



# Center for Transportation Analysis Research Capabilities Brief Oak Ridge National Laboratory

## Heavy Truck Safety Research Program

### Center for Transportation Analysis (CTA) Research Areas

Aviation Safety  
Air Traffic Management Analysis  
Data, Statistical Analysis  
Geo-Spatial Information Tools  
Defense Transportation  
Energy Policy Analysis  
Environmental Policy Analysis  
Highway Safety  
Intelligent Transportation Systems  
Logistics Management  
Supply Chain Management  
Modeling and Simulation  
Transportation Operations  
Planning and Systems Analysis  
Transportation Security

The Oak Ridge National Laboratory (ORNL) has been conducting research in the Heavy Truck Safety Area for more than seven years. The primary areas of emphasis have been on braking systems, performance-based brake testers, truck stability and rollover, vehicle dynamics, wireless roadside inspections, infra-red imaging, weigh-in-motion, vehicle immobilization technologies for safety and security of hazmat, finite-element truck-infrastructure crash modeling, and truck visibility and conspicuity. Research is conducted in six research domains. They are: (1) Field and test track testing, (2) Modeling and simulation, (3) Data and information analyses, (4) Laboratory testing, (5) Demonstration projects, and (6) National program support.

### Field and Test Track Testing

- **Truck Rollover Characterization** – This research examines the impact of new generation single wide-based tires (NGSWBTs), electronic stability control and advanced trailer suspension systems on heavy truck stability. A tractor/box-trailer configuration was tested in 2004. A tractor/flatbed trailer is currently being tested. The NGSWBTs, in conjunction with a wider-slider suspension, significantly reduced the roll propensity of the tractor/box-trailer.



- **Heavy Truck Brake Performance Characterization** – This research involved the comparison of Original Equipment Brake Lining Performance to Aftermarket Brake Lining Performance in a laboratory (small-scale coupon testing), a test track (performance testing based on FMVSS-121), and field testing environments involved single-, double-, and tri-axle dump trucks and a refuse hauler outfitted with the brake linings being studied. Stopping performance and wear were assessed over a 12-month period of time.



- **Commercial Motor Vehicle Roadside Technology Corridor** – This permanently designated FMCSA research corridor located along a 70-mile stretch of I-40 and I-81 in east Tennessee involves the testing of new and emerging technologies for inspection efficiency improvement, safety, and truck-based vehicle-infrastructure integration (VII). Testing is being done in the following areas: performance-based brake testing, wireless roadside inspection, and infra-red imaging for truck inspections.
- **Advanced High-Speed Weigh-in-Motion (WIM) Technologies** – The WIM program leverages several complementary technology demonstration and development

Patricia S. Hu, Director  
Center for Transportation Analysis  
Oak Ridge National Laboratory  
2360 Cherahala Boulevard  
Knoxville, TN 37932  
865.946.1349  
(Fax) 865.946.1314  
Website: [cta.ornl.gov](http://cta.ornl.gov)

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efforts underway in the US Army, US Air Force, and ORNL with the goal of reducing manual processes, and mitigating safety and operational concerns.

- **Heavy Truck Duty Cycle** – Collection of real-world heavy truck (Class-8) operational data (60 channels involving data related to fuel consumption, velocity, location, direction, weight, gear ratio, road-grade, precipitation, wind velocity/direction, etc., collected at five Hz for twelve months on six instrumented tractors and ten instrumented trailers). This data supports DOE's Class-8 energy efficiency modeling efforts, and will be utilized to generate customized Class-8 duty cycles for stakeholder designated parameters. In FY-2008, data collection on selected vocations of Class-6 vehicles will be initiated.

### **Data and Information Analyses**

ORNL assists in data and information analyses such as content development for FMCSA's Safety Technology Website which reflects input from over 200 private industry contributors (expected to come on-line in FY-2006). ORNL has also evaluated the FMCSA's SafeStat Program, contributed to the Large Truck Crash Causation Study data, and the Commercial Vehicle Driver Risk Factors Study.

### **Modeling and Simulation**

ORNL has developed Finite Element Models for Single Unit Truck and Infrastructure Crashes to support infrastructure designs which enhance safety. Other projects areas include: DynaSmart-P Modeling of the Effects of Truck Traffic in Emergency Evacuations; and enhancement of the Braking Module of TruckSim to account for fade, humidity and braking torque. ORNL has also developed the GeoFreight Modeling Software that graphically displays geographic relationships between freight movements and infrastructure, assists freight policymakers and planners in identifying the flows of domestic and international freight across the nation, and assists in identifying current and potential major freight bottlenecks in the US transportation system.

### **National Program Support**

ORNL supports the 21st Century Truck Partnership (21CTP), led by US DOE and supported by US DOT, US EPA and US DoD. The 21CTP goals include efficiency improvements for Class-8, Class-6 and Class-2B trucks while enhancing safety and environmentally friendliness. ORNL led the

preparation of the 21CTP Technology Roadmap, and has had the lead laboratory role in preparing the 21CTP Safety White Paper with goals of: (a) Reducing stopping distance by 30%, (b) Eliminating blind spots, and (c) Enhancing survivability in a 35mph closing crash.

### **Laboratory Testing**

ORNL has developed an aftermarket brake material classification system and conducted studies on long-persistence phosphors in highway paint striping. ORNL has also studied truck conspicuity enhancements and the development of a prototype pulsed U-V headlight system for application to truck safety. ORNL's sub-scale brake-material coupon tester is used to test heavy truck brake friction and wear in the Lab.

### **Heavy Truck Safety Research Partnerships**

ORNL's heavy truck safety research involves significant federal, industry and academia partnering. Such partners include: (a) US DOT's Federal Motor Carrier Safety Administration (FMCSA), the Federal Highway Administration (FHWA), the National Highway Traffic Safety Administration (NHTSA), and the Research and Innovative Technologies Administration (RITA), (b) US DOE's Office of FreedomCar and Vehicle Technologies, (c) US DoD's Tank Automotive and Armaments Command (TACOM), (d) Private industry, including the National Transportation Research Center, Inc. (NTRCI), Dana Corporation, Michelin American Research and Development Corporation, Volvo Trucks of North America, International Truck and Engine Corporation, Link Engineering, Waste Management, TRC, Inc., Laurens Proving Grounds, Walker Trucking, and USXpress, and (e) research organizations and academia including Battelle Memorial Institute, the University of Tennessee, Clemson University, George Washington University, and the University of California, Berkeley.

### **Future Directions**

ORNL is pursuing in several major themes related to heavy truck safety. These themes include: (1) Development of an integrated tractor-trailer concept that will build on the heavy truck test track and field experiences being led by ORNL, (2) Testing and evaluation of new and emerging safety, and security technologies in real-world environments, and (3) Truck-based Vehicle Infrastructure Integration (VII) research.

**For more information regarding this research contact Bill Knée, Center for Transportation Analysis, Oak Ridge National Laboratory, phone (865) 946-1300 or email [kneehe@ornl.gov](mailto:kneehe@ornl.gov).**