

Mobile Locomotive Simulator for Human Factors Research

The Federal Railroad Administration's Cab Technology Integration Laboratory

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PHOTO: VOLPE NATIONAL TRANSPORTATION SYSTEMS CENTER

The Cab Technology Integration Laboratory (CTIL) is a mobile, full-sized locomotive simulator configured with tools for analyzing crew performance with new cab technologies and configurations. The CTIL is owned by the Federal Railroad Administration (FRA) and housed and operated by staff at the Volpe National Transportation Systems Center in Cambridge, Massachusetts. Unlike most locomotive cab simulators, the CTIL was designed specifically for human factors research.

The CTIL provides a platform for research into human-machine interface in relation to human performance, enabling assessment of the safety impact of various technologies, procedures, concepts of operations, and operating scenarios. The lab is a national resource available to railroad, industry, academic, and government researchers, facilitating collaborations.

CTIL's capabilities and features include the following:

- ◆ *System mobility*, which allows packaging and transport to other laboratories, rail facilities, and demonstration venues;
- ◆ *A reconfigurable cab*, which can accommodate new control, display, and automation technologies, as well as components such as new seating;
- ◆ *Scenario customization*, which adjusts track, grade, signals, signage, scenery, and more to create experimental scenarios for any project;
- ◆ *Postrun analysis*, which allows for visualization of locomotive crew performance based on the track, consist, and locomotive state and compares crew performance against the standards set for the scenario;
- ◆ *Audio and video recording*, which offers several video and audio recording channels;

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- ◆ *Video data analysis*, which allows live coding of behavior and environmental occurrences for analysis and aids in the retrieval of relevant segments of video;
- ◆ *High-fidelity head-and-eye tracking system*, which can identify, record, and analyze the engineer's head and eye movements;
- ◆ *Anthropometric and behavioral modeling tools*, which allow for manipulation and animation of human manikins in a three-dimensional representation of the cab, useful for evaluating control and display positions, visual angles, and other ergonomic considerations; and
- ◆ *Locomotive crew task and workload modeling software*, which permits the modeling of crew behavior and performance—such as task completion times, workload, and the potential for human error.

FRA and Veolia Transdev are collaborating on a CTIL project to improve understanding of human error caused by distraction during locomotive railroad operations. The study examines the effect of distraction on practicing locomotive engineers who operate the simulator over animated track segments while experiencing a variety of distractions. The goal is to develop an effective, comprehensive training program in sustained attention for railroad engineers and conductors. Measures of head and eye movement are being applied, as well as other operator performance measures—such as speed maintenance, proper stopping distances, adherence to signals, and temporary speed restrictions.

For more information about the CTIL or about collaboration with FRA to use the CTIL, contact Michael Jones at michael.e.jones@dot.gov.