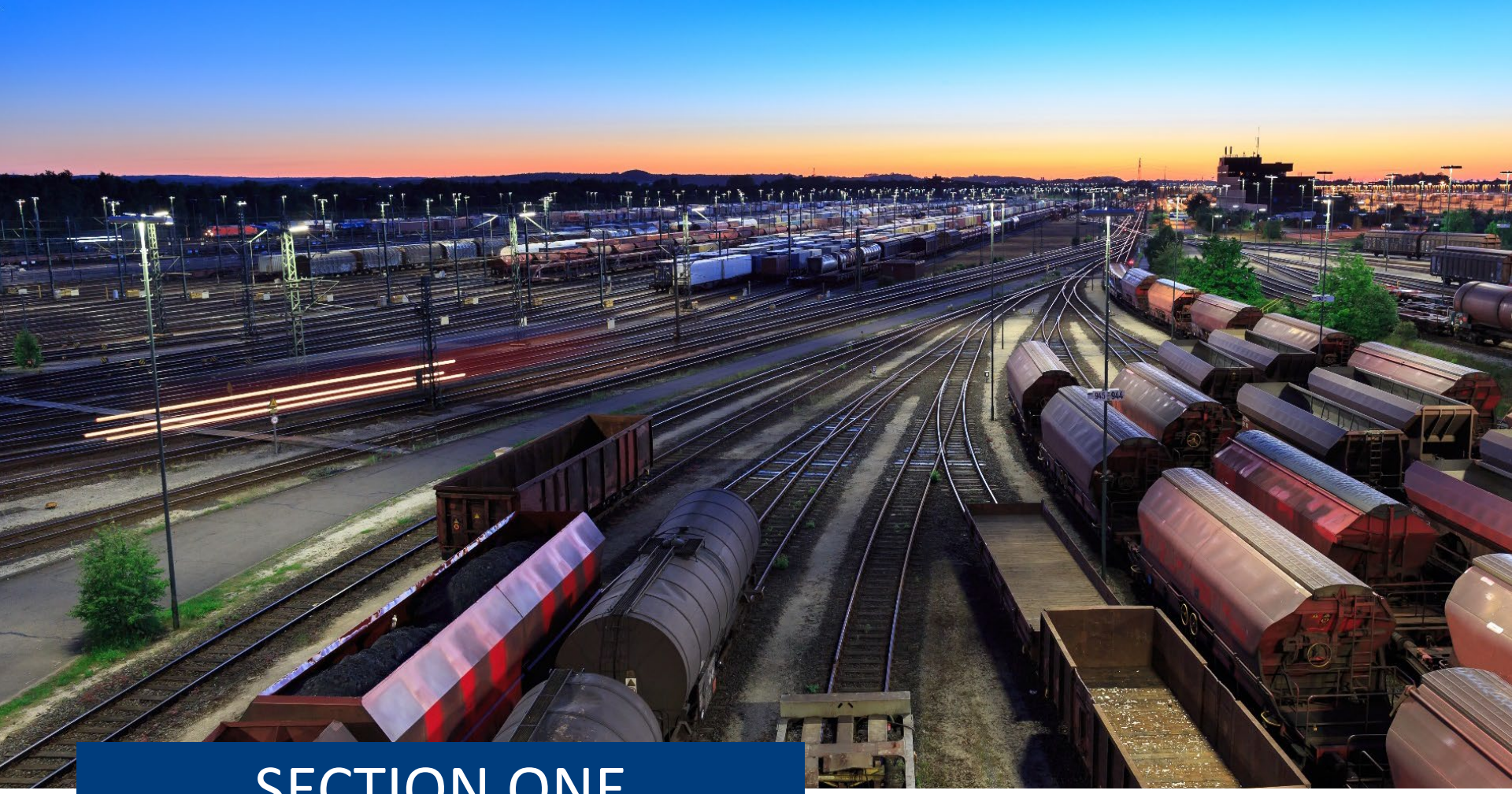
RAIL

*MOVING AMERICA FORWARD*

# FRA Office of Research, Development, and Technology

## Current Research Projects

U.S. Department of Transportation
Federal Railroad Administration



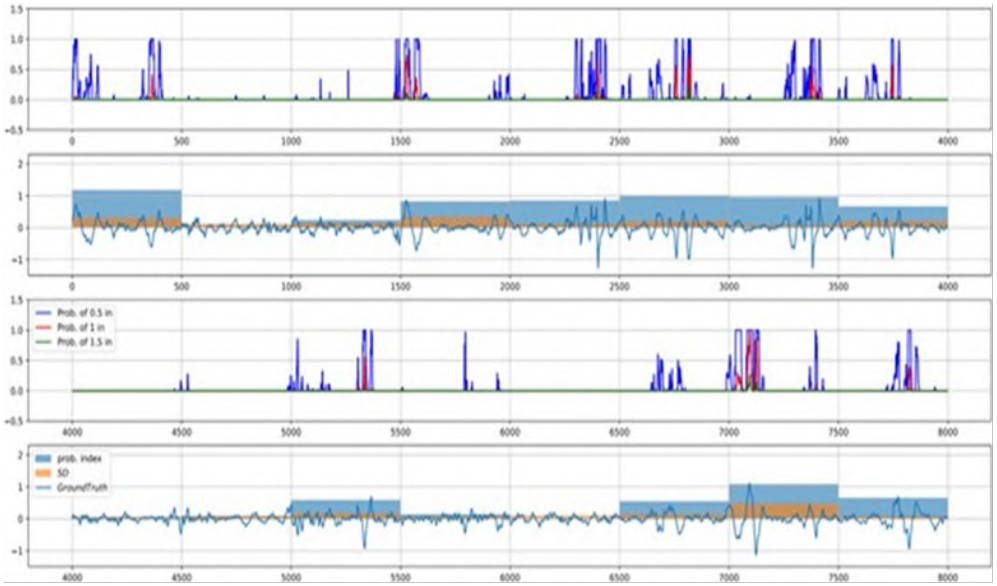
SECTION ONE

# TRACK

# Development of a Multi-Dimensional Track Quality Index (TQI) and Defect Risk Model in Support of Autonomous Track Geometry Inspection

## PROJECT DESCRIPTION

- Develop 3D track geometry running surface growth model based on densely gathered inspection data.
- Develop artificial intelligence (AI) model to determine growth rate probabilities and projected time to defect development.
- Develop AI model to determine probability of defect/exception development.
- Provide for identification of track locations with potential for track geometry defect development with a focus on safety-related defects that can result in geometry related derailments.
- Develop analysis algorithm(s) to create multi-dimensional TQI with time/MGT component.
- Validate the algorithms.




## RAILROAD IMPACT

- Increased inspection car frequency and autonomous inspection vehicle data provide additional information about condition and adequacy of the track geometry.
- Ability to better understand degradation and defect occurrence is a valuable tool for railroads and FRA.
  - Indicate areas in which high-risk track geometry defects could develop.
  - Provide prioritized maintenance through new TQI.
- Reduction of severe geometry defects and associated derailments.

## PROJECT PARTNERS

- University of Delaware (Railroad Engineering and Safety Program)
- Amtrak

## COST & SCHEDULE

- Funding, FY20–24: $238,551
- Project Duration: September 2020 – October 2024

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Hugh B. Thompson, II • (202) 493-6383 • hugh.thompson@dot.gov

# Innovative Track Inspection Technologies

## PROJECT DESCRIPTION

- Support the introduction of new track inspection approaches and advancement of existing track inspection technologies with a focus on data interpretation and analysis.
- Support assessment of FRA's Vertical Rail Deflection Measurement System (VRDMS).
- Develop alternative approaches to directly measure absolute vertical defection under load.
- Provide engineering and data analysis support for Gage Restraint Measurement System (GRMS), Ground Penetrating Radar (GPR), VTDMS, and similar track evaluation technologies.
- Investigate alternative methods to assess the tie support conditions using fiber optics and fiber Bragg gratings (FBG) sensors or other means that can provide an indication of non-uniform support conditions over longer segments of the track.
- Support field activities for FRA track research.

## RAILROAD IMPACT

- Broaden the application of innovative technologies to detect degraded track conditions.
- Improve the understanding of track behavior by characterizing various track components and parameters.
- Provide practical uses of technology to improve railroad safety and maintenance practices.

## PROJECT PARTNERS

- ENSCO, Inc.
- Oklahoma State University

## COST & SCHEDULE

- Funding, FY25: $249,969
- Project Duration: September 2023 – September 2024



FRA PROJECT MANAGER: Hugh B. Thompson, II • (202) 493-6383 • hugh.thompson@dot.gov

# Innovative Track Inspection Technologies II

## PROJECT DESCRIPTION

- Support the introduction of new track inspection approaches and advancement of existing track inspection technologies with focus on data interpretation and analysis.
- Support assessment of FRA's Vertical Rail Deflection Measurement System (VRDMS).
- Develop an approach to directly measure the full amount of vertical defection from a moving platform.
- Provide engineering and data analysis support for Gage Restraint Measurement System (GRMS), ground penetrating radar (GPR), VTDMS, and similar track evaluation technologies.
- Provide engineering and data analysis support to advance innovative track strength performance assessment using a combination of existing technologies.
    - Evaluate the feasibility of estimating a gage restraint parameter using non-contact technologies.
- Support field activities for FRA track research.


## RAILROAD IMPACT

- Broaden the application of innovative technologies to detect degraded track conditions.
- Improve the understanding of track behavior through characterization of various track components and parameters.
- Provide practical uses of technology to improve railroad safety and maintenance practices.

## PROJECT PARTNER

- ENSCO, Inc.

## COST & SCHEDULE

- Funding, FY26: $299,993
- Project Duration: September 2024 – September 2025



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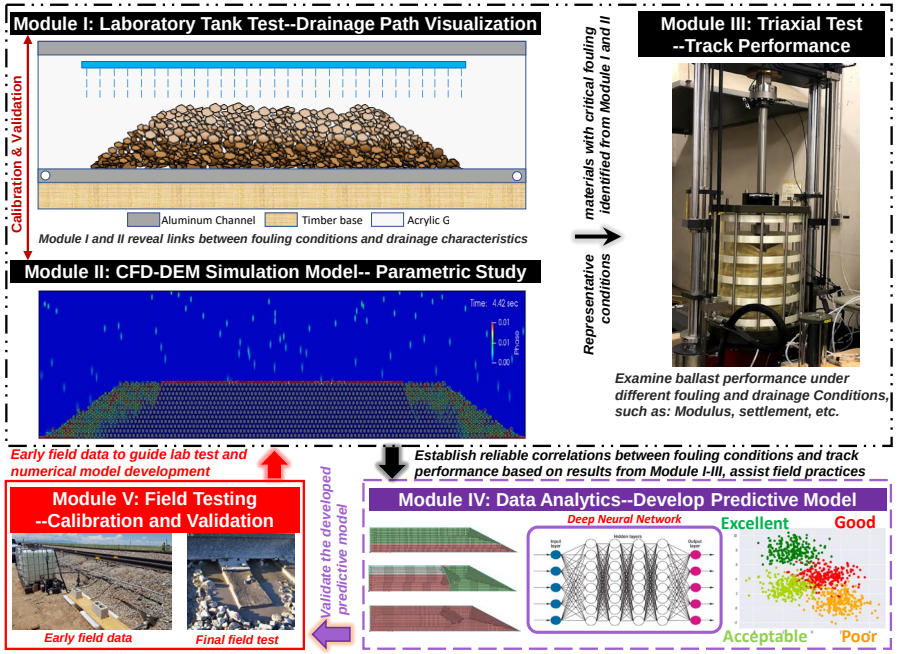
# Quantitative Assessment of the Influence of Drainage on Track Support

## PROJECT DESCRIPTION

- Quantitatively study ballast drainage characteristics under different fouling levels and fouling materials.
- Establish accurate correlations between ballast fouling conditions, drainage characteristics, and track performance.
- Examine the effectiveness of popular track maintenance methods, such as shoulder cleaning, track lifting, undercutting.
- Develop a practical predictive model to assist in-field track maintenance decision making.




## RAILROAD IMPACT

- Use a practical numerical predictive model to assist field track maintenance decision making.
- Provide guideline for selecting the best maintenance method according to specific track conditions.
- Provide reference information to help create a cost-effective maintenance schedule.
- Assist with condition-based track maintenance and improve track safety and operation efficiency.

## PROJECT PARTNERS

- University of South Carolina
- CSX Transportation
- MxV Rail
- BNSF Railway
- Loram
- RTS
- HNTB

## COST & SCHEDULE

- FRA Funding: $385,000
- Project Duration: August 2021 – August 2024

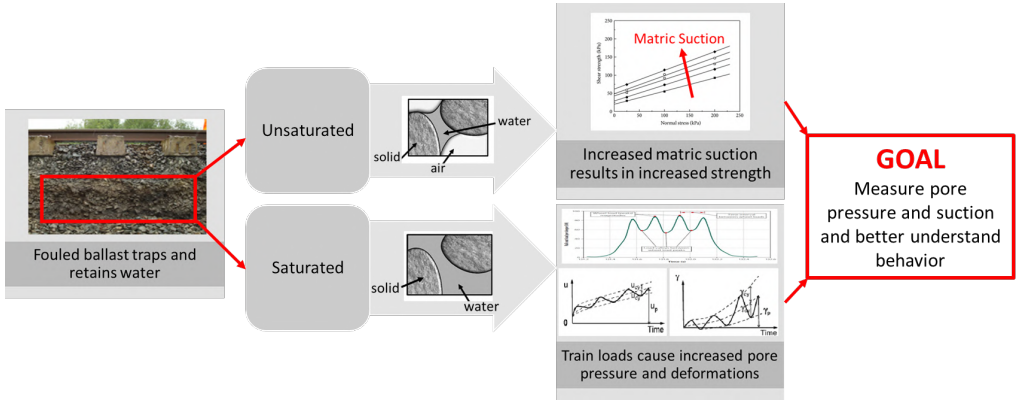


FRA PROJECT MANAGER: Hugh B. Thompson, II • (202) 493-6383 • hugh.thompson@dot.gov

# Pore Water Pressure and Matric Suction Sensor: Laboratory Strength Testing and Field Substructure Monitoring

## PROJECT DESCRIPTION

- Trapped and retained moisture can have varying effects on ballast strength and track deformation. A system of sensors capable of measuring localized pore water pressure and matric suction is needed to better describe the overall behavior of fouled ballast.
- Develop a laboratory pore pressure and matric suction sensor system capable of localized measurements within the specimen.
- Modify the laboratory system for field implementation.
- Develop a particle-based wireless sensor system capable of localized measurements of strain, particle motion, pore pressure, suction, temperature, barometric pressure, and humidity.




## RAILROAD IMPACT

- Improve understanding of the role of pore water pressure and suction in laboratory and field conditions.
- Improve understanding of ballast strength degradation with increased fouling and moisture.
- Improves understanding of overall ballast behavior (i.e., strength and deformation) under train-induced loads.
- Increases safety and efficiency for rail industry.
- Improves nondestructive detection of fouled ballast using traditional and novel technologies.

## PROJECT PARTNER

- BNSF Railway

## COST & SCHEDULE

- Funding, FY22: $104,576, FY23: $100,280, Total: $204,856
- Project Duration: 36 months



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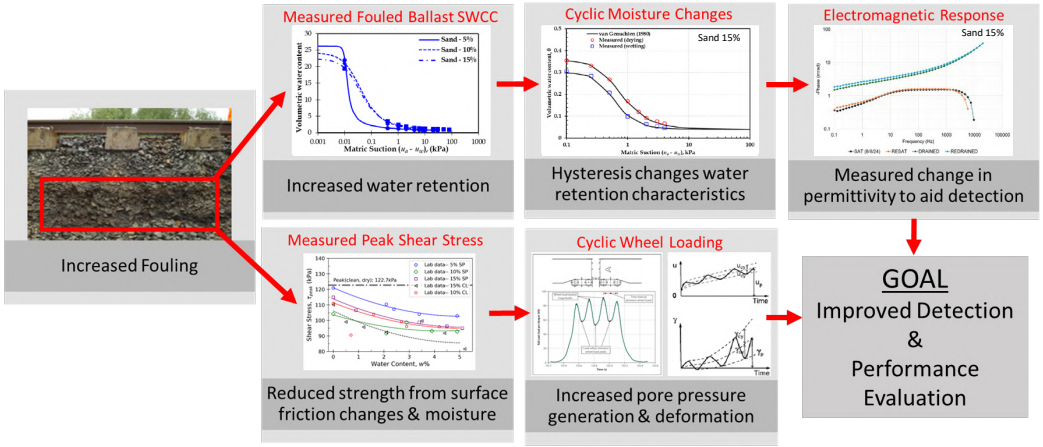
# A Mechanistic-Phenomenological Investigation of Fouled Ballast to Support In-Situ Identification of Fouling

## PROJECT DESCRIPTION

- Cyclic loading and wetting and drying impact unsaturated fouled ballast behavior in the field, yet quantification of the strength-deformation-electromagnetic response is remains limited.
- Measure inter-particle friction and examine surface properties.
- Measure cyclic mechanical response of unsaturated fouled ballast.
- Measure hysteretic suction coupled with complex dielectric permittivity.
- Generate a phenomenological model that couples the mechanical and electromagnetic mechanisms with the overall response.




## RAILROAD IMPACT

- Improve understanding of unsaturated and electromagnetic characteristics of fouled ballast, including the role of different fouling materials, water content, density, and shear strength.
- Improve understanding of the cyclic response and the role of pore water pressure in the laboratory and field.
- Increase safety and efficiency for the rail industry.
- Improve nondestructive detection of fouled ballast using technology used by the rail industry.

## PROJECT PARTNERS

- BNSF Railway
- Texas State University

## COST & SCHEDULE

- Funding, FY22: $156,686, FY23: $142,888, Total: $299,574
- Project Duration: 36 months



FRA PROJECT MANAGER: Hugh B. Thompson, II • (202) 493-6383 • hugh.thompson@dot.gov

# Upgrade and Support for the DOTX218 Vertical Rail Deflection Measurement System (VRDMS)

## PROJECT DESCRIPTION

- Upgrade DoTX218 VRDMS system hardware to newly redesigned system:
  - New sensor heads
  - New brackets
  - New control units
    - Upgraded computer
    - Upgraded networking
    - Upgraded power system
- Commission system for production use.


## RAILROAD IMPACT

- Provide a reliable solution for obtaining continuous vertical deflection information on FRA inspection vehicles.
- Provide a platform for expanded research opportunities for FRA partners.

## PROJECT PARTNER

- Harsco Rail

## COST & SCHEDULE

- Funding, FY23–24: $44,000.00
- Project Duration: June 2023 – December 2024



FRA PROJECT MANAGER: Hugh B. Thompson, II • (202) 493-6383 • hugh.thompson@dot.gov

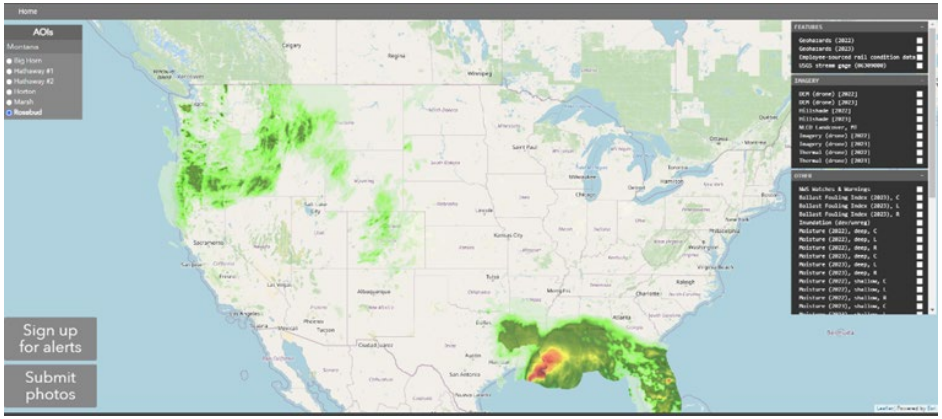
# Integrated and Automated Decision Support System for Ground Hazard Risk Mitigation for Railways Using Remote Sensing and Traditional Condition Monitoring Data

## PROJECT DESCRIPTION

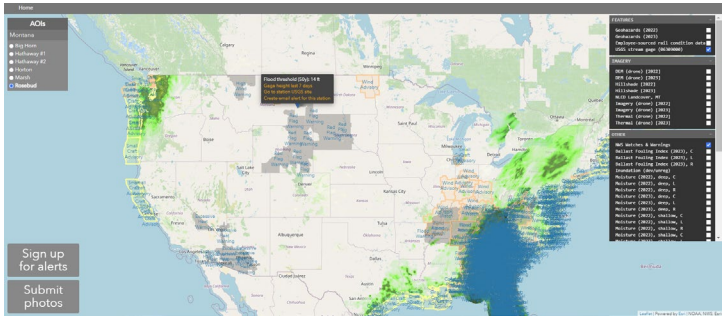
- Establish a geospatial database and decision support system of railway ground hazard locations and failures.
- Develop and monitor high ground hazard segments of the rail corridor by integrating real-time environmental data, satellite, unmanned aerial vehicle (UAV), and railcar-mounted remote sensing technologies with traditional condition monitoring data.
- Use automated change detection and a smartphone-based data entry portal as a tool for incident reporting using field photographs to validate remote sensing-based ground hazard and the condition of the rail infrastructure and the right-of-way in high ground hazard zones.
- Ground-truth the automated change detection and develop a decision support system based on the triggering levels of ground hazard obtained from historic data.

## RAILROAD IMPACT

- Geospatial database and decision support system for integrating ground hazard information with traditional condition monitoring data
- Proactively locate, monitor, and mitigate ground hazard risks along the right-of-way.
- Enhance safety and reliability along corridors prone to ground hazard risks.
- Reduce geohazard-based operational disruptions and safety risks through predictive evaluation and monitoring.




Decision support system live feed during Hurricane Francine




Red flag warning indicating critical fire conditions are expected in an area of interest in Montana

## PROJECT PARTNERS

- Loram
- BNSF Railway
- Wisconsin & Southern Railroad
- Michigan DOT

## COST & SCHEDULE

- Funding: $606,922 (+$88,000 cost share)
- Project Duration: October 2021 – September 2024

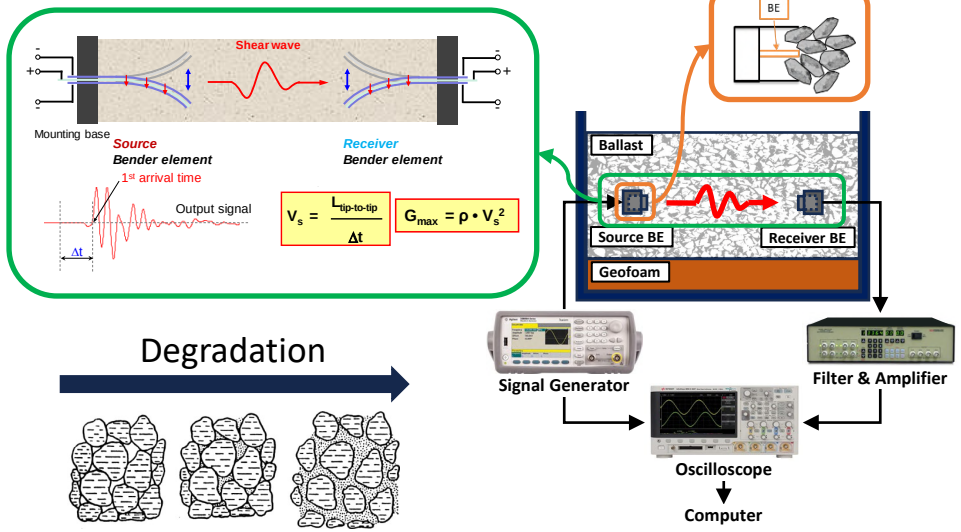
U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Hugh B. Thompson, II • (202) 493-6383 • hugh.Thompson@dot.gov

# Bender Element Field Sensors for Long-Term Monitoring of Ballasted Track Condition

## PROJECT DESCRIPTION

- Establish an advanced field sensing technology using bender element (BE) sensors for quantifying stiffness characteristics and evaluating fouling condition of ballast and sub-ballast layers.
- Finalize design and manufacture field BE sensors for ballast stiffness determination.
- Install BE sensors both in laboratory and field railway facilities to conduct seismic testing and shear wave velocity measurements.
- Develop a database with ballast fouling condition and shear wave measurements through the use field BE sensors.





