa.Shurland@dot.gov)

## KEYWORDS

Emergency egress, egress time, evacuation, passenger train, passenger rail, passenger train emergencies

*Notice and Disclaimer: This document is disseminated under the sponsorship of the United States Department of Transportation in the interest of information exchange. Any opinions, findings and conclusions, or recommendations expressed in this material do not necessarily reflect the views or policies of the United States Government, nor does mention of trade names, commercial products, or organizations imply endorsement by the United States Government. The United States Government assumes no liability for the content or use of the material contained in this document.*