## RAILROAD IMPACT

- This research will develop a robust tool for field quantification of ballast stiffness characteristics based on embedded BE sensors and timely scheduling of maintenance activities.
- The long-term monitoring ability of embedded field BE sensors will allow practitioners to specify the ballast quality and stiffness during the design procedure.
- Successful research outcomes will provide the needed link between substructure conditions and track performance, thus ensuring safe operations and improving rail network reliability.

## PROJECT PARTNERS

- BNSF Railway
- ENSCO, Inc.
- Sol Solution

## COST & SCHEDULE

- Funding: $220,000, plus an estimated TTC facility cost of $30,000
- Project Duration: 18 months

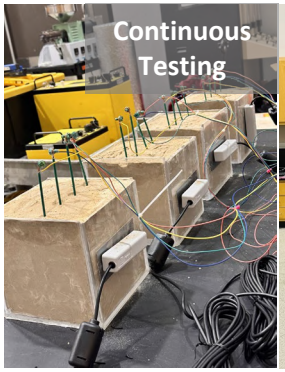

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Hugh B. Thompson, II • (202) 493-6383 • hugh.thompson@dot.gov

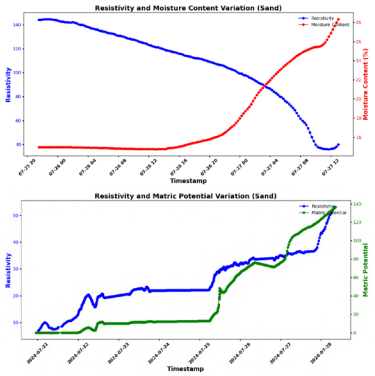
# Detection of Large-Scale Soil Moisture Content, Pore Water Pressure, and Matric Suction Using Electrical Resistivity Imaging Techniques

## PROJECT DESCRIPTION

- Poor drainage and a soft subgrade cause poor track geometry, track instability, settlement, ballast pocket development, increased maintenance, and possible derailment. Subsurface evaluation and monitoring are essential for targeted track maintenance.
- Improve the subsurface investigation technique by developing models to use electrical resistivity imaging to determine the large-scale soil moisture content, pore water pressure, and matric suction of the railroad subgrade.
- Design and develop an electrical resistivity system to deliver real-time, continuous subsurface data.
- Develop predictive models to estimate soil moisture content, pore water pressure, and matric suction using electrical resistivity data.










## RAILROAD IMPACT

- Improve the site investigation technique for identifying large-scale moisture variability and pore water pressure within the subgrade soil.
- Detect foul percentages in railway tracks by analyzing variations in electrical resistivity corresponding to changes in moisture content.
- Reduce maintenance costs by detecting potential failure zones early, preventing costly repairs, and ensuring track integrity.

## PROJECT PARTNERS

- Jackson State University
- The U.S. Army Engineer Research and Development Center

## COST & SCHEDULE

- Funding, FY23–25: $359,304
- Project Duration: July 2023 – September 2024

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Hugh B. Thompson, II • (202) 493-6383 • hugh.thompson@dot.gov

# Advanced Imaging for Roadbed Condition Monitoring and Assessment

## PROJECT DESCRIPTION

- Equipment used to detect weak track locations with unsatisfactory tie conditions must be accurate, efficient, and cost-effective.
- Non-contact, vision-based measurement technologies are used for rapid deployment for real-time monitoring and assessment of roadbeds conditions, vertical track deflections, and rail components.
- Develop a framework that links target detectors with digital image measurement technologies for roadbed condition monitoring and assessment.

## RAILROAD IMPACT

- Roadbed conditions can be monitored in real-time.
- Digital image and videos can be archived for performance history to inform digital databases for “digital twins.”
- Advanced imaging can be used to make data-driven decisions for track safety, inspection, repair, and maintenance.

## PROJECT PARTNERS

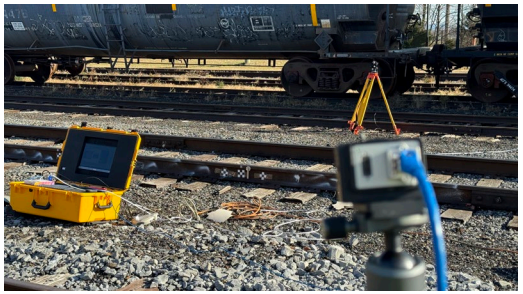
- University of Delaware
- ENSCO, Inc.

## COST & SCHEDULE

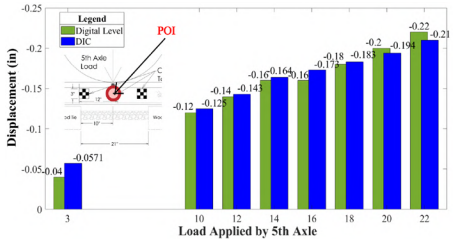
- Funding, FY25: $122,000
- Project Duration: September 2023 – August 2025

**Loading Device DOTX T18 and DIC targets**

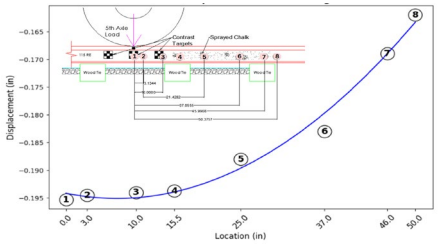

**Portable Dynamic Monitoring System and Sensor Camera**



**Vertical Deflection Measured by DIC and Digital Level**




**Beam on Elastic Foundation (BoEF) response from multi-point, digital image correlation (DIC) measurements**




**Section of track monitored at Letterkenny, PA**



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# Support for Testing with FRA Inspection Fleet

## PROJECT DESCRIPTION

- FRA owns several inspection vehicles used for rail safety assurance and improvement under the ATIP program.
- The Office if Research, Development and Technology (RDT) has several systems installed on the inspection fleet vehicles used for R&D efforts.
- Efforts under this task focus on supporting the operations, maintenance, repairs and upgrades to the RDT systems installed on the DOTX 218/DOTX 220 consist, including Vertical Rail Deflection Measurement System (VRDMS) and GPR.
- Provide engineering support for RDT test efforts and new technologies with the FRA inspection fleet.
- Support the installation of FRA's new upgraded VRDMS.

## RAILROAD IMPACT

- Provide research platforms to develop, improve, and demonstrate track inspection technologies.
- Allow for the expansion of current track inspection capabilities throughout the railroad industry.
- Improve railroad safety and maintenance practices.

## PROJECT PARTNERS

- ENSCO, Inc.
- Harsco Rail
- Zetica Rail

## COST & SCHEDULE

- Funding, FY25: $329,604
- Project Duration: August 2023 – December 2024

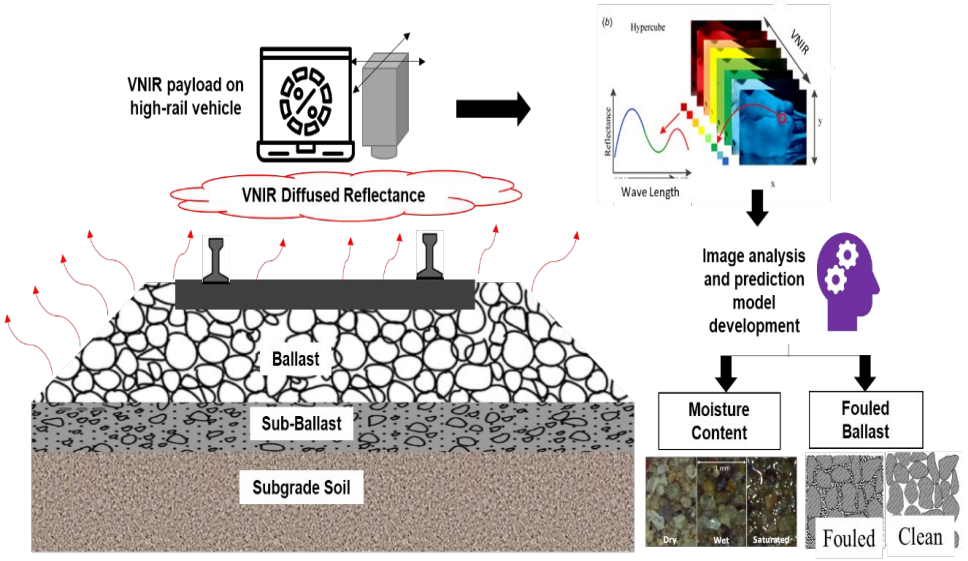


FRA PROJECT MANAGER: Hugh B. Thompson, II • (202) 493-6383 • hugh.thompson@dot.gov

# Railroad Substructure Moisture Measurement and Monitoring Using Hyperspectral Imagery

## PROJECT DESCRIPTION

- Noncontact evaluation of railroad ballast to detect and measure:
  - Moisture content
  - Fouling contamination
  - Both moisture content and fouling contamination simultaneously
- Hypothesis: the presence of water and contamination in a granular medium such as ballast change its light reflectance.
- Use hyperspectral sensors to prove the concept and to measure light reflectance under relevant environment.
- Develop technology to pave the commercialization path of noncontact platforms for ballast condition assessment.




## RAILROAD IMPACT

- Immediately increase safety:
  - Noncontact sensing is safer for inspectors.
  - Increase the ability to quantify the ballast health, leading to increased safety of railroad operators and passengers.
- Increase efficiency and sustainability:
  - Reduce the required resources.
  - Potentially prolong the life of the ballast.

## PROJECT PARTNERS

- University of North Dakota (lead)
- North Dakota State University

## COST & SCHEDULE

- Funding: $416,791
- Project Duration: September 2022 – September 2025

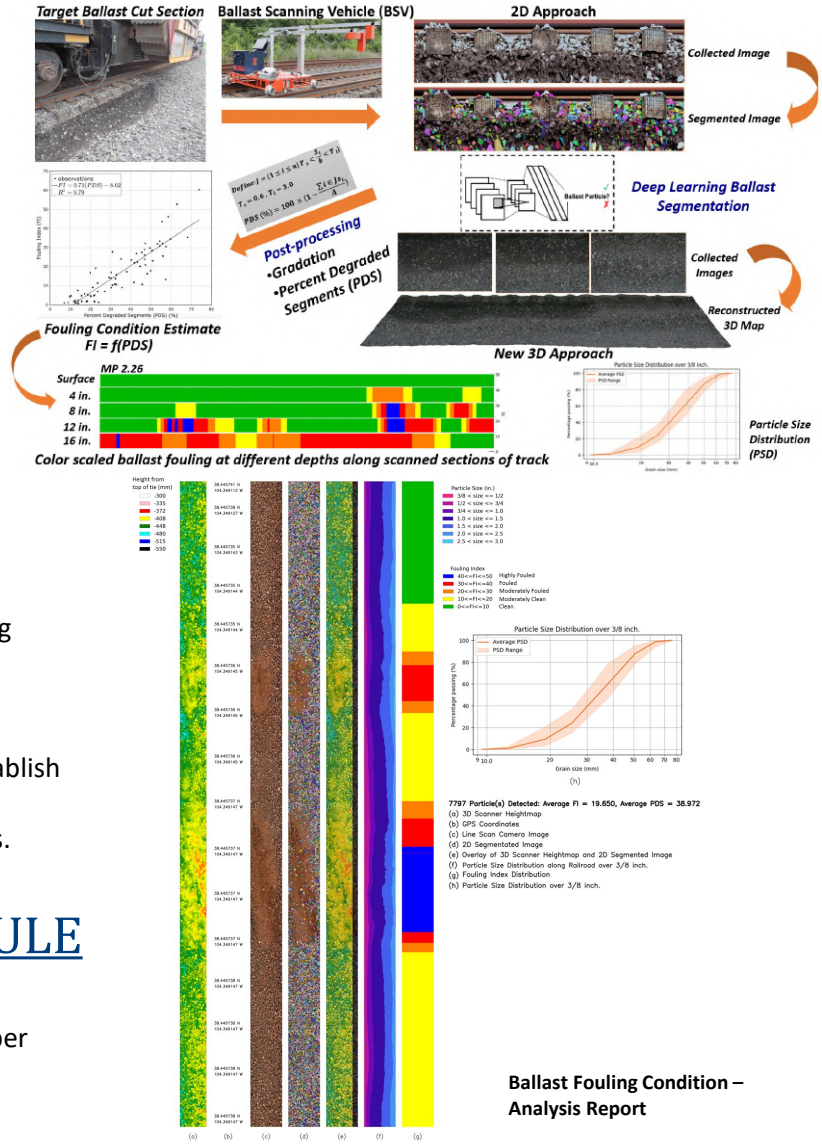


FRA PROJECT MANAGER: Hugh B. Thompson, II • (202) 493-6383 • hugh.thompson@dot.gov

# Automated Machine Vision-Based Ballast Scanning System

## PROJECT DESCRIPTION

- Develop and demonstrate an implementation of a computer vision-based ballast inspection system mounted on an automated rail vehicle.
- Propose a portable and efficient method for acquiring continuous longitudinal scans and depth profiles for ballast shoulder and crib sections.
- Provide a rapid and automated inspection approach, capable of quantifying ballast condition along the track without sampling.
- Calculate percent degraded segments (PDS) from ballast field images and link these values to Selig's fouling index (FI).
- Determine particle size distribution (PSD) from ballast field images.
- Develop I-BALLAST software to perform fast and automated data pre-processing, image segmentation and visualization.




## RAILROAD IMPACT

- Real-time (or near) detection and/or prediction of track-related issues using innovative artificial intelligence (AI) technologies (user independent).
- Automated, consistent, and objective imaging-based evaluation of ballast condition.
- Inspection results can be paired with GPR and track settlement data to establish correlations and provide ground truth.
- Effective ballast management strategies can be developed based on results.
- Rail network safety and reliability will be improved.

## PROJECT PARTNERS

- Loram Maintenance of Way
- BNSF Railway
- CN Railway
- Amtrak

## COST & SCHEDULE

- Funding: $398,694
- Project Duration: September 2020 – June 2023

**Ballast Fouling Condition – Analysis Report**


U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Hugh B. Thompson, II • (202) 493-6383 • hugh.thompson@dot.gov

# Advancement of Continuous Welded Rail Management

## PROJECT DESCRIPTION

- Provide a well-diversified research portfolio to advance longitudinal rail force technologies and management.
- Advance longitudinal rail force measurement technologies by facilitating university and private industry testing of new equipment through in-situ rail neutral temperature (RNT) monitoring sites.
- Improve continuous welded rail (CWR) management practices in curves by investigating RNT behavior and refining break/cut management and movement control methods.
- Enhance rail break theory and CWR management guidelines for small gaps and low deltaT (RNT-Rail Temp) conditions.

## RAILROAD IMPACT

- Increase track buckling safety through improved CWR management practices.
- Provide more accurate input and parameters for rail break theory implementations.
- Provide RNT testing capabilities attractive for researchers, industry professionals, and universities nationwide.
- Support the development of measurement equipment for rail longitudinal force in a realistic environment.

## PROJECT PARTNERS

- ENSCO, Inc. (Lead)
- Kandrew, Inc.

## COST & SCHEDULE

- Funded: $200,000
- Additional funding options for out years: $600,000
- Project Duration: January 2025 – December 2028

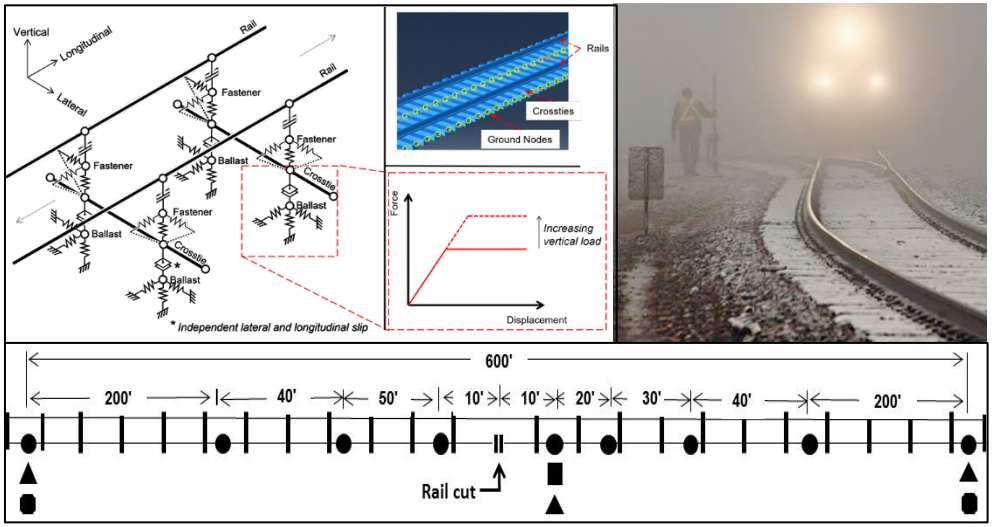


FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 999-0061 • robert.wilson@dot.gov

# Investigation of the Effects of Frozen Ballast on RNT Loss and RNT Remediation

## PROJECT DESCRIPTION

- Investigate rail neutral temperature (RNT) behavior in frozen ballast conditions.
- Improve the applicability of current rail break mechanics by determining the values of longitudinal rail restrain in frozen conditions.
- Conduct laboratory testing to determine parameters that quantify the capacity for frozen ballast.
- Update previously developed FRA 3D track model to account for frozen ballast conditions.
- Propose new recommended practices aimed at improving RNT management.




## RAILROAD IMPACT

- Proper consideration of frozen ballast conditions in future countermeasures developed to prevent and mitigate the potential for derailments in cold-weather regions
- New remediation strategies and RNT adjustment recommendations that account for the effects of frozen ballast and can be implemented into existing RNT management plans
- Improved understanding of rail break mechanics in cold weather conditions
- Decreased risk of track buckle derailments caused by improper RNT adjustments

## PROJECT PARTNERS

- ENSCO, Inc. (Lead)
- University of Illinois at Urbana-Champaign
- Kandrew, Inc.
- National Research Council Canada

## COST & SCHEDULE

- Funded: $499,958
- Project Duration: August 2023 – August 2025



FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 999-0061 • robert.wilson@dot.gov

# Technical Support for FRA Office of Railroad Safety

## PROJECT DESCRIPTION

- Assist the FRA Office of Research, Development, and Technology in conducting tests, detailed analyses, and technical reviews on behalf of the Office of Railroad Safety to ensure the safety of the U.S. railroad network.
- Efforts can include analyses to ensure appropriate and justifiable regulations as well as support for efforts focused on railway infrastructure, passenger safety, and freight accident prevention.
- Support the theoretical development of continuous welded rail (CWR) management methodologies and expand CWR training.


## RAILROAD IMPACT

- This task provides quick-response instrumentation, test, and analysis support to resolve safety-related problems and emergencies, determine causal factors, and reduce future problems.
- Support data-gathering for high-speed/high-cant deficiency qualification and revised safety standards reflecting sound science and engineering expertise.
- Facilitate ongoing technical evaluation required to demonstrate and deploy new technologies for improved safety and operational efficiency.
- Training material for CWR management developed under this task will serve as a resource for the rail industry.

## PROJECT PARTNERS

- ENSCO, Inc. (Lead)
- Kandrew, Inc.

## COST & SCHEDULE

- Funded: $150,000
- Optional Funding for out years: $450,000
- Project Duration: January 2025 – December 2028

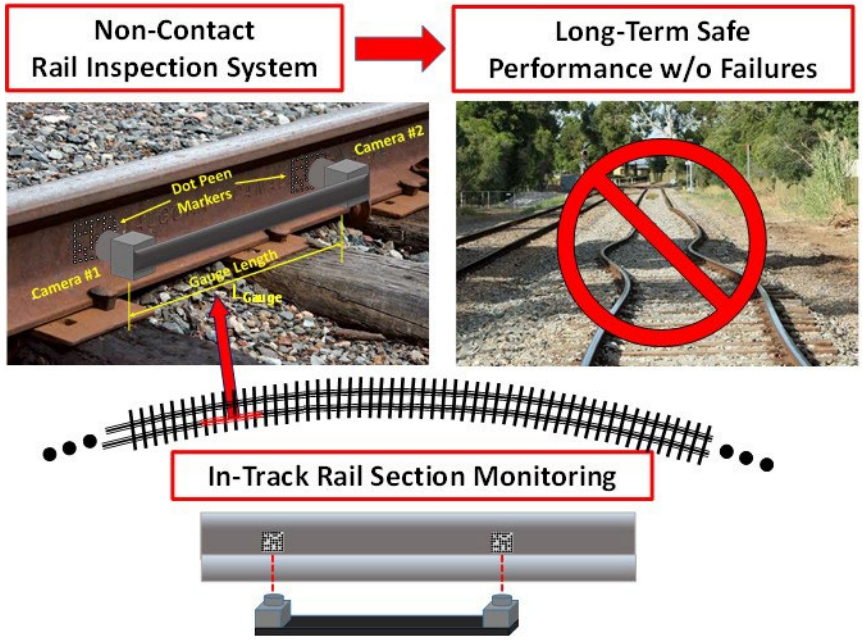


FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 999-0061 • robert.wilson@dot.gov

# In-Track Measurement of the State of Stress in Steel Rail

## PROJECT DESCRIPTION

- Use existing sensor technology (proven LSI system).
- Modify sensor to provide extended gage length and optimize for use on steel rail.
- Use dot peen “rail markings” as a tag for displacement (strain) measurements.
- Fabricate and calibrate the sensor.
- Design a special rail test frame to demonstrate the procedure and verify the accuracy of the test method.
- Fabricate the rail test frame.
- Conduct full-scale tests and troubleshoot errors.
- Conduct field tests in-track at BNSF Railway.
- Write and submit the final report.




## RAILROAD IMPACT

- Improve safety by reducing the risk of in-track failures due to breakage or buckling.
- Identify severe departures from rail neutral temperature.
- Enable railroads to predict the progressive and/or sudden failure of track structures.
- Application of the technology will be fully developed into a routine track inspection tool.
- Provide long-term capability to monitor the state of in-track rail stress and identify at-risk areas.

## PROJECT PARTNERS

- Kansas State University (Lead)
- BNSF Railway
- KSU Technology Development Institute (TDI)

## COST & SCHEDULE

- Funding, FY24: $306,154 (total for 2 years)
- Project Duration: August 2024 – August 2026

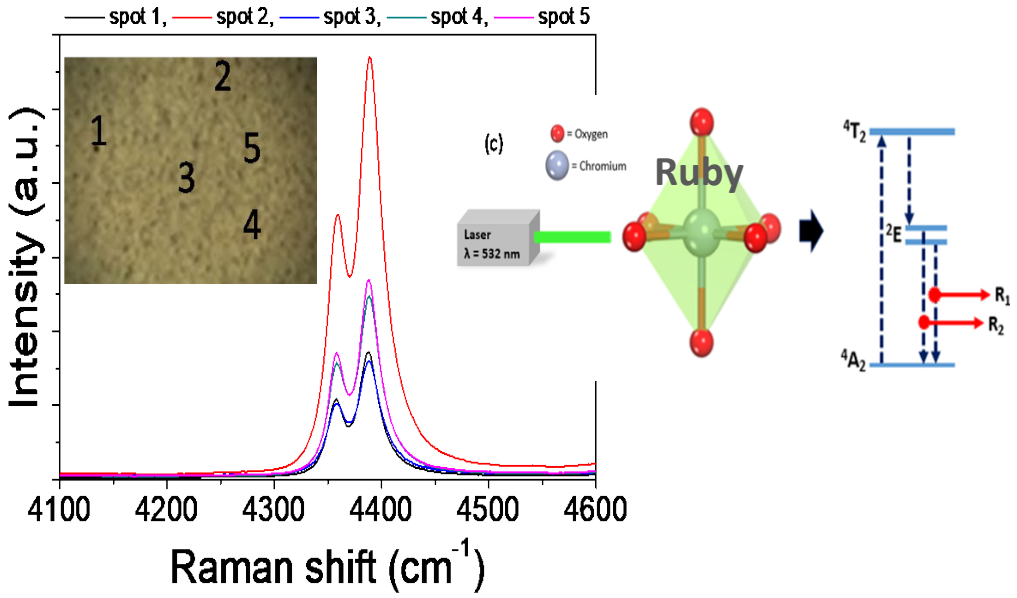


FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 999-0061 • robert.wilson@dot.gov

# Neutral Temperature Determination Using Reliable Pressure-Sensing Ceramics

## PROJECT DESCRIPTION

- Develop accurate, alumina-based, (e.g., ruby, sapphire) pressure-sensing ceramics.
- Determine residual stress buildup.
- Determine the rail's state of linear stresses.
- Correlation among temperature, stresses, and ruby resonant band's shift
- Machine learning algorithms




## RAILROAD IMPACT

- Improve safety through rail buckle and pull-apart prevention.
- Prevent catastrophic failure.
- More accurate slow orders.
- Better rail stress monitoring.

## PROJECT PARTNERS

- University of Houston (Lead)
- ENSCO, Inc.

## COST & SCHEDULE

- Funding: $95,751
- FY25 Optional Funding: $91,352
- Project Duration: 24 months

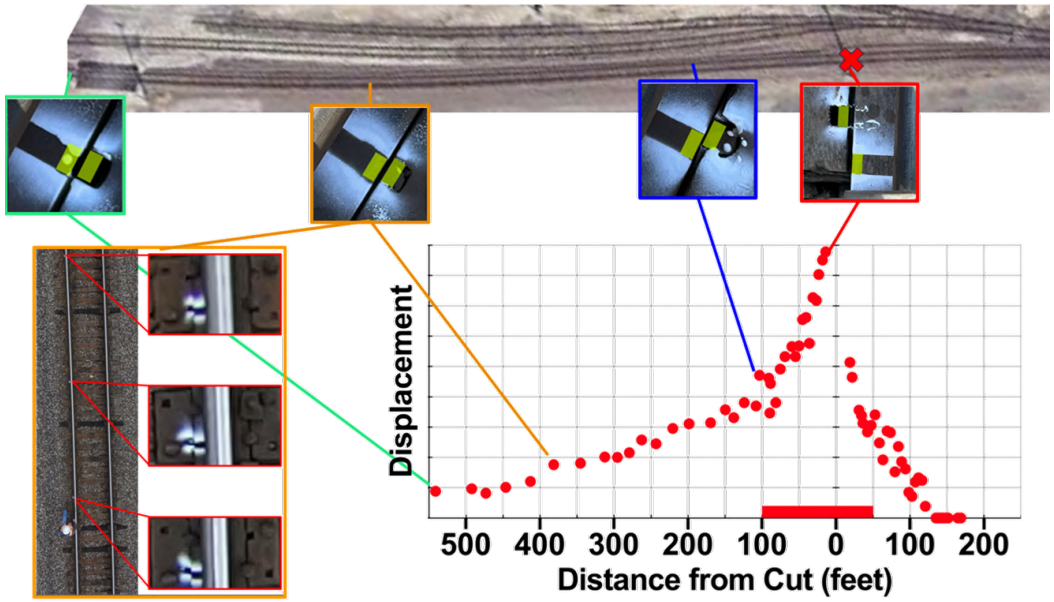


FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 999-0983 • robert.wilson@dot.gov

# Improving Rail Adjustment Procedures through Assessment of Longitudinal Rail Stress and Resistance at Critical Locations – Phase I

## PROJECT DESCRIPTION

- Provide quantitative assessment of variables influencing axial stress influence zones and guide future rail stress adjustment practices.
- Quantify how rail stress changes over time via monitoring differential rail displacement at:
  - Fixed structures
  - Cuts with variable de-anchoring lengths
- Use vision technologies to monitor rail infrastructure change to compare to rail stress changes over time.




## RAILROAD IMPACT

- Improve rail integrity and maintenance guidance for de-anchoring rail during rail destressing.
- Improve quantification of how rail gap size and influence zone are influenced by fixed structures.

## PROJECT PARTNERS

- University of Illinois at Urbana-Champaign (Lead)
- BNSF Railway
- CSX Transportation
- Union Pacific Railroad

## COST & SCHEDULE

- Funding: $245,000
- Project Duration: 18 months (2024 –2025)

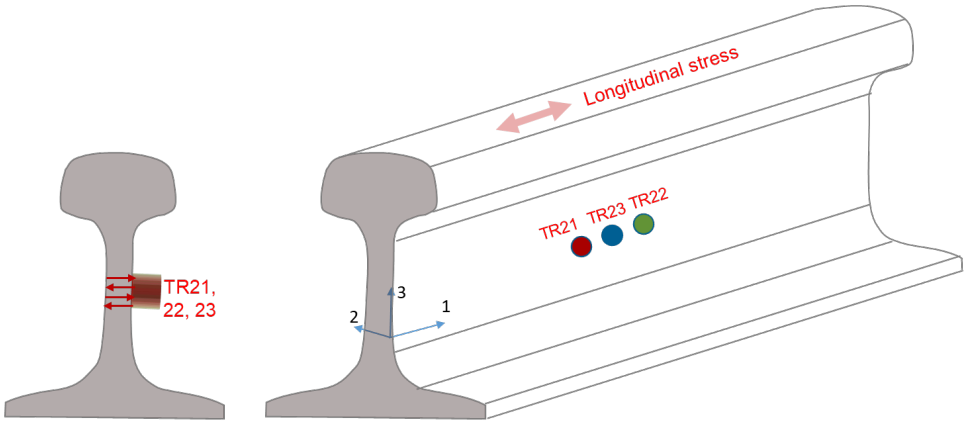
U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 999-0061 • robert.wilson@dot.gov

# Self-Referenced Ultrasonic System for Measuring Longitudinal Rail Stress

## PROJECT DESCRIPTION

- Develop a self-referenced ultrasonic testing system to measure longitudinal stress in rail based on acoustoelastic effect.
- Use shear wave velocity difference between V21 and V23 to evaluate longitudinal stress; V22 is the zero-stress reference.
- The temperature effect will be corrected for all measurements.
- Initial anisotropy due to residual stress will be evaluated in-situ using the thermal modulation method (change temperature).
- Phase I: Conduct a feasibility study in the laboratory.
- Phase II: Validate the concept at FRA's Transportation Technology Center, improve the accuracy and sensitivity, and develop a portable non-destructive evaluation system for field application.



Measure three wave velocities through web thickness

## RAILROAD IMPACT

- Measure longitudinal stress using a nondestructive test method without reference.
- Predict in-place rail neutral temperature without cutting the rail.
- Reduce derailment related to thermal stress-induced rail bucking or pull-apart failure.
- Increase safety through technological development.

## PROJECT PARTNERS

- University of Nebraska-Lincoln (C-STTAR member, Lead)
- ENSCO, Inc

## COST & SCHEDULE

- Funding to date: $164,953 (phase I)
- FY25 Funding Option: $157,811
- FY26 Funding Option: $ 166,600
- Project Duration: October 2024 – September 2025

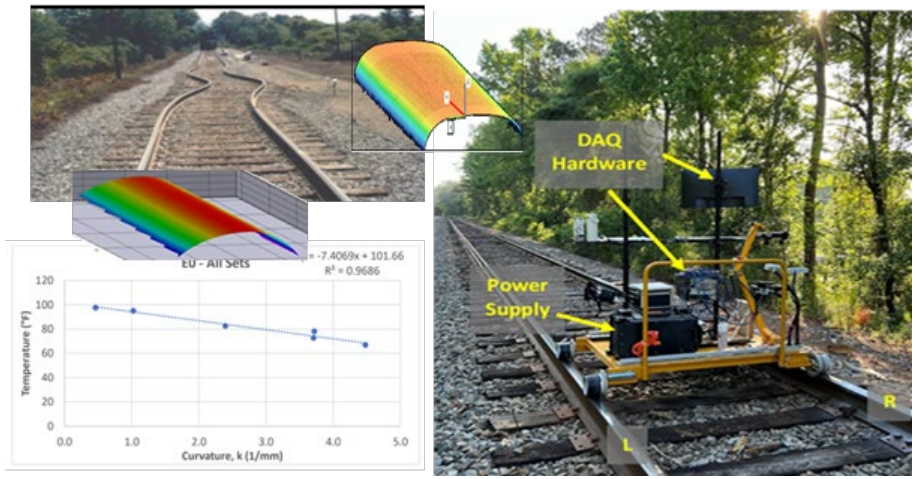
U.S. Department of Transportation
Federal Railroad Administration

PROJECT MANAGER: Robert Wilson, Ph.D. • 617-999-0061 • robert.wilson@dot.gov

# Qualification of a Mobile, Non-Contacting System for Rail Neutral Temperature and Longitudinal Rail Stress Measurements

## PROJECT DESCRIPTION

- Develop, deploy, test, and qualify the second-generation prototype system that implements a proven methodology and measurement system for estimating rail neutral temperature (RNT) and computing longitudinal stress.
- Develop new-generation hardware for a mobile, on-track system based on stereoDIC and/or 3D laser scanner technology. This hardware will enable full-field deformation measurements of rail, providing more accurate and comprehensive data.
- Develop new-generation software that implements the novel reference-free algorithm for RNT and stress calculations and enables automation within a graphical user interface environment.
- Thoroughly validate and qualify the system at FRA's Transportation Technology Center, instilling confidence in its reliability. Deploy, test, and demonstrate in the field under various track parameters and operating conditions and acquisition modes.




## RAILROAD IMPACT

- Improve safety through early detection of potential rail failure.
- Facilitate effective management of thermal stresses.
- In-situ, non-destructive, reference-free testing that does not disrupt service.
- Simple, easy-to-use, accurate, and cost-effective technology deployed routinely or on demand.
- Ability to integrate data with information acquired by other track-sensing technologies.

## PROJECT PARTNERS

- University of South Carolina (Lead)
- Correlated Solutions, Inc.
- CSX Transportation

## COST & SCHEDULE

- Funding, FY24: $193,026
- Optional Funding, FY25: $205,187
- Project Duration: September 2024 – September 2026

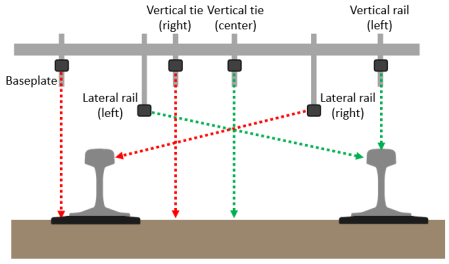
U.S. Department of Transportation
Federal Railroad Administration

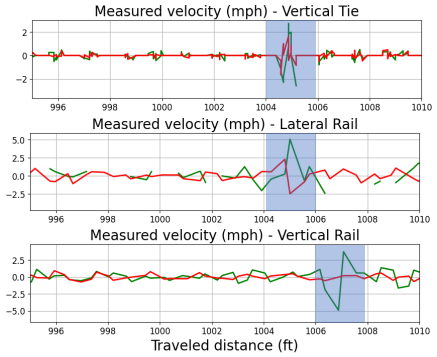
FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 999-0061 • robert.wilson@dot.gov

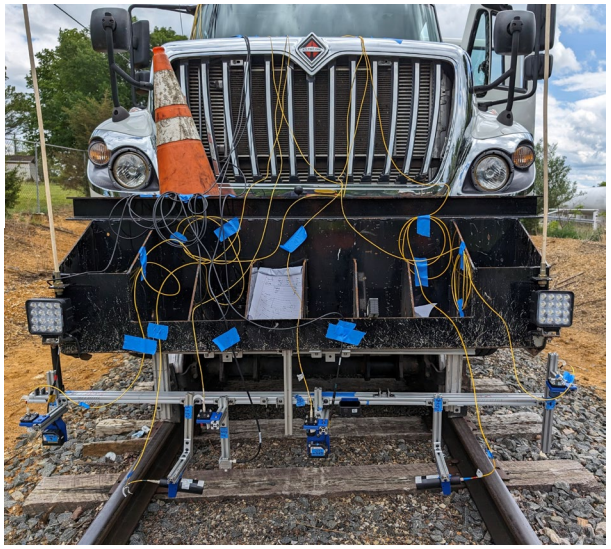
# Advanced Non-Contact Detection of Lateral Track Strength

## PROJECT DESCRIPTION

- Develop a proxy measurement for track lateral strength.
- Evaluate the applicability of non-contact Doppler LiDAR sensors for the detection of lateral track and crosstie motions/vibrations as they relate to rail movement and buckling under rolling wheel loads.
- Evaluate the applicability of noncontact sensors for in-situ detection of lateral track strength.
- Determine the effectiveness of Doppler LiDAR systems or similar non-contact sensors (eddy current, etc.)
- Develop advanced data analytics methods that can provide efficient, accurate, and autonomous post-processing means for the large volume of data resulting from revenue service and test track testing.
- Provide recommendations for the use of noncontact sensors for detecting weak or “soft” track.



## RAILROAD IMPACT

- Improve safety by preventing track buckle derailments.
- Provide improved systems for rail stability detection with significantly better timeliness than currently possible.
- Develop data analytics methods for semi/fully-automated processing of a large volume of data.
- Advance railroad operational safety and maintenance efficiency.
- Advance FRA and Class I railroads' ability to perform autonomous track inspection to determine lateral track strength beyond available methods.

## PROJECT PARTNERS

- Virginia Tech (Lead)
- Norfolk Southern
- LB Foster

## COST & SCHEDULE

- Funding, Year 1: $195,496
- Funding, Year 2: $204,495
- Project Duration: August 2022 – June 2025


U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Robert Wilson, Ph.D. • (617) 999-0061 • robert.wilson@dot.gov

# Advancement in Rail Integrity Inspection

## PROJECT DESCRIPTION

- Evaluate, maintain, and expand rail integrity efforts at FRA's Transportation Technology Center (TTC).
- Maintain and expand the Rail and Weld Flaw Library by manufacturing flaws in-house and collecting naturally occurring rail flaws (unbroken) from railroads.
- Support lending samples from the Rail and Weld Flaw Library to requestors for advancement of rail-flaw inspection technologies.
- Maintain and improve both the existing Rail Defect Testing Facility (RDTF) and the new High-Speed Rail Flaw Test Facility (HS-RFTF) at TTC that allow testing at speeds up to 80 mph.
- Build and maintain a world-class metallurgical laboratory at TTC.
- Conduct rail and weld testing using multiple tests tracks at TTC.
- Conduct modeling investigations including crack growth, among other factors.
- Support third-party rail integrity testing at TTC.


## RAILROAD IMPACT

- Improve reliability of NDE techniques for rail and weld flaw detection and characterization.
- Provide industry with a safe, controlled, and realistic environment for developing and evaluating innovative rail and weld flaw inspection technologies.
- Support ground-breaking research aimed at improving rail and weld flaw inspection.
- Advance rail integrity and metallurgical research capabilities at TTC.
- Reduce broken rail and weld derailments through better rail/weld performance, flaw detection, and operating practices.

## PROJECT PARTNERS

- ENSCO, Inc.
- North American Class I and Shortline/Regional Railroads

## COST & SCHEDULE

- Phase 1 Funding: $ 179,994
- Phase 1 Duration: August 2024 – September 2025

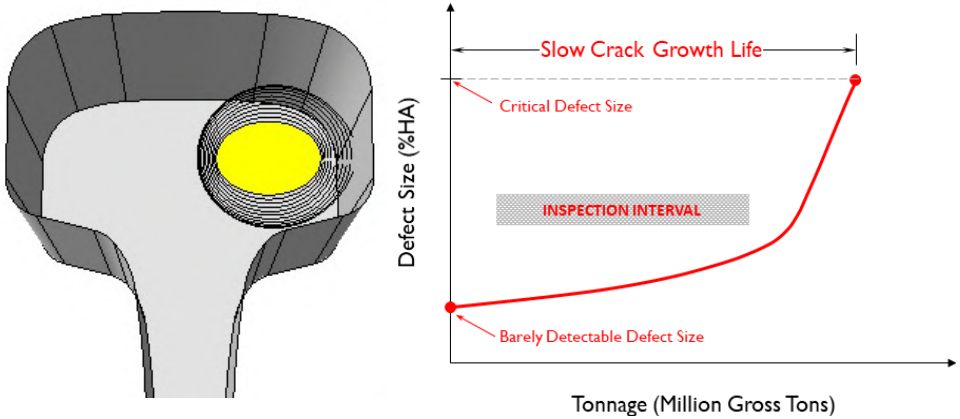
U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Megan Brice • (719) 601-7964 • megan.brice@dot.gov

# Upgrade of the Analytical Detail Fracture Model

## PROJECT DESCRIPTION

- Develop an upgraded detail fracture model based on the methodology of finite element-based solution.
- Identify assumptions applied which negatively impact accuracy of current model.
- Develop new finite element-based solution (removing requirement for simplifications) to provide accurate stress intensities and fatigue life predictions.
- Develop an embedded finite element-based solution, considering a range of representative rail profiles and crack sizes in discrete locations in the railhead.




**Detail Fracture Growth Simulation**

## RAILROAD IMPACT

- Improved rail safety through more accurate prediction of safe inspection interval for modern rail.
- Development of a new embedded finite element-based solution to accurately calculate the remaining life of rail which may be applied to any flaw detection research.

## PROJECT PARTNERS

- Thornton Tomasetti
- Dr. David Jeong (Independent Consultant)
- Harvard University

## COST & SCHEDULE

- Phase 1 Funding: $ 225,000
- Phase 1 Duration: August 2024 – July 2025

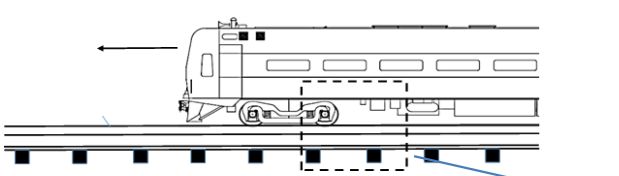


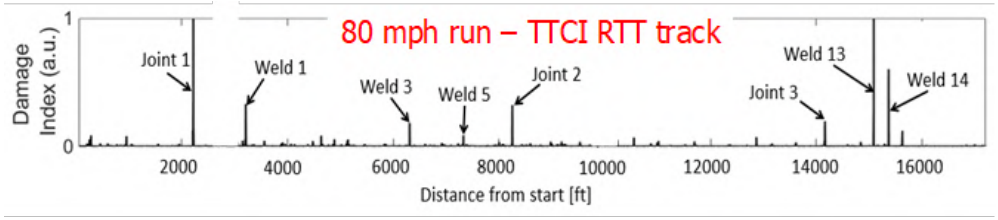
FRA PROJECT MANAGER: Megan Brice • (719) 601-7964 • megan.brice@dot.gov

# Non-Contact Rail Inspection at Track Speed

## PROJECT DESCRIPTION

- Develop a next-generation non-contact system for rail inspection at track speed.
- Develop technology that uses lower ultrasonic frequencies (~kHz instead of ~MHz) to inspect defects under rail surface shelling.
- Analyze data from previous field tests conducted at speeds up to 40 mph at the Transportation Technology Center.
- Optimize the system aspects such as mounting the sensing head underneath the car, cabling, electrical power, and data collection and storage.
- Conduct in-track testing of the prototype hardware and software on Class I railroad track.




## RAILROAD IMPACT

- Minimize traffic disruptions and maximize probability of detection by using the redundancy of multiple tests over the same track and detecting internal rail flaws at track speed.
- Reduce derailments by detecting rail flaws such as detail fractures, transverse fissure and vertical split heads that are responsible for train accidents and high damage cost.
- Improve the defect detection capability over current roller search units to improve safety and efficiency of rail transportation.

## PROJECT PARTNERS

- University of California, San Diego
- San Diego State University
- BNSF Railway

## COST & SCHEDULE

- Phase 1 Funding: $223,936
- Phase 1 Project Duration: June 2024 – May 2025

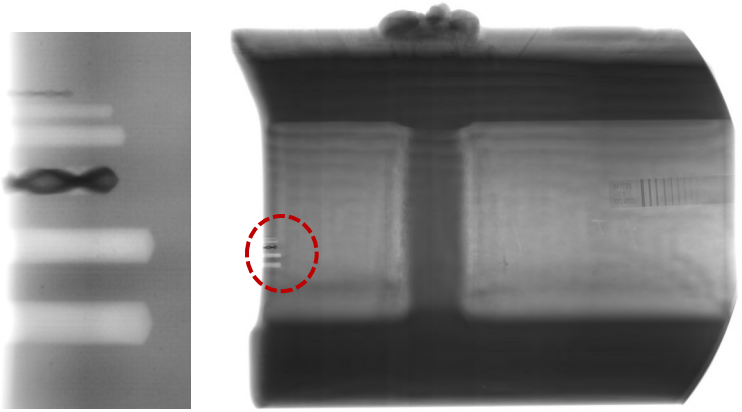


FRA PROJECT MANAGER: Megan Brice • (719) 601-7964 • megan.brice@dot.gov

# Radiographic Inspection of Rail Welds

## PROJECT DESCRIPTION

- Apply cutting-edge x-ray source detection technologies to detect voids and solid impurity flaw nucleation sites within rail welds.
- Determine the optimal imaging perspective methods of rail weld inspection using an x-ray source.
- Determine the smallest resolvable flaws and features and imaging processing methods to enhance flaw detection.
- Create a database of rail weld images for data-driven regulatory guidance of weld inspection.
- Construct a non-contact radiographic rail weld inspection system that can be deployed from a hi-rail truck.



**Processed radiograph a flash-butt with a zoomed-in view (left) highlighting the machined holes to represent flaws with diameters of 0.5 mm (tungsten impurity), 1 mm, 1.5 mm, 2 mm, 2.5 mm, and 3 mm (top to bottom)**

**Experimental setup featuring the Comet mesofocus 450 kV X-ray source**

## RAILROAD IMPACT

- Forge a path for radiographic inspection of rail welds.
- Reduce rail weld failures and improve infrastructure by performing robust radiographic, non-destructive testing on rail welds.
- Reduce human error in weld inspection using a real-time artificial intelligence to analyze the data, immediately pass or fail the weld, and provide annotated feedback.

## PROJECT PARTNERS

- University of Tennessee, Knoxville

## COST & SCHEDULE

- Phase 1 Duration: September 2022 – September 2023
- Phase 1 Funding: $ 246,995
- Phase 2 Duration: September 2023 – March 2024
- Phase 2 Funding : $137,821

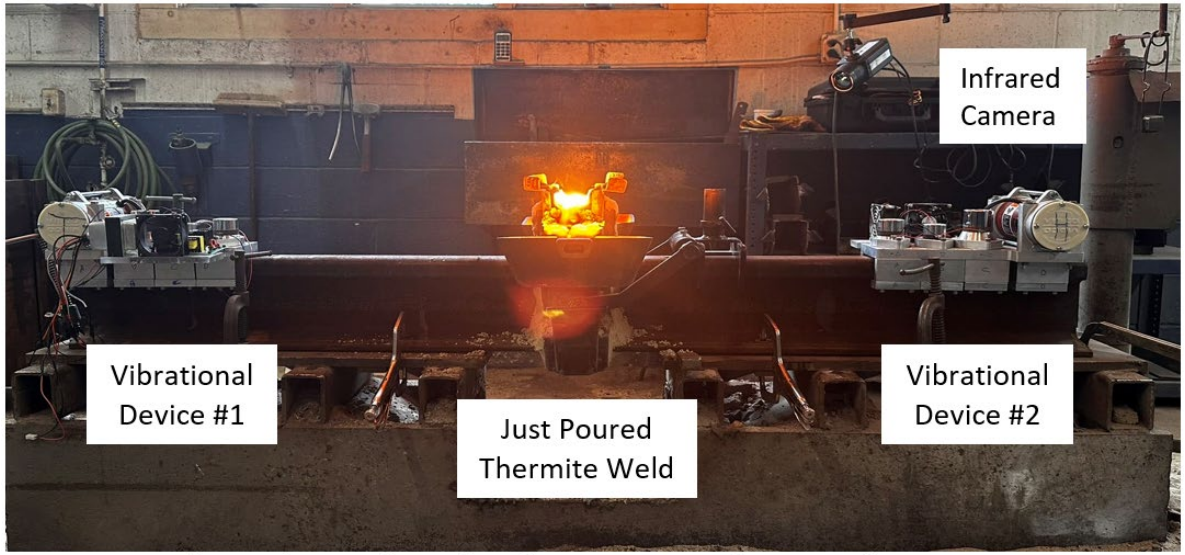


FRA PROJECT MANAGER: Megan Brice • (719) 601-7964 • megan.brice@dot.gov

# An In-Track Apparatus to Improve Thermite Weld and Rail Integrity

## PROJECT DESCRIPTION

- Construct an instrumented vibration system for an optimized and semiautomated apparatus to treat thermite welds.
- Determine the optimized conditions for test welds to be cast and treated to demonstrate repeatability and reproducibility.
- Determine tensile, fatigue, fracture toughness, and wear properties of the improved thermite welds under laboratory conditions.
- Develop improved thermite welds by minimizing porosity and reducing grain size.




**Experimental setup featuring the Comet mesofocus 450 kV X-ray source**

## RAILROAD IMPACT

- Extend rail life and improve track safety through enhancement of thermite weld strength and fatigue.
- Reduce the negative effects associated with a weld's heat-affected zone.
- Decrease track time delays and costs with an in-track weld treatment device made for easy implementation.

## PROJECT PARTNERS

- University of Houston
- Orgo-Thermit, Inc.
- Union Pacific Railroad

## COST & SCHEDULE

- Phase 1 Duration: September 2022 – September 2023
- Phase 1 Funding: $ 202,114
- Phase 2 Duration: September 2023 – September 2024
- Phase 2 Funding : $182,933
- Phase 3 Duration: September 2024 – September 2025
- Phase 3 Funding : $153,405



FRA PROJECT MANAGER: Megan Brice • (719) 601-7964 • megan.brice@dot.gov

# Experimental Evaluation of Wheel/Rail Contact, Third Body Layer, and Surface Finish on Risk of Derailment (Phase III)

## PROJECT DESCRIPTION

- Extend the studies performed by VT/FRA in Phase I and II to better understand the fundamentals of wheel-rail contact mechanics and dynamics.
- Evaluate additive agents that influence the wheel-rail traction by either decreasing (e.g., leaf residue and flange grease) or increasing (e.g., aluminum and iron oxides) traction for better on-demand management of motive and braking power.
- Evaluate the effect of wheel flanging on wheel-rail contact profile and pressure distribution.
- Evaluate the effect of wheel flange contact on longitudinal and lateral traction under various two-point and conformal contact conditions.

## RAILROAD IMPACT

- Understand the complex mechanics and dynamics that occur at the wheel-rail interface is critical to improve railway operational safety and efficiency.
- Scientifically evaluate additive agents that affect contact forces, traction, and wheel-rail wear that cannot be evaluated accurately in the field due to the naturally-varied conditions.
- Provide a better understanding of wheel-rail flange contact that can significantly increase wheel-rail wear and affect railroad safety.
- Provide a guideline to industry practitioners for improving rail safety and cost efficiency.

## PROJECT PARTNERS

- Virginia Tech
- Standard Steel, LLC

## COST & SCHEDULE

- Funding FY22–23: $499,518
- Project Duration: September 2022 – December 2024

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Alexandra D'Andrea • (202) 578-6218 • alexandra.dandrea@dot.gov

# Ground Hazard Database and Warning System

## PROJECT DESCRIPTION

- Create an advanced ground hazard database.
- Populate the database using trackbed surveys, remote sensing data, and various imagery (e.g., LiDAR, thermal, optical, moisture, etc.)
- Real-time hazard warning system for settlement.
- Final deliverables: user-friendly ground hazard database and real-time change detection system for ground hazards with traffic light alert levels to categorize changes on revenue service corridors.

## RAILROAD IMPACT

- Easier, quicker, and more reliable means for assessing ground hazards, such as slides or washouts, instead of human inspection to remote areas.
- Increased safety, reliability, and revenue due to less disruption of service.
- New ground hazard database to allow real-time monitoring.

## PROJECT PARTNERS

- University of Illinois at Urbana-Champaign
- Sixense, Inc.
- BNSF Railway

## COST & SCHEDULE

- Funding, FY21: $485,336
- Project Duration: September 2021 – September 2025



FRA PROJECT MANAGER: Alexandra D'Andrea • (202) 578-6218 • alexandra.dandrea@dot.gov

# Vehicle-Track Interaction Testing, Modeling, and Analyses: Development of Model Parameters

## PROJECT DESCRIPTION

- Develop a general procedure for gathering parameters for the vehicles and trucks to create validated simulation models.
- Perform tests and evaluation to measure parameters needed for modeling the selected railroad vehicles.
- The first vehicle to be modeled and evaluated under this effort is a box car.
- Use the Rail Dynamic Lab (RDL) and different tracks at the Transportation Technology Center to perform characterization tests and develop box car vehicle model in VAMPIRE.

## RAILROAD IMPACT

- Mitigate potential for derailment risk or other vehicle dynamic issues that compromise railroad safety.
- Improve the understanding and modeling of the dynamic interaction between the train and the railroad track.
- Provide validated models of different equipment or components being used in railroad operations.
- Enable simulations to establish geometry standards, assess vehicle responses to different situations, perform derailment investigations, or evaluate performance-based track geometry standards.

## PROJECT PARTNER

- ENSCO, Inc.

## COST & SCHEDULE

- Funding, FY23: Phase I – $691,889
- Funding, FY25: Phase II – $975,083 (Option)
- Project Duration: July 2023 – December 2025

U.S. Department of Transportation
Federal Railroad Administration

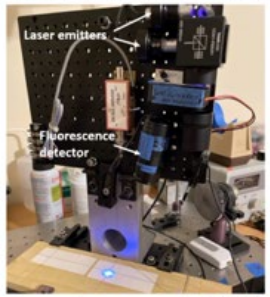
FRA PROJECT MANAGER: Alexandra D'Andrea • (202) 578-6218 • alexandra.dandrea@dot.gov

# Non-Contact Detection and Evaluation of Rail Gage-Face Lubricant Using Optical Sensing Methods

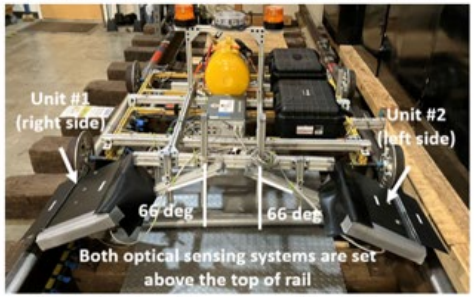
## PROJECT DESCRIPTION

- Design and develop non-contact sensing devices that use laser-induced fluorescence to identify the state of gage-face lubrication.
- Develop an easily-deployable onboard optical system for use in revenue service.
- Determine the efficacy of the system through extensive testing, first in the lab and then in the field.
- Provide recommendations on whether the sensing devices can effectively be deployed in revenue service for gage-face lubrication detection.

Optical sensing device development

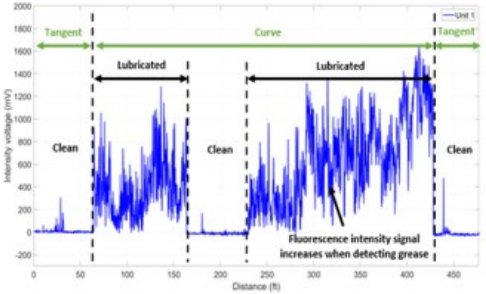



Rail-cart-mounted grease detection system




Optical sensing system in Field testing


Intensity signal increases when detecting




## RAILROAD IMPACT

- Provide a reliable solution for effectively detecting the presence and adequacy of gage-face lubricants.
- Advance maintenance of way practices and improve rail operation safety and efficiency.
- Provide cost saving by reducing wheel/rail wear and reducing derailments in curves.

## PROJECT PARTNERS

- Virginia Tech
- Norfolk Southern Railway

## COST & SCHEDULE

- Funding, FY22–23: $373,186
- Project Duration: September 2022 – December 2024

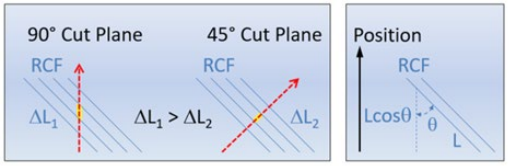


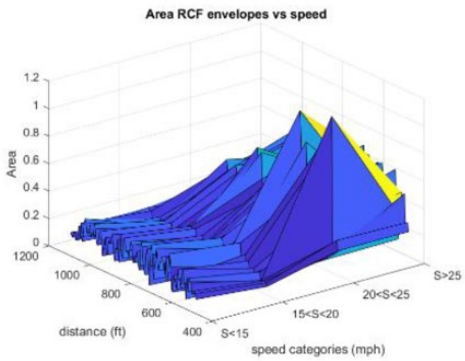
FRA PROJECT MANAGER: Alexandra D'Andrea • (202) 578-6218 • alexandra.dandrea@dot.gov

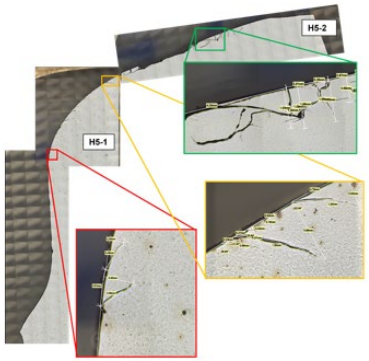
# Wheel/Rail Interface Research and Investigation with National Research Council Canada

## PROJECT DESCRIPTION

- Extend the previous research performed by NRC and the International Collaborative Research Initiative examining rolling contact fatigue and rail wear.
- Conduct research in areas of vehicle-track interaction, rolling contact fatigue (RCF), and rail integrity.
- Improve upon an “RCF matrix,” quantifying rail running surface fatigue damage as a function of rail type and position in track, tonnage accumulation, traffic condition, and other environmental and maintenance conditions rails are subjected to during their life cycle.
- Field testing and analysis on commuter railroad rail wear.




## RAILROAD IMPACT

- Understand relationships between visible surface damage and depth of damage.
- Understand surface damage and risk, particularly with respect to ultrasonic testing and service failures.
- Understand wear and RCF relationships that account for loading environment, curvature, type of steel and friction conditions.
- Improve models including well-characterized loading environment to well-characterized track to predict wear and RCF.
- Simulation results to provide a guidance to industry practitioners for improving rail safety.

## PROJECT PARTNER

- National Research Council Canada

## COST & SCHEDULE

- Funding FY24: $300,000 (Unfunded options $450,000)
- Project Duration: September 2024 – September 2029

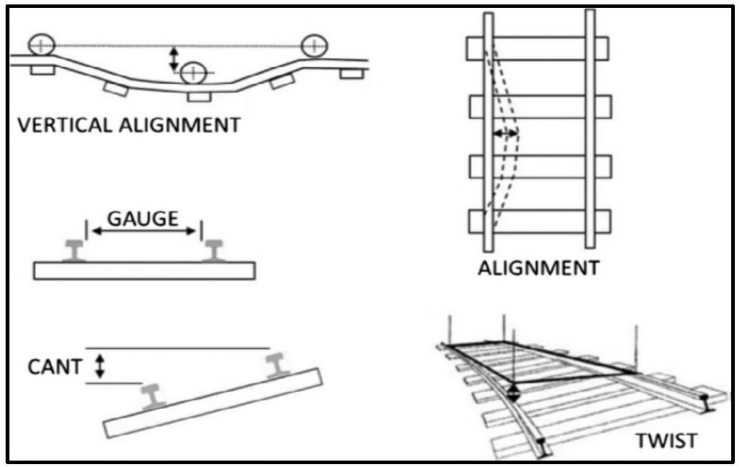


FRA PROJECT MANAGER: Alexandra D'Andrea • (202) 578-6218 • alexandra.dandrea@dot.gov

# Probabilistic Modeling of Track-Caused Derailment Risk for Rail Safety Improvement

## PROJECT DESCRIPTION

- Develop probabilistic models of derailment risk due to track conditions and defects.
- Conduct controlled experiments to determine probability of detection of different inspection methods.
- Analyze human factors in manual inspection and develop causal models.
- Analyze and mitigate derailment risk through adjusted inspection frequency and combined human and automated inspections.


## RAILROAD IMPACT

- Provide an analysis framework and probabilistic models that can quantify derailment risk due to specific track condition and geometry defect.
- Minimize safety risk through combined manual and automated inspection and optimized inspection frequency.

## PROJECT PARTNERS

- Rutgers University (Lead)
- Stony Brook University
- University of Maryland
- ENSCO, Inc.

## COST & SCHEDULE

- Funding: $527,534
- Project Duration: September 2024 – September 2027

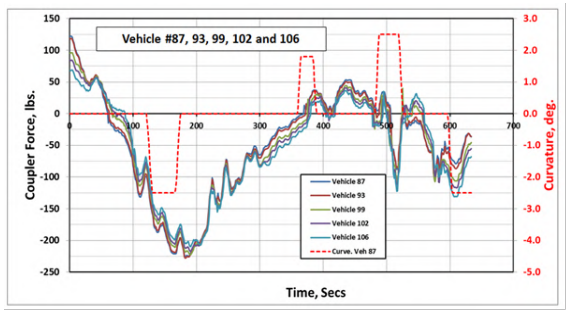


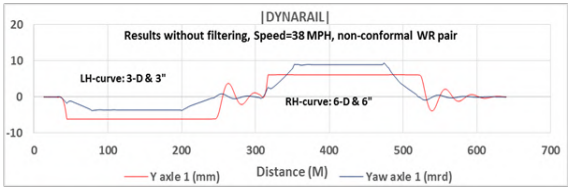
FRA PROJECT MANAGER: Abe Meddah • (719) 585-1809 • abderrahmane.meddah@dot.gov

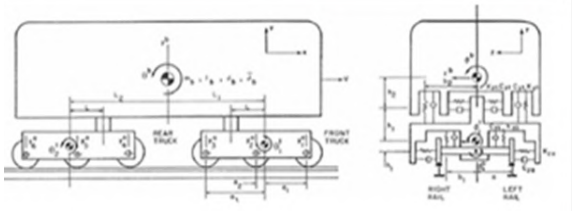
# Track/Train Dynamic Simulations of Multi-Vehicle Consist

## PROJECT DESCRIPTION

- This project will improve the state-of-the-art in computer modeling capabilities and practices of simulating train/track interactions using the railway specialized dynamics approach.
- Analytic development will include the links between the traditional railway vehicle dynamics and longitudinal train action models for simulations of train/track systems, capturing the effects of general tracks layouts, geometry defects and wheel and rail profiles.
- The simulation methodology will allow for the more accurate assessment of train and vehicle dynamics, leading to a better understanding of adverse wheel-rail and in-train forces, which can result in derailments.




## PROJECT PARTNER

- Sharma & Associates, Inc.

## RAILROAD IMPACT

- Comprehensive train derailment simulation capabilities.
- Improved vehicle dynamics and longitudinal train dynamics interaction.
- Improved simulation practices in train/track dynamics studies and derailment investigation.
- Reduced risk of train accidents and derailments.

## COST & SCHEDULE

- Funding: $300,000
- Project Duration: July 2024 – January 2026



FRA PROJECT MANAGER: Abe Meddah • (719) 585-1809• abderrahmane.meddah@dot.gov

# Friction Modifier Modelling: Development and Implementation

## PROJECT DESCRIPTION

- Enhance the current top-of-rail (TOR) product creep force model to improve its capability and implement it in a multi-body dynamics (MBD) environment.
  - Extend the model capabilities and accuracy.
  - Conduct relevant tribological testing.
  - Identify various modelling scenarios.
  - Implement model in MBD environment (SIMPACK).
  - Model identified operational scenarios.

## RAILROAD IMPACT

- With the integration of the model into vehicle-track interaction simulations, create a tool that can help define TOR product choice and application protocols.
- More accurate force prediction that will improve vehicle dynamics, wear, and rolling contact fatigue assessments.
- Provide more useful information to help with creating the business case for TOR product selection and application.

## PROJECT PARTNERS

- University of Sheffield
- Virtual Vehicle Research, GmbH

## COST & SCHEDULE

- Funding: $293,133
- Project Duration: September 2024 – March 2026

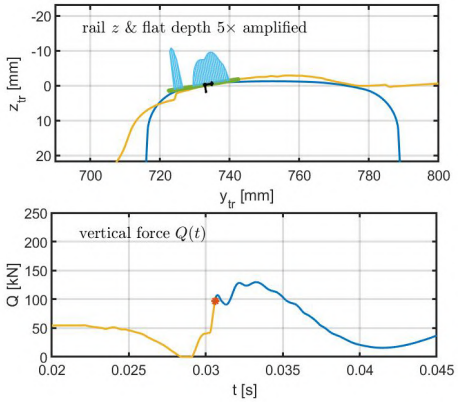


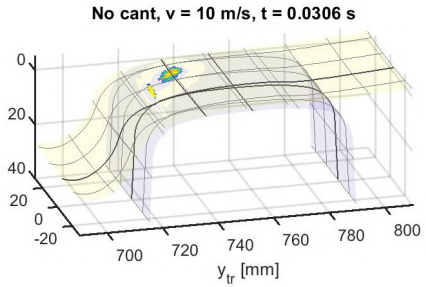
FRA PROJECT MANAGER: Abe Meddah • (719) 585-1809 • abderrahmane.meddah@dot.gov

# Detailed Wheel-Rail Contact Geometry for 3D Profile Deviations

## PROJECT DESCRIPTION

- Simulate effects of wheels and rail defects (flats, out-of-roundness, and corrugation).
- Develop detailed 3D analysis of contact stresses including transient rolling.
- Demonstrate this for cases with wheel flat in dynamic simulation.
- Open-source, plug-in accessible for stakeholders.




## RAILROAD IMPACT

- Investigate peak stresses associated with damaged wheels and rails.
- Understand economic consequences and mitigate safety concerns.

Extreme wheel flat

## PROJECT PARTNERS

- Vtech CMCC
- Vehicle Dynamics Group, LLC
- AtkinsRealis
- MxV Rail

## COST & SCHEDULE

- Funding: $199,100
- Project duration: August 2022 – September 2024

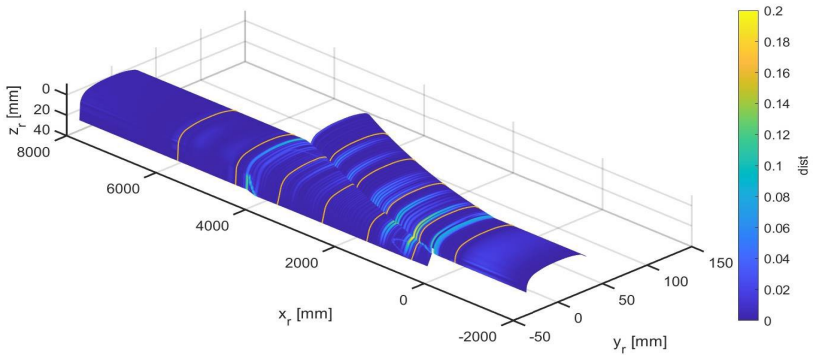


FRA PROJECT MANAGER: Abe Meddah • (719) 585-1809 • abderrahmane.meddah@dot.gov

# Detailed Wheel-Rail Contact Geometry for 3D Special Trackwork

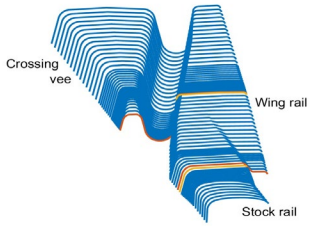
## PROJECT DESCRIPTION

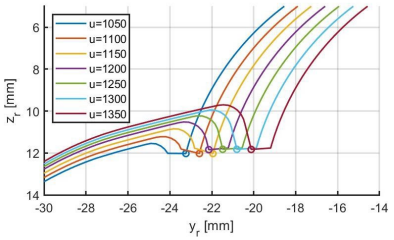
- Simulate vehicle-track interaction (VTI) on rails with longitudinal profile variation (switches and crossings (S&C), turnouts, and guard rails).
- Develop smooth interpolation and 3D analysis of contact location, including near-vertical contacts.
- Demonstrate this for the recent S&C benchmark problem.




## RAILROAD IMPACT

- Demonstrate VTI with detailed, 3D contact solution for special trackwork.
- Permit derailment investigation for trying configurations.
- Optimize layout of S&C using detailed numerical simulation.




## PROJECT PARTNERS

- Vtech CMCC
- Vehicle Dynamics Group, LLC
- AtkinsRealis
- MxV Rail

## COST & SCHEDULE

- Funding: $198,300
- Project Duration: June 2022 – August 2024.




FRA PROJECT MANAGER: Abe Meddah • (719) 585-1809 • abderrahmane.meddah@dot.gov

# Evaluation of Potential Risk for Track-Caused Derailments Using Markov Chain Probabilistic Modeling

## PROJECT DESCRIPTION

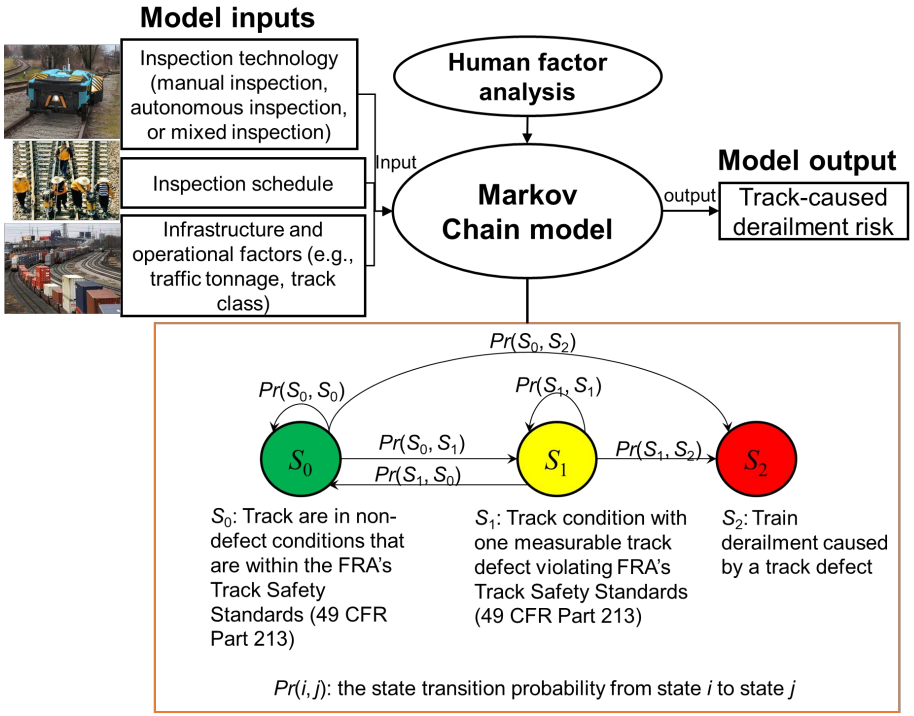
- Perform a comprehensive analysis of human factors to estimate the effectiveness of manual inspections of track defects.
- Develop a Markov chain-based probabilistic modeling framework for evaluating the potential risk of track-caused train derailments.
- Collect data on track-caused train derailments, inspection schedules, traffic patterns, track class, and other pertinent factors.
- Develop a risk calculator that implements the proposed probabilistic model.

## RAILROAD IMPACT

- Innovative tool designed to accurately assess track-caused derailment risks and enhance the safety and efficiency of the railroad operations.
- Support safety improvement initiatives and regulatory decisions regarding railroad operations.

## PROJECT PARTNER

- University of Houston




## COST & SCHEDULE

- Funding:
  - Phase I: FY24–25: $151,988
  - Phase II (Optional): FY25–26: $189,540
- Project Duration (Phase I): August 2024 – August 2025


U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Abe Meddah • (719) 585-1809 • abderrahmane.meddah@dot.gov

# Field Testing Support at the FRA Transportation Technology Center

## PROJECT DESCRIPTION

- Provide multiple university- and third-party-led research initiatives with on-site testing services and equipment at FRA's Transportation Technology Center (TTC) to support technology evaluation in a real-world setting.
- Recent activities under this task:
  - 3D track imaging to characterize track structures and identify missing components
  - Automated characterization of the severity of rolling contact fatigue on rail
- Upcoming testing activities:
  - Field validation of machine-vision algorithms designed to detect defective/missing track fasteners
  - Laboratory characterization of primary and secondary spring sets for vehicle-qualification modeling


## RAILROAD IMPACT

- Provide support for controlled testing at TTC, including opportunities for evaluation in a real-world environment, for new and emerging technologies.
- Develop critical prototype hardware/software for advanced rail inspection technology.
- Focus on the development and evaluation of advanced inspection technologies under revenue-service-like conditions.
- Support field testing efforts included in FRA R&D tasks.

## PROJECT PARTNERS

- ENSCO, Inc.
- Northern Plains Railroad Services
- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding: $298,924
- Project Duration: October 2022 – September 2025



FRA PROJECT MANAGER: Jay Baillargeon • (719) 584-7155 • jay.baillargeon@dot.gov

# Vibration Test Unit Modifications for Track Geometry Measurement Systems Validation

## PROJECT DESCRIPTION

- Assess the current state of the art regarding systems capable of mimicking dynamically-changing physical conditions for laser-based measurements.
- Conduct a feasibility study and a preliminary design for a complementary system that can be integrated into the Vibration Test Unit to accommodate track geometry measurement validation efforts at the Transportation Technology Center (TTC).
- Develop a 3D CAD model to illustrate the conceptual design.
- Develop engineering estimates for final design and construction.

## RAILROAD IMPACT

- Support the validation and technological improvement of track geometry systems to facilitate more effective track inspections.
- Provide a concept design for a laboratory-based mechanism to test and validate track geometry measurement systems.
- Advance the research capabilities at TTC in area of track geometry measurement system accuracy and reproducibility to complement the High-Speed Adjustable Perturbation Slab Track.

## PROJECT PARTNER

- ENSCO, Inc.

## COST & SCHEDULE

- Funding: $288,522
- Project Duration: 12 months



FRA PROJECT MANAGER: Jay Baillargeon • (719) 584-7155 • jay.baillargeon@dot.gov

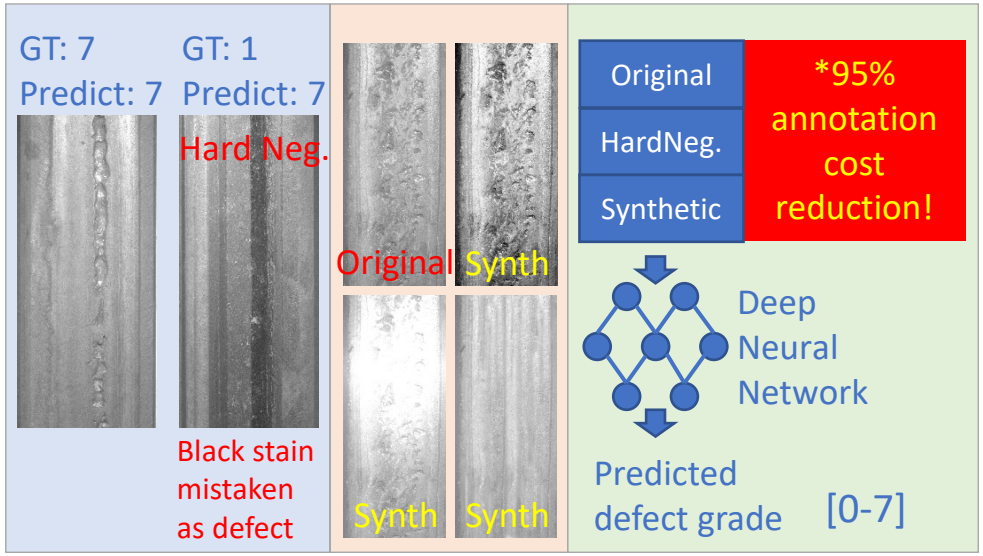
# Deep Learning for Large-Scale Rail Defect Inspection

## PROJECT DESCRIPTION

- Develop a fully automated framework for rail surface defect classification using deep-learning techniques.
- Leverage existing rail imagery to build a generative model to synthesize realistic surface defects in the absence of sufficient training images.
- Detect out-of-distribution or "unexpected" imagery (e.g., multiple tracks or joints) to enhance the reliability of automated inspection results.
- Evaluate the resultant framework in a large-scale field test in conjunction with industry partners.

## RAILROAD IMPACT

- Reduce surface-generated rail failures and, in turn, improve safety for both passenger and freight systems.
- Support unbiased and comprehensive rail maintenance planning programs, leading to improved rail life and reduction in network disruptions due to maintenance.
- Reduce data annotation costs (up to 5% of manual annotation) for intelligence-based monitoring applications.
- Rapidly evaluate rail surface imagery, enabling large-scale defect inspection and reduced response time for maintenance events.




## PROJECT PARTNERS

- Stony Brook University
- KLD Labs, Inc.
- CSX Transportation

## COST & SCHEDULE

- Funding: $458,824
- Project Duration: September 2021 – December 2024

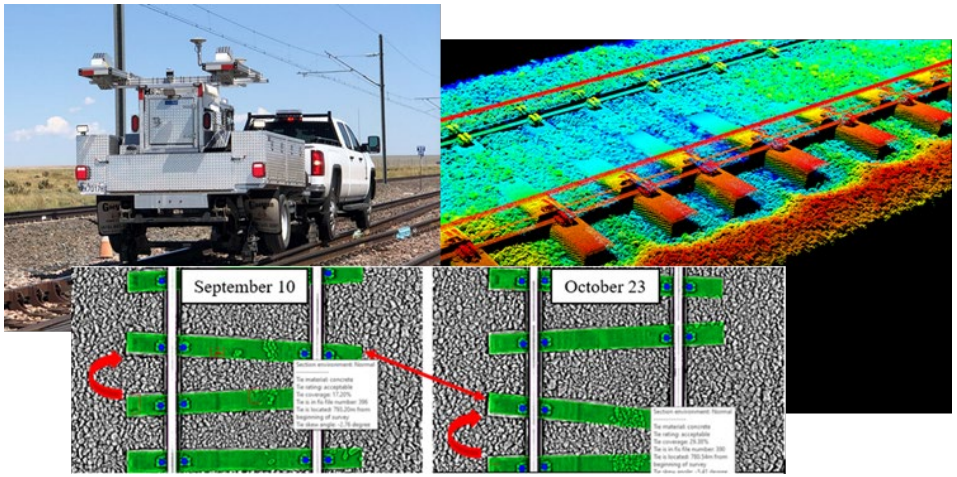


FRA PROJECT MANAGER: Jay Baillargeon • (719) 584-7155 • jay.baillargeon@dot.gov

# Automated Track Change Detection (ATCD)

## PROJECT DESCRIPTION

- Develop and demonstrate new technology to augment human track inspection activities.
- Adapt commercially available 3D scanning sensors and artificial intelligence technologies to identify and classify track features and to compare the changes in these features over time.
- Understanding how track conditions change in response to loads provides valuable insight into track degradation rates and maintenance effectiveness.




## RAILROAD IMPACT

- Comprehensive track feature detection and classification employing 3D laser/camera system
- Automated track inspection technology at a high detail level, suitable for component inventory, change detection, and higher analytics
- Technology to augment human inspection requirements producing highly reliable safety information with actionable resolution
- Advances technology-augmented human inspection capabilities to yield improved track condition awareness and safety.

## PROJECT PARTNERS

- University of Illinois at Urbana-Champaign
- Railmetrics
- CSX Rail
- Florida East Coast Railway
- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding: $623,583
- Project Duration: September 2023 – December 2025

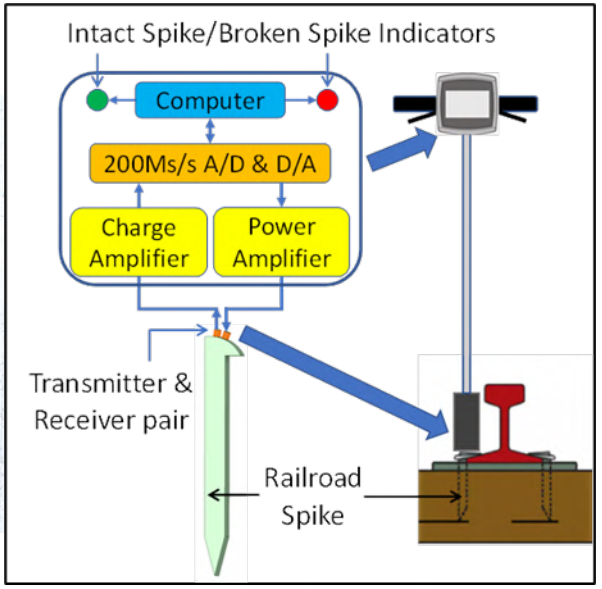


FRA PROJECT MANAGER: Cameron Stuart • (202) 306-5326 • cameron.stuart@dot.gov

# Handheld Broken Spike Detection

## PROJECT DESCRIPTION

Spike failures are identified as the root causes of recent derailments. FRA research has identified spike failures in wood ties with elastic fastening systems resulting from overloading conditions. The industry lacks an effective and efficient method to detect cracked or failed spikes in track. This project develops a handheld system for automated broken spike detection in timber track using resonant ultrasound spectroscopy.




## RAILROAD IMPACT

- Improved technology to identify track locations with failed spikes.
- Quantitative, repeatable measurement of spike condition.
- Provides inspection reliability — a key consideration in the safety and operations of railroads.
- Increases safety by using technology to increase spike testing speed.
- Improves rail preventative maintenance and condition-based maintenance.

## PROJECT PARTNER

- Transportation Technology Transfer, Inc.

## COST & SCHEDULE

- Phase 1 funding: $244,062
- Project Duration: May 2024 – May 2025



FRA PROJECT MANAGER: Cameron Stuart • (202) 306-5326 • cameron.stuart@dot.gov

# Autonomous Power-Efficient Track Inspection System (APTIS)

## PROJECT DESCRIPTION

Machine vision and artificial intelligence technologies are maturing rapidly in many industries. This project conducts research to adapt these technologies for use as an efficient, effective method to inspect track conditions. The project goal is to develop and test a modular, field-deployable system combining edge computing with advanced artificial intelligence processing to detect and classify track features from a moving platform in near-real-time.

## RAILROAD IMPACT

- Low cost, low power, machine vision/AI - based optical track feature detection and inspection technology
- Highly accessible and precise track inspection technology
- Encourages wide-spread adoption of automated technologies for augmenting human track inspection
- Improves rail safety through improved inspection methods

## PROJECT PARTNERS

- University of South Carolina
- CFD Research Corp.
- CSX Rail
- Florida East Coast Railway

## COST & SCHEDULE

- Funding: $599,782
- Project Duration: September 2021 – March 2026

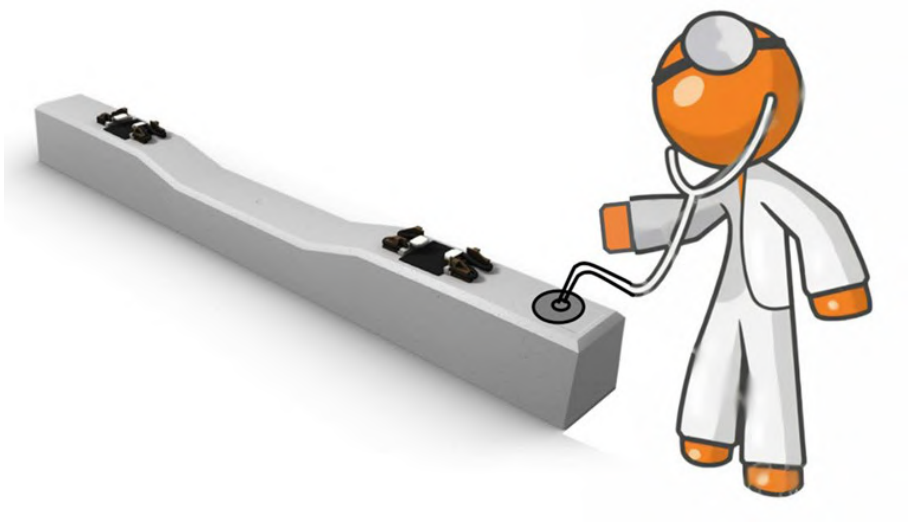


FRA PROJECT MANAGER: Cameron Stuart • (202) 306-5326 • cameron.stuart@dot.gov

# Determining the Health of Prestressed Concrete Ties

## PROJECT DESCRIPTION

- Establish a systematic evaluation process to determine if pre-tensioned concrete ties are close to reaching a failure limit state or still have a significant remaining service life.
- Focus on evaluating post-tensioned concrete ties to determine their likely failure modes and associate inspection requirements.
- Evaluate the true health of ties that have been in service for over 45 years and still appear to be in good condition.
- Document the failure modes of post-tensioned concrete ties.
- Determine the ability of post-tensioned concrete ties to withstand occasional water submersion.



## RAILROAD IMPACT

- Assessment of reserve capacity and failure modes of long service ties and new post-tensioned ties.
- Increased knowledge of the remaining service life of older ties and the unique failure modes of post-tensioned tie designs.
- Improved engineering and inspection methods that support rail safety and an improved state-of-good-repair.

## PROJECT PARTNERS

- Kansas State University
- Amtrak
- Florida East Coast Railway

## COST & SCHEDULE

- Funding: $129,467 (Phase 1)
- Project Duration: August 2023 – August 2025

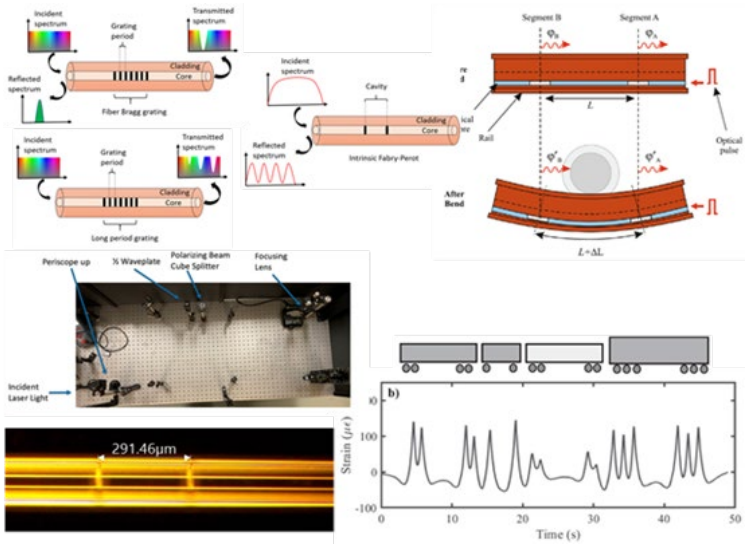


FRA PROJECT MANAGER: Cameron Stuart • (202) 306-5326 • cameron.stuart@dot.gov

# Intelligent Track Transitions Using Optical Fiber Sensors

## PROJECT DESCRIPTION

- Optical fiber technologies are finding new applications in many industries for presence detection and load measurements. This project researches optical fiber sensors for continuous, automated monitoring of track, especially track transitions. This technology development effort focuses on measuring the load distribution characteristics and load-deflection behavior of track.
- Three different optical fiber sensor technologies will be implemented (FBG, LPG, and IF-P).
- Field testing at will be conducted at the FRA Transportation Technology Center.
- Data will include wheel counts, wheel load magnitudes, tie reaction forces, rail temperatures, rail deflections.




## RAILROAD IMPACT

- Advances industry knowledge of the capabilities of new technology for track monitoring.
- Encourages use of advanced technologies for long term, automated monitoring of track conditions.
- Research findings will advance use of existing fiber-optic cable network for railroad track condition monitoring (distributed sensing).

## PROJECT PARTNERS

- Oklahoma State University
- HNTB Corp.
- ENSCO, Inc.
- Amtrak
- The U.S. Army Engineer Research and Development Center

## COST & SCHEDULE

- Funding: $614,269
- Project Duration: September 2022 – September 2025

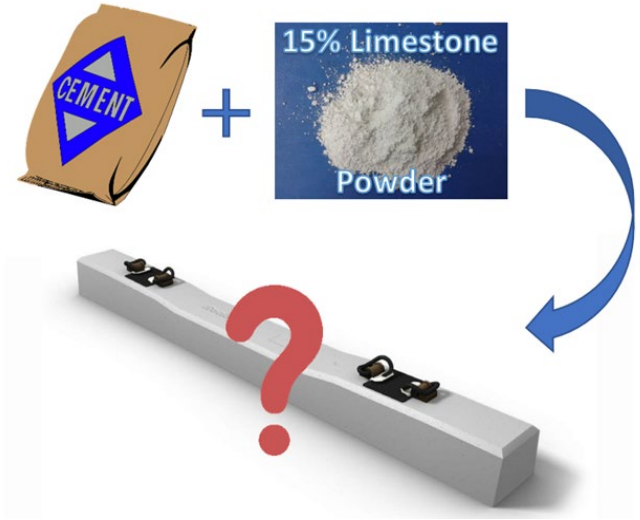


FRA PROJECT MANAGER: Cameron Stuart • (202) 306-5326 • cameron.stuart@dot.gov

# Impact of Type 1L Cement on Concrete Tie Properties

## PROJECT DESCRIPTION

- This research aims to determine the necessary modifications to be made during concrete railroad tie production when using Type IL cement to ensure safe tie designs.
- The increased focus on sustainability and its cost effectiveness are why Type 1L has grown in popularity and is approved for use by many states.
- Laboratory tests will be conducted to evaluate changes in bond performance, splitting potential, moment capacity, and failure modes when using Type 1L cement for tie production.




## RAILROAD IMPACT

- Comparison of performance between Type 3 and Type 1L cements for concrete railroad ties.
- Data documenting the bond performance of new, Type 1L cement, and mitigation measures to ensure concrete tie performance standards.
- Advances the state of knowledge with respect to potentially deleterious effects of Type 1L cement on concrete tie performance.

## PROJECT PARTNERS

- RJ Peterman and Associates
- voestalpine Railway Systems Nortrak

## COST & SCHEDULE

- Funding: $149,069
- Project Duration: August 2023 – December 2025



FRA PROJECT MANAGER: Cameron Stuart • (202) 306-5326 • cameron.stuart@dot.gov

SECTION TWO

# ROLLING STOCK

# Rail Research and Development Center of Excellence Program

## PROJECT DESCRIPTION

- Establish and maintain a shared Center of Excellence to advance research and development that improves the safety, efficiency, and reliability of passenger and freight rail transportation.
- Conduct innovative rail research to understand the needs and implications of emerging transportation technologies such as automation and unmanned aerial systems, transportation system use and operations, and infrastructure design.
- Research topics will include train control, human factors, rail infrastructure, shared corridors, grade crossings, inspection technology, remote sensing, rail systems maintenance, network resiliency, operational reliability, energy efficiency, and other advanced technology.
- Develop partnerships to expand rail training.
- Develop rail-focused curricula and programs.
- Build STEM competencies of local and future rail workforce.


## PROJECT PARTNERS

- National University Rail Center of Excellence
- Leading University: University of Illinois Urbana-Champaign

## RAILROAD IMPACT

- Consortium of universities to advance rail research and innovation.
- Increased university participation and partnership.
- Expanded talent pool of rail professionals.
- Increased technology transfer of prioritized research.

## COST & SCHEDULE

- Funding: $2.5M per year; $7.5M total
- Project Duration: May 2024 – May 2027

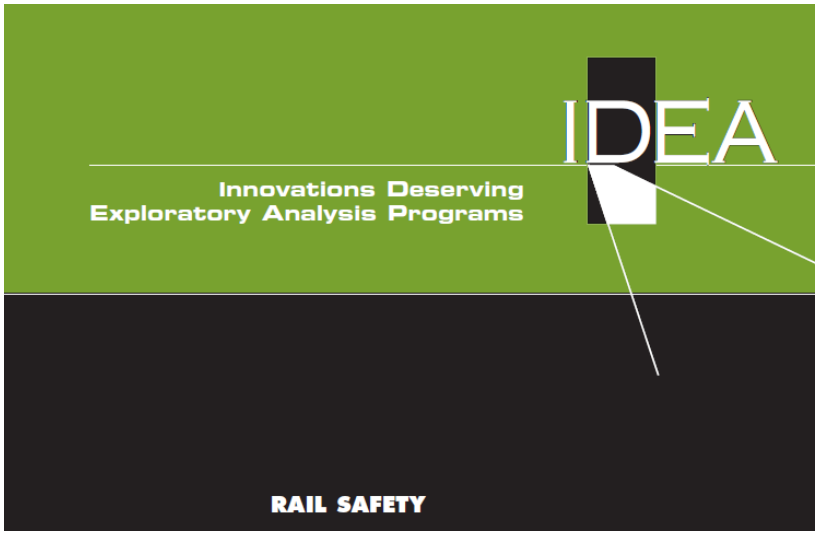


FRA PROJECT MANAGER: Tarek Omar, Ph.D. • (202) 493-6189 • tarek.omar@dot.gov

# Rail Safety Innovations Deserving Exploratory Analysis (IDEA) Program

## PROJECT DESCRIPTION

- IDEA programs differ from traditional research programs in that they are initiated by researchers, inventors, universities, or companies, both within and outside the usual transportation research community, rather than by a request for proposals.
- Each year, three proposals are selected and funded for up to $130,000 each.
- The National Academy of Sciences carries out the Rail Safety IDEA program through the Transportation Research Board.
- Rail Safety IDEA 55, 56, and 57 will be funded in the FY24 IDEA program.




## RAILROAD IMPACT

- Capture the unexpected concepts that challenge conventional thinking.
- Explore promising but unproven concepts with the potential to advance railroad safety and performance.
- Support university research centers and small companies to improve their railroad research capabilities and expertise.

## PROJECT PARTNER

- Transportation Research Board

## COST & SCHEDULE

- Funding, FY24: $500,000
- Project Duration: November 2024 – October 2027

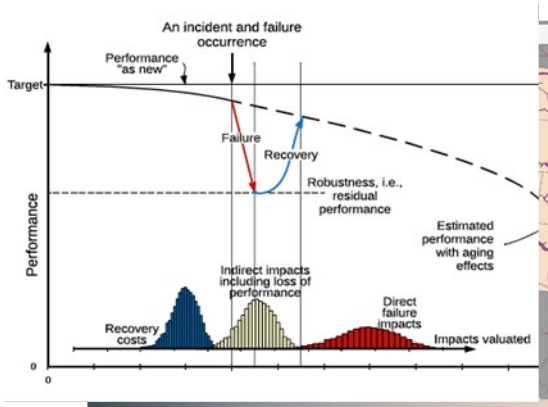


FRA PROJECT MANAGER: Tarek Omar, Ph.D. • (202) 493-6189 • tarek.omar@dot.gov

# Quantifying the Resilience of Freight Railroad Networks (Phase 2)

## PROJECT DESCRIPTION

- Using the technology developed in Phase 1, analyze the topology of Class I railroad networks to assess the impacts of a disruptions on performance, including network connectedness efficiency and other network attributes using waybill information.
- Implement novel models developed in Phase 1 and develop a tool for assessing connectedness efficiency for intelligent rail network infrastructure using attribute weights from waybill information.
- Enable the use of connectedness efficiency as a performance measure in risk and asset management practices and for enhancing railroad resilience.





## RAILROAD IMPACT

- Enhance topology for increased network robustness and resilience in cost-effective terms.
- Inform policy and decision-making practices.
- Increase economic efficiency.
- Enhance planning and design methods at the network level.
- Plan for and improve on capital spending.

## PROJECT PARTNER

- University of Maryland Center for Technology and Systems Management

## COST & SCHEDULE

- Funding: $560,000
- Project Duration: September 23 – August 2026

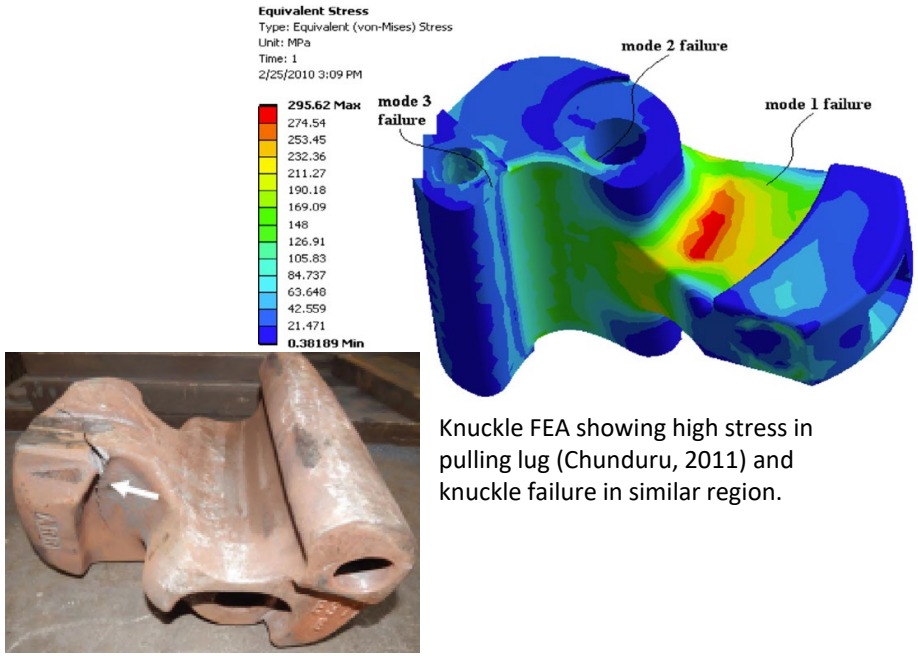


FRA PROJECT MANAGER: Tarek Omar, Ph.D. • (202) 493-6189 • tarek.omar@dot.gov

# Wire-Arc Additive Manufacturing (WAAM) for Weld-Enhanced Cast Steel Couplers

## PROJECT DESCRIPTION

- Increase coupler safety and reliability by weld-enhancing knuckle locally in high-stress areas through wire-arc additive manufacturing (WAAM).
- Coupler knuckles fail in high-stress regions by corrosion fatigue accelerated by casting defects, surface decarburization during heat treatment, and environment (salt).
- WAAM is a weld repair process for high-stress regions that can improve fatigue strength and corrosion resistance by removing casting and heat treatment defects in three tasks:
  - Process development with standard AWS wire grades.
  - High-cycle fatigue on weld material and weld-substrate in air and salt environments.
  - Prototype production knuckle and perform M-216 knuckle testing.




Knuckle FEA showing high stress in pulling lug (Chunduru, 2011) and knuckle failure in similar region.

## RAILROAD IMPACT

- Safer coupler system that is less likely to fail due to fatigue or corrosion.
- More reliable coupler system with consistent load capacity over its lifetime.
- Will not change geometry of coupler.
- Will build on current weld repair procedures.
- High-volume production strategy with limited cost implications.

## PROJECT PARTNERS

- Michigan Technological University
- Amsted Rail

## COST & SCHEDULE

- Funding: $500,00
- Project Duration: April 2022 – December 2024

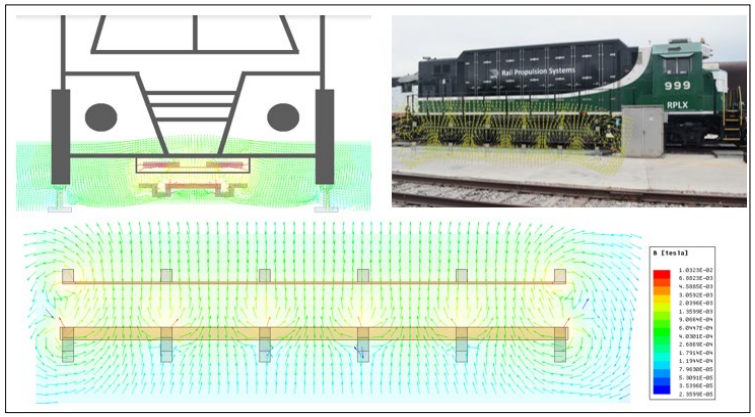


FRA PROJECT MANAGER: Tarek Omar, Ph.D. • (202) 493-6189 • tarek.omar@dot.gov

# Intelligent Wireless Power Transfer (IWPT) for Safe Electric Power Charging

## PROJECT DESCRIPTION

- Improve the safety of the electric power charging system for rolling stock using intelligent wireless power transfer (IWPT) technology for power charging.
- IWPT technology completely removes humans from the hazardous environments of wired high-voltage power charging operations and improves the safety of the railroad environment from electric fire.
- The integrated 1-2-Cut technology determines receiver and transmitter impedance, detects correlation to charging position, arc fault, and fire risk potentials and automatically cuts power off to eliminate fire risk.




**IWPT system magnetic flux distribution**

## RAILROAD IMPACT

- IWPT can minimize human contact with high voltage/amperage electricity to increase worker safety.
- IPT charging stations allow a locomotive to be parked to charge on a charging mat, thus providing a lower plug-in operation and saving time.
- IWPT represents a technological step forward for the passenger rail industry.
- Fire safety, arc fault, and damaged or deteriorating component information are provided by the intelligent detection algorithm and the automatic shutoff function.

## PROJECT PARTNER

- University of North Carolina at Charlotte

## COST & SCHEDULE

- Funding: $435,548
- Project Duration: June 2021 – January 2025

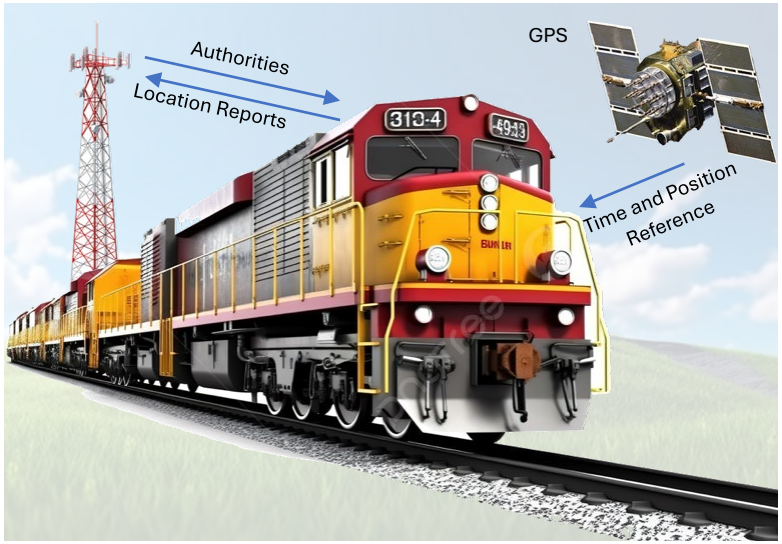


FRA PROJECT MANAGER: Tarek Omar, Ph.D. • (202) 493-6189 • tarek.omar@dot.gov

# GPS Outage Mitigations

## PROJECT DESCRIPTION

- Critical rail safety applications such as PTC heavily rely on GPS.
- Natural (solar and atmospheric disruptions) and malicious (GPS jamming and spoofing) events can cause GPS service interruptions, causing significant risks and rail service disruptions.
- This project investigates the detailed causes for GPS gaps in rail services through extensive modeling and simulation.
- The research provides potential solutions for alternative location and timing sources to avoid rail service degradation from temporary GPS loss.
- This project demonstrates the merits and benefits of the researched solution through various prototyping, experimental and simulation studies.




## RAILROAD IMPACT

- Establishes path towards GPS gap mitigation through alternate precision timing solutions and non-GNSS positioning.
- Avoids train slowdowns and stops during GPS gap events, thus reducing operational losses and improving rail safety and efficiency.
- Directly supports the operation of PTC, a critical rail safety application.
- It will augment and coexist with existing Positioning, Navigation, and Timing (PNT) sources, both onboard and wayside-deployed.
- All developed design documents, simulations, models, and performance results will be available to the rail industry.
- All work will be conducted in coordination with stakeholders.

## PROJECT PARTNER

- University of Nebraska-Lincoln Advanced Telecommunications Engineering Laboratory

## COST & SCHEDULE

- Funding: $150,000
- Project Duration: January 2025 – December 2025



FRA PROJECT MANAGER: Tarek Omar, Ph.D. • (202) 493-6189 • tarek.omar@dot.gov

# Development and Testing of Fire-Resistant Coating Materials for Tank Cars Transporting Flammable Liquids

## PROJECT DESCRIPTION

- Conduct field tests on a novel coating material for tank car fire resistance at FRA's Transportation Technology Center.
- The testing will comprise two phases: partial coating of the valve assemblies (Phase 1) and full coating of an entire tank car (Phase 2).
- In each scenario, the team will assess: 1) material retention when experiencing vibration or light impact for a tank car in motion (material stability test) and 2) USDOT field testing for fire resistance.

## RAILROAD IMPACT

- Novel tank car coating material aimed at enhancing tank car fire resistance.
- Enhance the safety of hazardous material transportation, particularly for flammable materials.
- The data collected during the field testing offers valuable information for railroad hazmat transportation risk management considering thermal protection.

## PROJECT PARTNERS

- Redstone Technologies, LLC
- Rutgers University
- Legacy Technologies
- ENSCO, Inc.
- Ambipar

## COST & SCHEDULE

- Funding: $919,912
  - Phase 1: $369,815 (Year 1)
  - Phase 2: $550,096(Year 2)
- Project Duration: Fall 2024 – Fall 2026

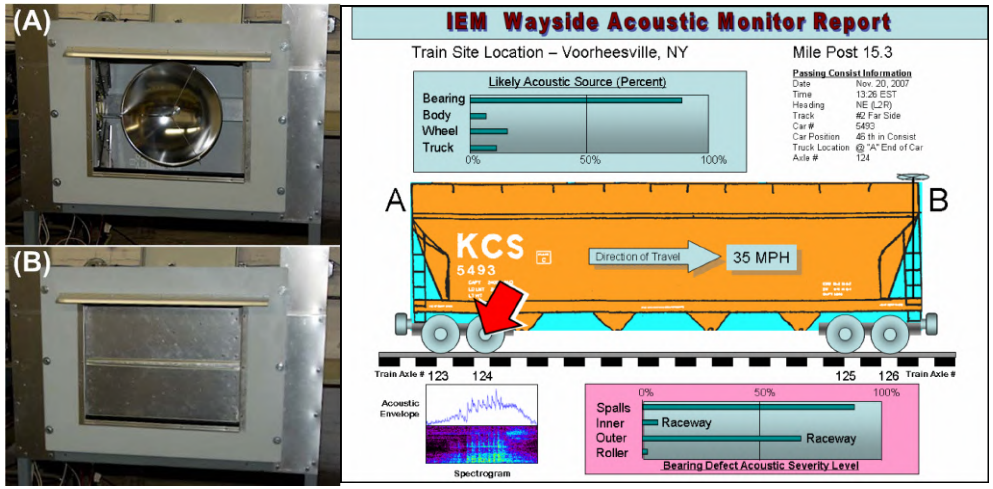


FRA PROJECT MANAGER: David C Brabb • (719) 500-9400 • david.brabb@dot.gov

# IEM Advanced Acoustic Bearing Monitor (AABM)

## PROJECT DESCRIPTION

- The AABM acquires high-bandwidth, targeted acoustic data from each passing wheel and bearing.
- Smart signal analysis, deep learning, and expert system input detect, measure, localize, and evaluate severity of bearing flaws and potentially others, such as wheel flats.
- Parabolic microphone and key processing allows small enclosures and long (up to 30') setbacks from rail.
- Accumulate data on repeated measurements.
- Enable predictive bearing and wheel maintenance.
- Operate at mainline speeds (up to 130km/hr.).
- This project builds upon 30+ years of experience in wayside and in-ground system design and acoustic and complex signal analysis.




## RAILROAD IMPACT

- Permit condition-based maintenance of bearing flaws by more sensitive and accurate detection.
- Detect potential derailing flaws well before accidents; prevent expensive and dangerous derailments.
- Provide the monetary, time, and safety savings inherent in predictive health maintenance.
- Can also detect other faults including slid flats, anomalous vibrations, etc.

## PROJECT PARTNERS

- International Electronic Machines Corp.
- Freight rail industry and stakeholders
- Transit rail operators

## COST & SCHEDULE

- Funding, FY24 and FY25: $453,305
- Project Duration: Sept. 2024– Sept. 2026

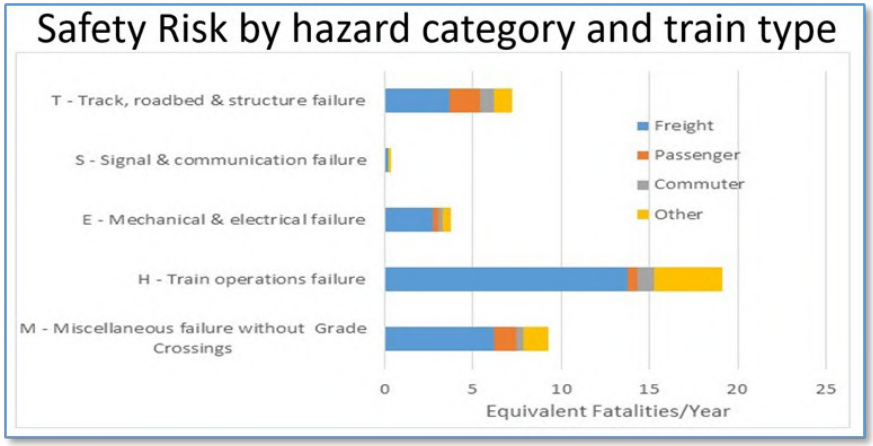


PROJECT MANAGER: David C. Brabb • (719) 500-9400 • david.brabb@dot.gov

# Extended Development of FRA Safety Risk Model

## PROJECT DESCRIPTION

- FRA's Office of Research, Development, and Technology (RD&T) has developed a means of assessing safety risk across the railroad industry: the Safety Risk Model (SRM) It is similar to a model created and implemented by the Railway Safety Standards Board in the U.K.
- The SRM provides a means for quantitative risk-ranking to facilitate project selection. Knowing the characteristics of the distribution of risk will allow FRA to make strategic investments. These investments will increase safety benefits and allow for future assessments of risk reduction resulting from implementing RD&T products.
- Future updates to the model will include the means to assess risk based on regional population density (rural, urban, super-urban) to derive "state level" safety risks for the purpose of guiding safety inspections.




## RAILROAD IMPACT

- Applying the results derived from the SRM will enable FRA to focus R&D efforts on topics which cause the greatest amount of harm (fatalities, injuries, property damage) in the railroad industry.
  - This should result in RD&T research products which are of the greatest benefit to the railroad industry in improving safety performance.

## COST & SCHEDULE

- Funding: $75,356 (Annual)
- Project Duration: September 2018 – September 2025

## PROJECT PARTNER

- Sharma & Associates, Inc.

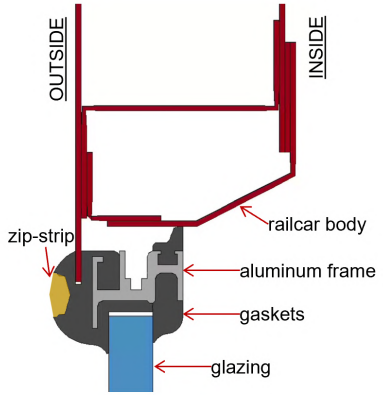


FRA PROJECT MANAGER: David C. Brabb • 719-584-0507 • david.brabb@dot.gov

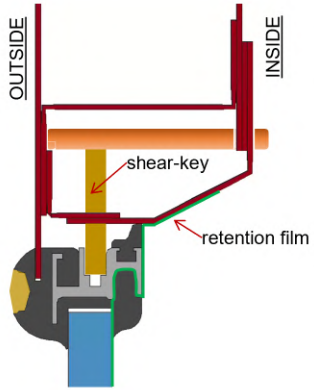
# Novel Passenger Railcar Glazing Retention Systems (SBIR Phase II)

## PROJECT DESCRIPTION

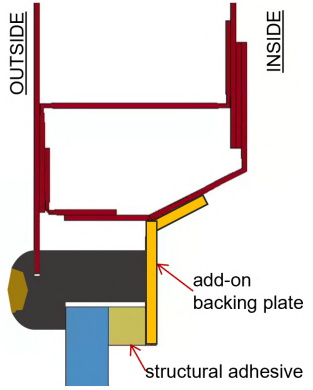
- Many existing railcar glazing retention systems fail in rollover-type derailment accidents, leading to passenger fatalities and injuries.
- Conduct advanced research to improve design of passenger railcar glazing retention systems.
- At the end of SBIR Phase I research, two proof-of-concept glazing retention systems are identified, one each for:
  - Emergency egress window
  - Non-emergency window
- Objectives for Phase II:
  - Fine-tune the proof-of-concept glazing retention systems for ease of installation/operation.
  - Optimize the innovative solutions via high-fidelity numerical analysis and experimental testing for enhanced effectiveness and balanced capacity.
  - Develop a market delivery roadmap for successful commercialization.




Existing Glazing Retention System




Down-Selected Glazing Retention System for Emergency Egress Windows




Down-Selected Glazing Retention System for Non-Emergency Windows

## RAILROAD IMPACT

- Advance rail research and innovation.
- Increase passenger safety through optimized product development.
- Increase technology transfer between businesses and government agencies.

## PROJECT PARTNERS

- Protection Engineering Consultants, LLC (Lead)
- Southwest Research Institute
- ProCurve Glass Technology, LLC

## COST & SCHEDULE

- Funding: $299,900
- Project Duration: 24 months



FRA PROJECT MANAGER: David C. Brabb • (719) 500-9400 • david.brabb@dot.gov

# Electrical Power System for Individual Freight Car Application

## PROJECT DESCRIPTION

- Develop a solar-charged electrical power system for freight car applications.
- Recent innovations in flexible solar panels allow for faster installation on the exterior of railcars, including tank cars.
- The system will be compact, allowing for greater flexibility in installation location.
- The prefabricated, modular design will expedite installation and minimize cost.


## RAILROAD IMPACT

- Facilitate low-cost instrumentation of unpowered rail vehicles.
- Enable a wide range of safety, security, and measurement systems to be deployed on revenue service vehicles.
- Reduce the cost of evaluating new technologies and encourage adoption of existing communications and measurement systems.

## PROJECT PARTNER

- ENSCO, Inc.

## COST & SCHEDULE

- Funding, FY24: $132,000
- Project Duration: August 2023 – September 2025



FRA PROJECT MANAGER: David C. Brabb • (719) 500-9400 • david.brabb@dot.gov

# Passenger Equipment Glazing Integrity

## PROJECT DESCRIPTION

- Develop engineering strategies for improved occupant containment by glazing systems, while meeting all other existing safety, service, and manufacturing requirements.
- Glazing system functions as windows and expected to be impact resistant, provide emergency egress, provide emergency access, be fire resistant, and provide occupant containment.
- Develop detailed plans for drafting, analyzing, and testing engineering strategies for glazing systems.
- Define all safety and operational requirements placed on glazing systems; assess the performance of current glazing systems in meeting those requirements; develop modifications for improving occupant containment; and conduct analysis and testing to compare the performance of conventional and modified glazing systems.

## RAILROAD IMPACT

- At least 25 fatalities attributed to glazing malfunction in the last 44 years.
- Subsequent to the commuter train derailment in Spuyten Duyvil, NY, on December 1, 2013, the National Transportation Safety Board (NTSB) issued a recommendation for more effective passenger containment by glazing systems in derailments.
- NTSB reiterated its recommendation after the derailment in Philadelphia, PA, on May 12, 2015.
- Currently, no FRA regulations exist related to passenger containment by glazing systems.
- Outcomes of this research include strategies for improving the survivability of glazing in rollover accidents to improve occupant containment.

## PROJECT PARTNERS

- Sharma & Associates, Inc.
- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding: $585,000
- Project Duration: September 2022 – June 2025

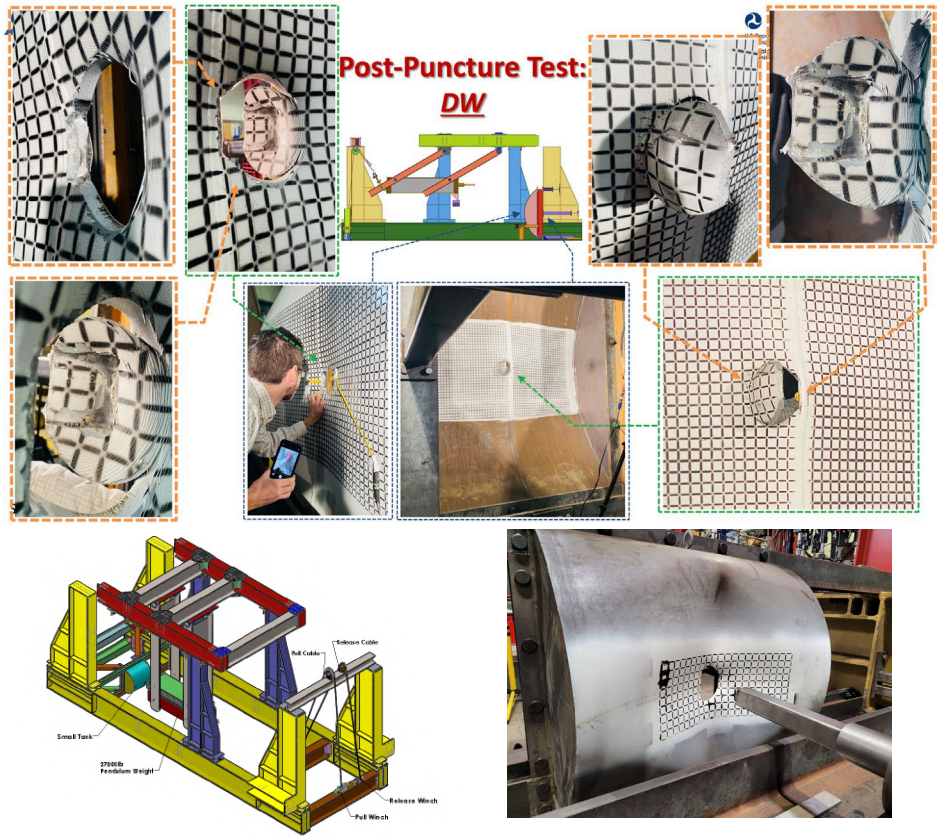


FRA PROJECT MANAGER: David C. Brabb • 719-584-0507 • david.brabb@dot.gov

# Pendulum Testing of Tanks

## PROJECT DESCRIPTION

- FRA has developed and prototyped a repeatable test setup that can be used for impact and puncture testing of small-scale tanks, full-scale tank sections, and weld samples.
- The setup uses a pendulum with a four-bar linkage, a heavy weight, and a defined impactor to conduct puncture testing of tanks.
- The system was used to test and evaluate weld performance on several full-scale tank sections from an LNG tank car.
- This research includes conducting additional puncture testing using the pendulum impact machine and related simulations to better understand puncture performance, including weld performance, cold weather performance, and scaling effects on different tank cars.




## RAILROAD IMPACT

- Better understand puncture behavior on tanks, leading to improved and safer tank car designs.
- Improve validation of design methods used by industry.

## PROJECT PARTNERS

- Sharma & Associates, Inc.
- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding: $498,000
- Project Duration: September 2024 – September 2026

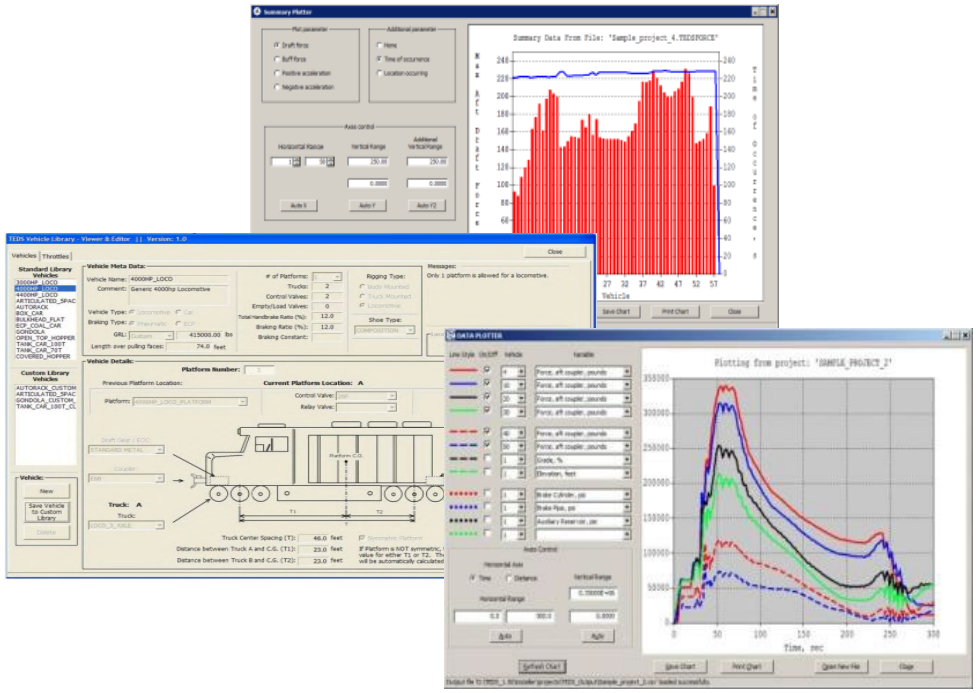


FRA PROJECT MANAGER: David C. Brabb • 719-584-0507 • david.brabb@dot.gov

# Train Energy and Dynamics Simulator (TEDS) Enhancements and Maintenance

## PROJECT DESCRIPTION

- TEDS is a computer program developed by FRA for conducting longitudinal train dynamics simulations.
- It may be used to assist the development of guidelines and recommendations to improve train operating safety.
- TEDS is capable of simulating train handling, train makeup, head-end and distributed power, ECP, and automatic brake applications for speed control, stopping distances, and emergency stops.
- Published validation detail can be found in an FRA Technical Report.
- It has been used successfully for several simulations to assist FRA's Office of Railroad Safety in various investigations.
- TEDS is available for public use under a service agreement with FRA and Sharma & Associates, Inc.



## RAILROAD IMPACT

TEDS facilitates simulation of train operation safety risk affected by:

- Train makeup and train handling
- Certain types of malfunctioning equipment, such as locomotive power drop and malfunctioning airbrake equipment
- Derailment/incidence investigation

## PROJECT PARTNER

- Sharma & Associates, Inc.

## COST & SCHEDULE

- Funding: $200,000 per year; $400,000 total
- Project Duration: 24 months



FRA PROJECT MANAGER: David C. Brabb • 719-584-0507 david.brabb@dot.gov

# Very Long Train Study: Follow-On Effort and Testing

## PROJECT DESCRIPTION

- Prior efforts evaluated the performance of Very Long Trains (VLTs) as a multi-phase study with laboratory tests, stationary train tests, and one moving train test.
  - However, all combinations of non-ideal conditions could not be covered by the tests, due to safety and practicality reasons.
- This effort includes simulations to evaluate VLT performance under various difficult-to-test and non-ideal equipment, environment, and operating conditions.
- Two additional revenue service tests using the eight instrumented box cars will be conducted, potentially including:
  - Eastern railroad
  - Mixed manifest train
  - Cold weather conditions
- The effort will be guided by a test review committee with participants from the regulators, railroads, railroad labor, and vendors.


| HE: L-133-L-67 | | Actual Flow [SCFM] | Gradient [psi] |
|---|---|---|---|
| Natural | Phase 3 | <20 | 0.5 |
| | Phase 3-TEDS | 12 | 0.3 |
| 60 SCFM | Phase 3 | 68 | 1.9 |
| | Phase 3-TEDS | 68 | 1.8 |
| 90 SCFM | Phase 3 | 102 | 2.9 |
| | Phase 3-TEDS | 102 | 3 |
| 140 SCFM | Phase 3 | 157 | 7.5 |
| | Phase 3-TEDS | 158 | 7.6 |

## RAILROAD IMPACT

- Create a common understanding of VLT performance among stakeholders.
- Improve train air brake and longitudinal dynamic performance data on VLT trains.
- Improve train dynamics simulation capabilities to study train operation in general and VLT operation for non-testable conditions.

## PROJECT PARTNERS

- Sharma & Associates, Inc.
- Test Review Committee

## COST & SCHEDULE

- Funding: $216,400 per year; $432,800 total
- Project Duration: 24 months

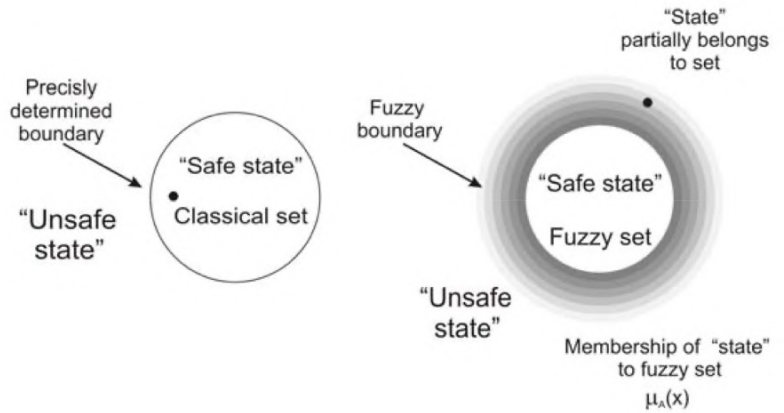


FRA PROJECT MANAGER: David C. Brabb • 719-584-0507 david.brabb@dot.gov

# Quantifying Uncertainty to Enhance Railroad Safety Risk and Decision Models

## PROJECT DESCRIPTION

- FRA has developed a Railroad Safety Risk Model (SRM) to quantify railroad risks from both likelihood and consequence perspectives:
  - The SRM uses 15 years of accident data from the RAIRS database to create a risk profile of the U.S. railroad network.
  - The model categorizes risk by accident cause code, accident type, location, and other factors.
  - This approach effectively identified problem areas for FRA to target for safety enhancements through enforcement, regulation, training, and other measures.
- Enhance the SRM by addressing previously unexplored uncertainties and variance in the data and modeling processes. By implementing fuzzy logic, it aims to predict future risk range within the railroad network and support decision-making.
- Normalize the risk based on appropriate denominators such as traffic volumes, gross tonnage, ton-miles, etc.




## PROJECT PARTNER

- Sharma & Associates, Inc.

## RAILROAD IMPACT

- The enhanced SRM will enable FRA to more precisely focus R&D efforts on topics which cause the greatest amount of harm (fatalities, injuries, property damage) in the railroad industry.
- This should result in research products of the greatest benefit to the railroad industry in improving safety performance.

## COST & SCHEDULE

- Funding: $294,500
- Project Duration: September 2023 – September 2025



FRA PROJECT MANAGER: David C. Brabb • 719-584-0507 • david.brabb@dot.gov

# Rail Dynamics Laboratory (RDL) Test Systems Restoration

## PROJECT DESCRIPTION

- Restore operational capability to critical test systems and return the RDL at FRA's Transportation Technology Center to a state-of-the-art facility for safety-related research and testing for rolling stock and equipment-related components.
- Equipment being restored includes:
  - Simuloader Unit
  - Vibration Test Unit
  - Minishaker Unit
  - Load bars
  - Air tables
  - Squeeze fixture

## RAILROAD IMPACT

- Rolling stock life estimation studies using compressed in-service data.
- Life extension studies for aging existing fleets, ensuring safe extended revenue service operations.
- Truck characterization providing physical parameters for better understanding of probable on-track dynamics.
- Improved computer simulations
- Structural integrity studies

## PROJECT PARTNER

- ENSCO, Inc.

## COST & SCHEDULE

- Funding: $880,580
- Project Duration: 18 months

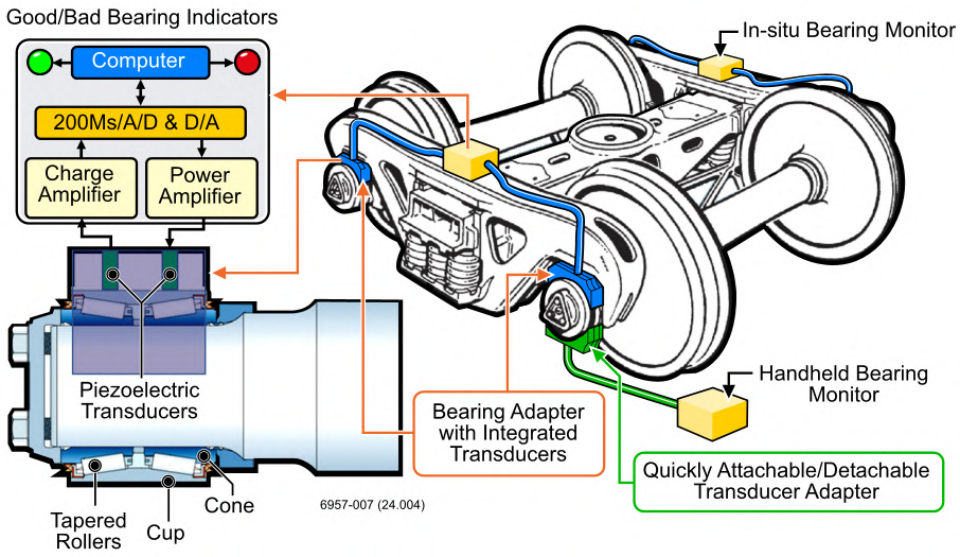


FRA PROJECT MANAGER: David C. Brabb • (719) 500-9400 • david.brabb@dot.gov

# Resonant Ultrasound Spectroscopy for Bearing Monitoring

## PROJECT DESCRIPTION

- Develop an in-situ/handheld non-destructive examination (NDE) system for automated bearing condition monitoring using resonant ultrasound spectroscopy (RUS).
- Perform simulations of different bearing geometries to determine system requirements.
- Perform laboratory tests on good and defective (e.g., spalling, water etch, etc.) bearings to evaluate the detection capability of RUS method.
- Develop defect detection algorithm using RUS signals recorded during tests.
- Perform laboratory and field tests of the prototype handheld NDE system for bearing defects detection to determine its performance.




## RAILROAD IMPACT

- Improve bearing defect detection capabilities during maintenance process.
- Enable bearing condition monitoring over time and predict bearing failure, which will improve efficacy and accuracy of predictive-based maintenance of bearing.
- Provide quantitative measurement of bearing condition with repeatability and reliability.

## PROJECT PARTNERS

- BlueHalo LLC
- ENSCO, Inc.

## COST & SCHEDULE

- Funding, FY25: $499,913
- Project Duration: October 2024 – March 2026

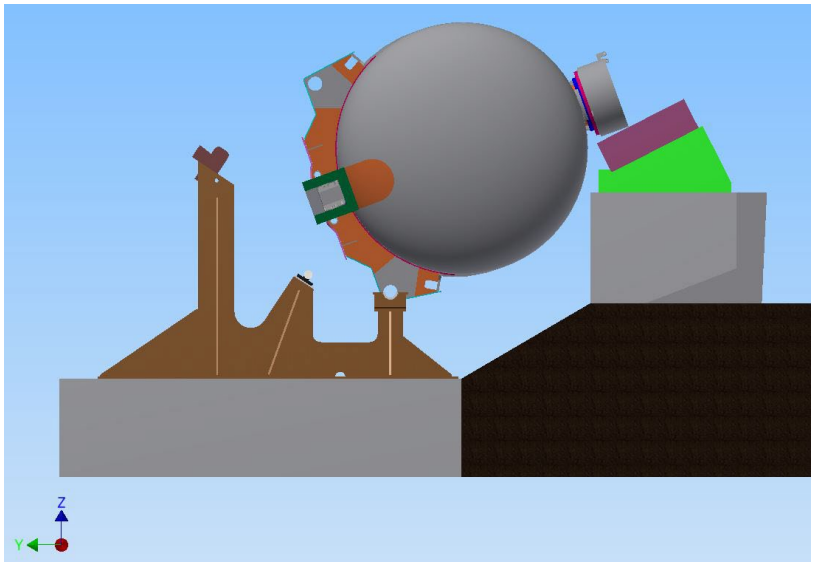


FRA PROJECT MANAGER: David C. Brabb • (719) 500-9400 • david.brabb@dot.gov

# Improving Safety of Tank Car Fittings in HazMat Service

## PROJECT DESCRIPTION

- Evaluate the performance of top fittings protection used on current design tank cars, particularly those used in unit trains carrying flammable materials, under rollover conditions.
- This will be accomplished by conducting a series of analytical simulations and full-scale rollover tests.
- Designs considered include:
  - CPC-1232 style designs
  - Innovative, industry-proposed options
- Calibrate analytical models to test results.
- Develop criteria and protocols for future industry research.




## RAILROAD IMPACT

- Improve overall safety of tank car operations by mitigating the release of hazardous material in tank car rollover derailments.
- Help develop performance information that can be used by the industry for standards development.
- Develop recommendations for future design and testing of fittings for industry use.

## PROJECT PARTNERS

- Sharma & Associates, Inc.
- ENSCO, Inc.
- Tank car manufacturers
- Class I Railroads (CSX, UP, BNF, CP, NS)

## COST & SCHEDULE

- Funding: $412,300
- Project Duration: August 2024 – August 2026

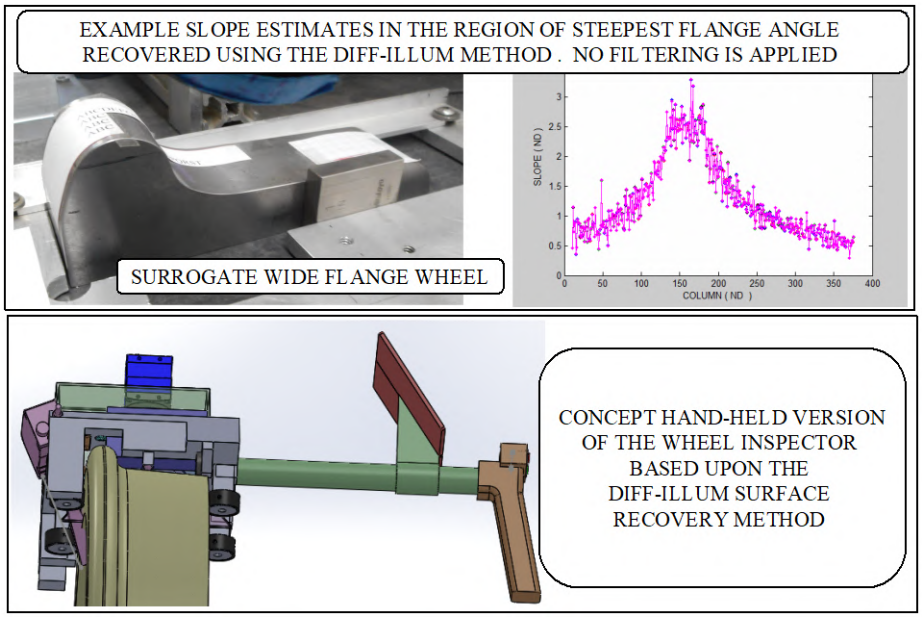


FRA PROJECT MANAGER: David C. Brabb • (719) 584-0507 • david.brabb@dot.gov

# Wheel Measuring Device – SBIR Phase II

## PROJECT DESCRIPTION

- Identify the factors which limit the precision of wheel profile measures made using optical means.
- Quantify the limits to precision imposed by:
  - Spatial variance of the wheel's surface reflectivity.
  - Spatial and temporal variance of the intensity of pixels in the image used for measurement.
- Quantify how these limits affect the derived slope estimate and the evaluation of the APTA PR-M-S-015-06 flange angle standard.
- Develop confidence bound measures for estimates.
- Develop a prototype system that maximizes the precision of profile and slope estimates using small changes in illumination, i.e., the DIFF-ILLUM method.
- Quantify the improved precision over existing laser line illumination and other methods.
- Compare output from the prototype and the Mini-Prof Wheel BT tool.
- Quantify limitations in the precision of single scan profile and slope outputs from the Mini-Prof Wheel BT and the Hegenscheidt MFD ARGUS systems.




## RAILROAD IMPACT

- Improved accuracy in the evaluation of:
  - The local slope at a point on the wheel's rim.
  - The APTA PR-M-S-015-06 flange angle standard.
- Metrics to assess the confidence in legacy single scan outputs from the Mini-Prof Wheel BT and the Hegenscheidt MFD ARGUS systems

## PROJECT PARTNERS

- Synetics Systems Engineering Corp.
- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding: $150,000 per year; $400,000 total
- Project Duration: 32 months



FRA PROJECT MANAGER: David C. Brabb • (719) 500-9400 • david.brabb@dot.gov

# Autonomous Detection of Train Air Leaks

## PROJECT DESCRIPTION

- Conduct field development of a wayside autonomous air leak detection system, continuing work completed for TRB IDEA program (SAFETY 48).
- Design and fabricate system hardware for wayside applications.
- Refine detection and identification capabilities through data collection, software modification, and machine learning.
- Conduct a feasibility study to identify the capabilities/ limitations of acoustic sensors in real world rail environment.
- Determine track speed limits of detection system.
- Phase I: Shorter duration, more hands-on
- Phase II: Longer duration, larger population


## RAILROAD IMPACT

- Significantly reduce labor and cost associated with finding air leaks.
- Increase safety through increased air brake reliability and reduction in times employees must go on, under, or between rolling stock when finding leaks.
- Potentially reduce criteria, greenhouse gas emissions, and fuel consumption industry-wide.
- Allow for large reductions in AESS restart events, prolonging component life, and further reducing criteria and GHG emissions and fuel consumption.

## PROJECT PARTNERS

- ENSCO, Inc.
- Shortline Railroads
- Class I Railroads

## COST & SCHEDULE

- Funding, FY24: $476,829
- Project Duration: October 2023 – September 2025



PROJECT MANAGER: David C. Brabb • (719) 500-9499 • david.brabb@dot.gov

# Tank Car Train Handling and Combination Track Perturbation Evaluation

## PROJECT DESCRIPTION

- High-magnitude coupling forces that occur in yard operations have the potential to exceed yield limits of mild steel.
- Complete a comprehensive test program to characterize tank carload environments.
- Complete autonomous testing over 10 months and 14,000 miles to characterize the typical load environment for revenue service.
- Comprehensively analyze the collected impact test data to arrive at limiting conditions for coupling speed and impacting mass.
- Evaluate the impact of train handing and combination track perturbations and comparing flat coupling test with previous impact testing.

## RAILROAD IMPACT

- Create a better understanding of the operational environment and root cause of fractures on tank cars.
- Develop speed and mass combination curves to mitigate tank car stub sill failures.
- Conduct over-the-road brake testing to target a variety of issues faced by the industry.

## COST & SCHEDULE

- Funding, FY23–24: $956,432
- Project Duration: September 2018 – September 2025

**Autonomous Testing**

**Stub Sill Crack**

**Impact Testing**


## PROJECT PARTNERS

- ENSCO, Inc.
- Union Tank Car Co.
- Amsted Rail Company, Inc.

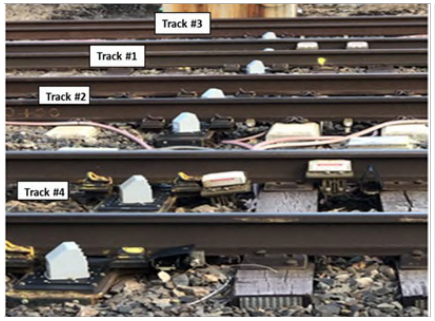
U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: David C. Brabb • (719) 584-0507 • david.brabb@dot.gov

# Wayside Advanced Technology Systems (WATS)

## PROJECT DESCRIPTION

- Partner with Metro-North Railroad (MNR), Long Island Railroad (LIRR) and New York Atlantic Railway (NYA) to assist with pilot demonstrations of new wayside technology systems to detect defects and precursors to safety-critical defects in rolling stock.
- Document new installation at MNR, LIRR, and NYA.
- Conduct detection threshold analysis to help railroads establish detection thresholds for inspection, alarm, and emergency level actions balanced against their shop capacity and commuter service demands for passenger coaches.
- Identify best practices for implementation and revise the Wayside Implementation Guide.




## RAILROAD IMPACT

- Improve the process for demonstrating and implementing new technology.
- Establish a standard process for wayside technology pilot demonstrations.
- Wayside technology systems will reduce the number of incidents and accidents through proactive maintenance, driven by monitored performance of rolling stock equipment and components.

## PROJECT PARTNERS

- Sharma & Associates, Inc.
- MNR
- LIRR
- NYA

## COST & SCHEDULE

- Funding: $89,865 per year
- Project Duration: September 2018 – December 2024

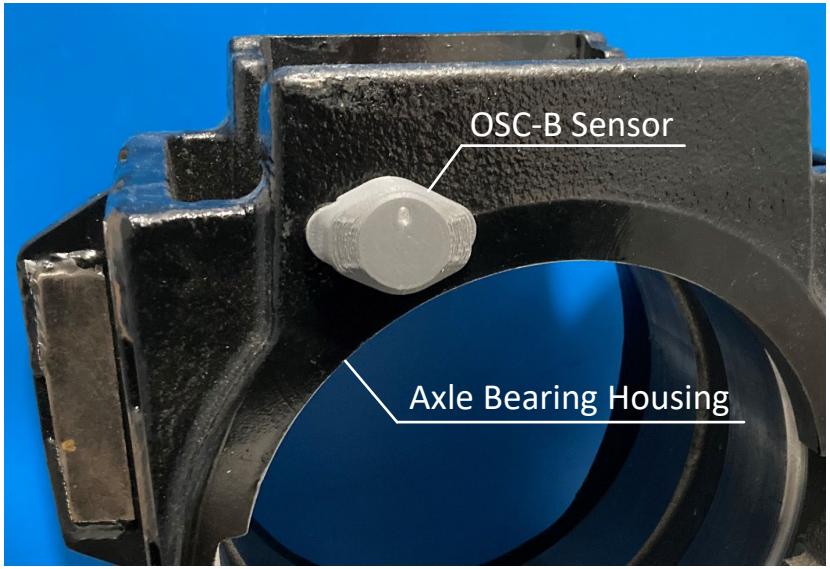


FRA PROJECT MANAGER: David C. Brabb • (719) 584-0507 • david.brabb@dot.gov

# Onboard Sensing and Communication System for Bearing Monitoring (OSC-B): SBIR Phase IIB

## PROJECT DESCRIPTION

- Develop a novel onboard wireless sensing and communication (OSC) system for continuous monitoring of train axle bearing and real-time detection/warning of failure.
- Design and fabricate battery-powered compact wireless sensor for temperature and vibration monitoring.
- Formulate a sensor fusion algorithm for reliable early detection of bearing failure.
- Create a wireless network and cloud computing for remote monitoring and alerts.




## RAILROAD IMPACT

- Address urgent critical needs for detecting axle bearing failures that frequently cause train derailments.
    - This poses a significant advantage over the current intermittent wayside monitoring system.
- The OSC has potential for comprehensive safety monitoring and operation improvement.
- Improve train safety while providing cost saving by preventing accidents.

## PROJECT PARTNERS

- Newport Sensors, Inc.
- Massachusetts Bay Transportation Authority

## COST & SCHEDULE

- Total Funding: $399,680
- Project Duration: May 2024 – April 2026

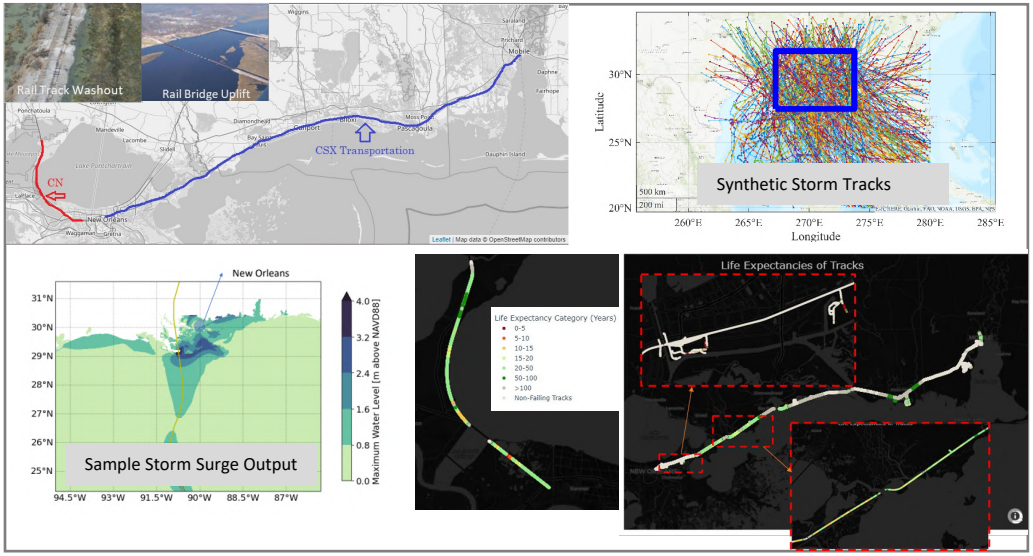


FRA PROJECT MANAGER: David C. Brabb • (719) 500-9400 • david.brabb@dot.gov

# A Risk-Informed, Decision-Making Framework for Coastal Railroad System Subjected to Storm Hazards and Sea Level Rise

## PROJECT DESCRIPTION

- Develop probabilistic storm simulations based on synthetic tropical cyclone data to estimate annual surge and wave values (accomplished in Year 1).
- Identify vulnerable segments of railway system (rail tracks and bridges) subjected to storm hazards (accomplished in Year 2).
- Provide short-term retrofit solutions to mitigate the vulnerabilities in the coastal rail system (accomplished in Year 2).
- Integrate wind speed and sea level projections to estimate future inundated rail tracks, water levels, and wave heights. Provide long-term retrofit solutions to mitigate the vulnerabilities in the coastal rail system subjected to climate change and sea level rise (planned for Year 3).




## RAILROAD IMPACT

- Develop an integrated Python-based Jupyter Notebook to be used by the railroad companies for short-term and long-term risk-based decision-making.
- High fidelity evaluation of storm impacts on coastal railroad with the consideration of uncertainties
- More reliable coastal railroad system in upcoming storm hazards

## PROJECT PARTNERS

- Michigan Technological University
- Argonne National Laboratory
- Canadian National Railway
- CSX Transportation

## COST & SCHEDULE

- Funding: $440,000
- Project Duration: May 2022 – May 2025

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland@dot.gov

# Advanced Development and Testing of Locomotive Waste Heat Recovery System (L-WHRS) Technology for Rail Decarbonization

## PROJECT DESCRIPTION

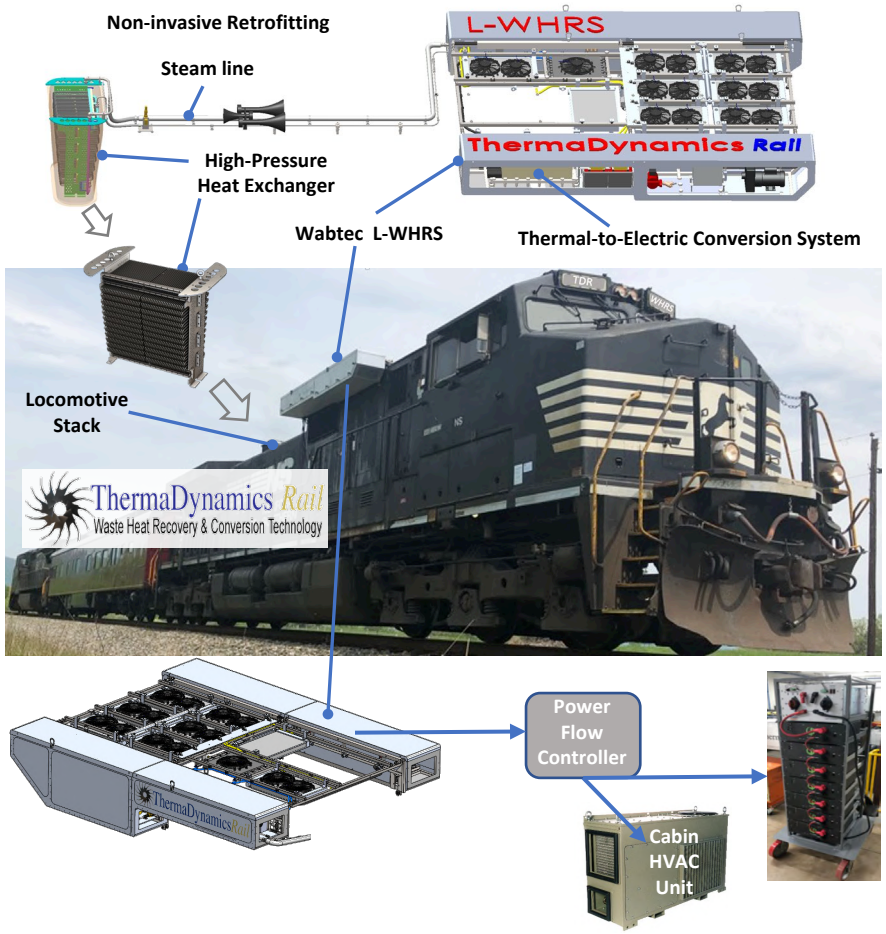
- Develop the digital twin of the L-WHRS to optimize techno-economic performance of the L-WHRS components for Wabtec (GE-type) locomotives.
- Universalize and identify the L-WHRS components for Wabtec locomotives that can support components.
- Retrofit the Progressive Rail (EMD-type) locomotives.
- Optimize manufacturing approaches for design optimization of the heat exchanger equipping the L-WHRS to lower production, operation, and maintenance costs.
- Quantify energy savings and emissions reductions for L-WHRS application on Wabtec and Progressive Rail locomotives.
- Deliver an optimized L-WHRS design for Wabtec installations.
- Install L-WHRS prototypes for commercial testing on Wabtec and Progressive Rail locomotives; conduct planning in subsequent phases of the project.

## RAILROAD IMPACT

- Provide locomotive augmented electric power supply.
- Reduce locomotive operating costs.
- Reduce thermal and pollutant emissions.
- Reduce fuel consumption.
- Enable load-shedding of OEM lead-acid locomotive battery.
- Enable power-flows from L-WHRS to locomotive electric loads and high-efficiency Energy Storage Systems.
- Support short-term rail decarbonization objectives.

## PROJECT PARTNER

- ThermaDynamics Rail (TDR)




## COST & SCHEDULE

- Funding: $500,000
- Project Duration: September 2023 – September 2026

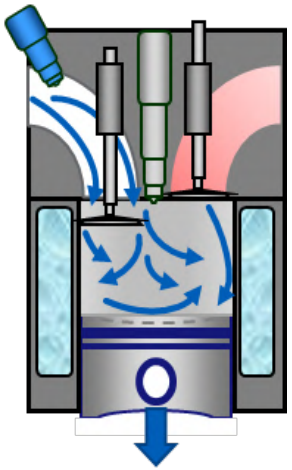
U.S. Department of Transportation
Federal Railroad Administration

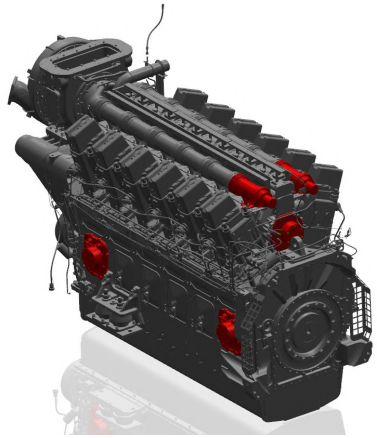
FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland @dot.gov

# Multi-Cylinder Hydrogen Dual Fuel Engine Development for Rail

## PROJECT DESCRIPTION

- Facilitate the use of dual fuel hydrogen in a multi-cylinder locomotive engine with port injected hydrogen.
- Test a multi-cylinder engine to demonstrate 50% hydrogen substitution.
- Create initial knock and backfire mitigation strategies.
- Demonstrate safe engine operation in a locomotive environment.





## RAILROAD IMPACT

- Demonstrate at least 50% reduction in $CO_2$ emissions.
- Forge a path for the safe introduction of hydrogen into rail industry.
- Facilitate a fuel flexible concept to enable phased introduction of hydrogen infrastructure.
- Retrofit technology to accelerate adoption to new and existing fleet.

## PROJECT PARTNERS

- Wabtec Corp.
- Southwest Research Institute

## COST & SCHEDULE

- Funding: $500,000
- Project Duration: October 2024 – April 2025



FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland@dot.gov

# Development of Fire Test Facility at TTC

## PROJECT DESCRIPTION

- Tank cars may be subjected to derailment-related fires under multiple scenarios. Current analytical models are either too complex or lack the fidelity to fully replicate certain fire conditions, requiring some evaluations to be done by physical fire tests.
- This effort seeks to investigate fire testing needs in the railroad and energy industries, develop plans for such test facilities, and further to develop the test facilities at FRA's Transportation Technology Center (TTC) or other suitable facility in the U.S. in a multi-phase effort.
- Key tasks include:
  - Review fire testing needs and existing gaps in testing infrastructure.
  - Develop plans for small-scale and full-scale fire tests.
  - Implement a small-scale test setup and demonstrate its functionality.
  - Update plans for test facilities based on results of demonstration test.

## RAILROAD IMPACT

- Access to test facility to verify fire safety performance.
- Access to test facility to evaluate emergency protocols and mitigation strategies.
- Reduced risk to RR, employees, and public from better quantification and reduction of fire related risks.

## PROJECT PARTNERS

- Sharma & Associates, Inc.
- ENSCO, Inc.

## COST & SCHEDULE

- Funding: $ 350,000
- Project Duration: September 2024 – September 2026



FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland@dot.gov

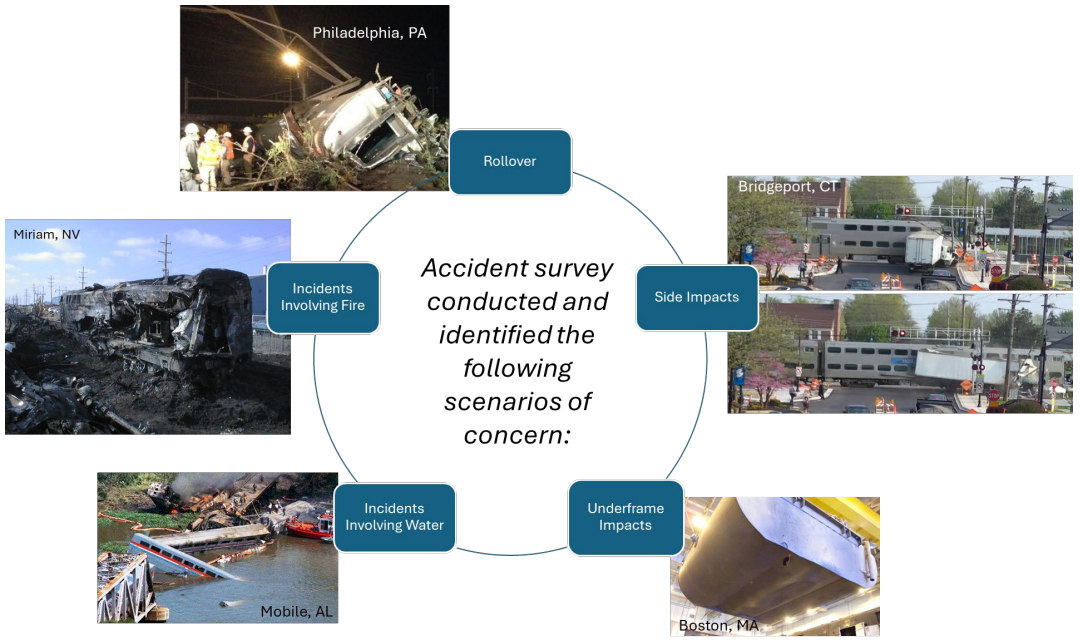
# Evaluation of Alternative Propulsion Rail Equipment

## PROJECT DESCRIPTION

- Conduct an accident survey to determine scenarios of concern for battery-powered and hydrogen-fueled rail equipment.
- Develop a testing plan to understand hydrogen, fuel cell, and battery equipment under scenarios of concern.
- Support FRA's Office of Railroad Safety with alternative propulsion equipment reviews.

## RAILROAD IMPACT

- Demonstrate performance of alternative propulsion equipment under impact scenarios, including side impacts, rollover, underframe impacts and other scenarios of concern – such as fire or submersion in water.




## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- ENSCO, Inc.

## COST & SCHEDULE

- Funding: $300,000
- Project Duration: May 2023 – May 2025

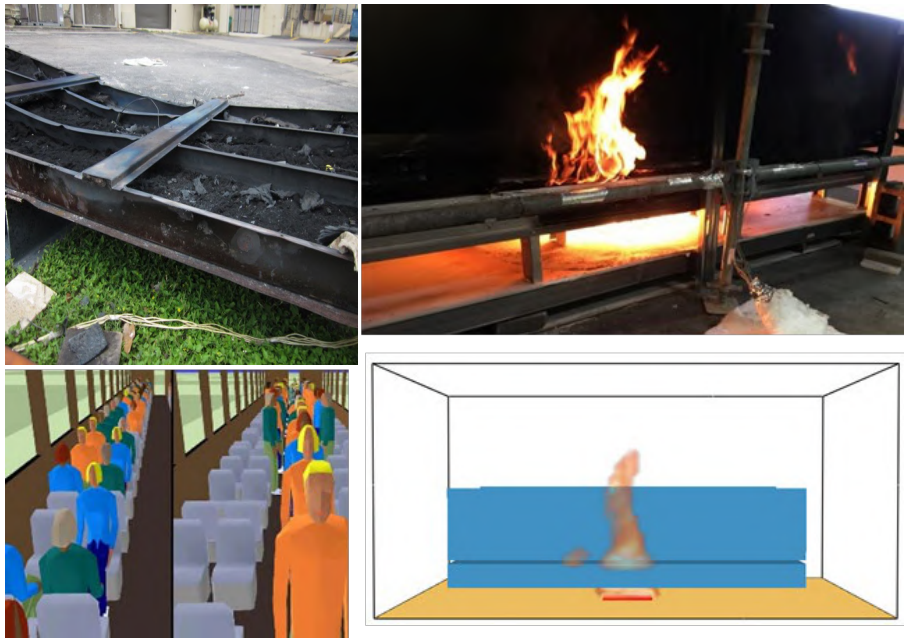


FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland@dot.gov

# Fire Safety and Emergency Egress Research

## PROJECT DESCRIPTION

- Support FRA in evaluating alternative fire performance criteria for passenger railcars and floor fire test alternatives.
- Provide technical assistance on egress model software and analysis of the alignment of egress modeling results when coupled with fire prediction models.
- Participate in meetings of the National Fire Protection Association 130 Committee to develop and maintain industry standards for fire safety of passenger rail cars.



## RAILROAD IMPACT

- Inform the development of knowledge for the quantification of rapid and easy egress from passenger railcars.
- Support the advancement of fire safety policies and standards for passenger railcars.

## PROJECT PARTNER

- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding: $53,130
- Project Duration: September 2024 – August 2029

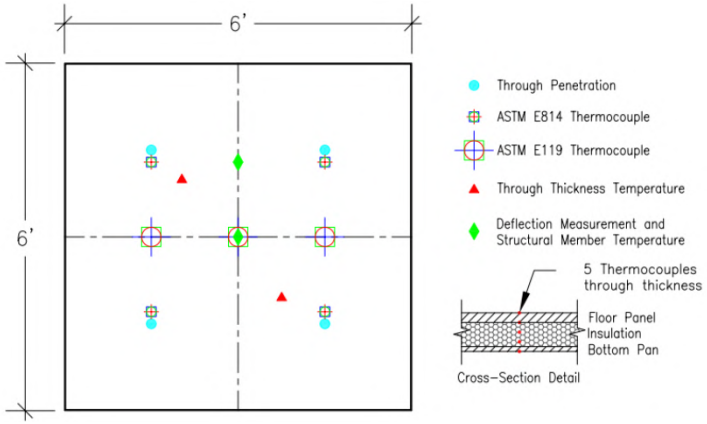


FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland@dot.gov

# Small-Scale Floor Penetration Fire Testing

## PROJECT DESCRIPTION

- Develop a small-scale fire resistance test procedure to evaluate changes in penetrations and insulation for an approved design.
- Determine whether load needs to be applied to small-scale testing.
- Evaluate whether penetrations have similar performance in small- and large-scale tests.
- Assess whether insulation provides similar fire resistance between small- and large-scale tests.
- Evaluate the effects of floor construction material and design.
- Recommend a test method for small-scale railcar floor and penetration test.




## RAILROAD IMPACT

- This research will establish a safe, repeatable method for determining when a small-scale test can be used and the requirements of such a test.
- The research will reduce the cost of conducting floor fire testing for previously qualified floor assemblies and will streamline the approval process.

## PROJECT PARTNERS

- Jensen Hughes, Inc.
- Hatch LTK
- Brian Lattimer (Consultant)

## COST & SCHEDULE

- Funding: $344,232
- Project Duration: July 2024 – January 2026

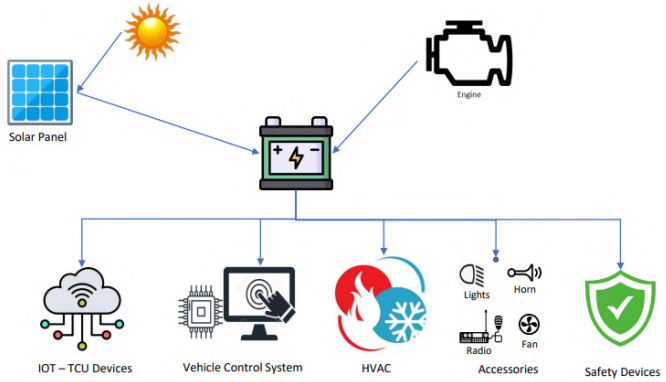


FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland@dot.gov

# Development, Field Testing, and Quantification of Anti-Idling Technology for Rail Maintenance-of-Way Vehicles

## PROJECT DESCRIPTION

- Development a maintenance-of-way (MoW) anti-idling kit.
  - Data collected from 130 MoW vehicles for Class I railroads in 2020 showed approximately 50–70% of engine ON time was used for idling.
- Install and test anti-idling kit during production.
- Analyze and compare MoW vehicle usage statics with and without anti-idling kit.


## RAILROAD IMPACT

- Significant cost savings due to reduced fuel consumption.
- Significant benefit to climate initiatives related to $CO_2$ emissions and fuel usage.

## PROJECT PARTNERS

- Harsco Rail
- TBD partner railroad (for production testing)

## COST & SCHEDULE

- Funding: $218,516
- Project Duration: September 2024 – June 2026

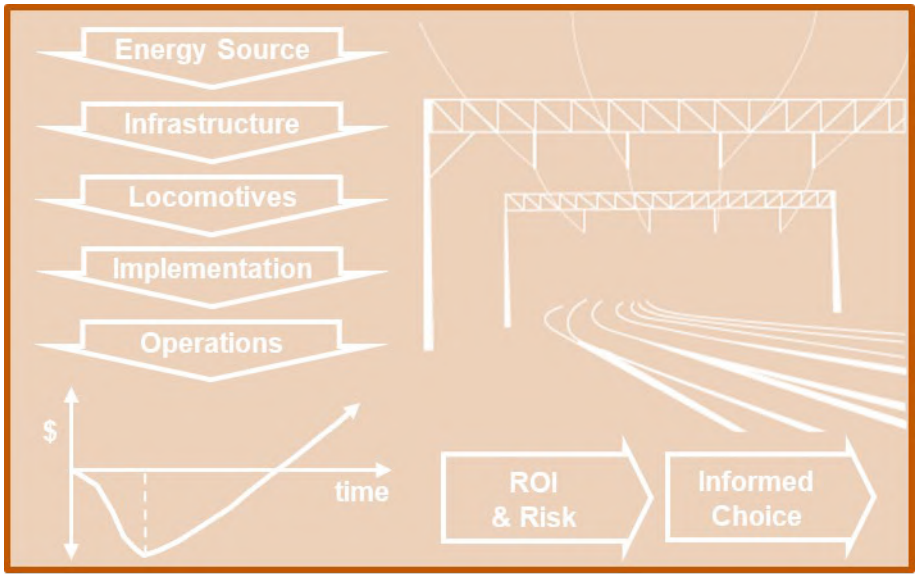


FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland@dot.gov

# Cost and Benefit Risk Framework for Modern Railway Electrification Options

## PROJECT DESCRIPTION

- Develop updated costs and benefits for innovative approaches to railway electrification.
- Review previous electrification studies to identify critical technical and economic barriers.
- Scan alternative technologies and operation and implementation approaches to identify solutions.
- Develop an updated cost-benefit framework that considers a carbon-focused decision environment plus uncertainty and risk in return on investment.
- Case study to show benefit and cost sensitivities.




## RAILROAD IMPACT

- Provide a holistic understanding of primary technical and economic barriers to railway electrification.
- A comprehensive evaluation of new approaches to operations and implementation that improve benefits and reduce costs, timelines, and risk will also guide future research and development.
- A novel Monte Carlo framework for analyzing updated electrification benefits/costs will yield a return on investment distribution to quantify risk.
- Help inform technology decisions and greater certainty in feasibility of new options to electrify.

## PROJECT PARTNERS

- University of Texas at Austin
- Tier 5 Locomotive, LLC
- Jim Blaze, Railroad Economist

## COST & SCHEDULE

- Funding: $200,000
- Project Duration: October 2023 – September 2024

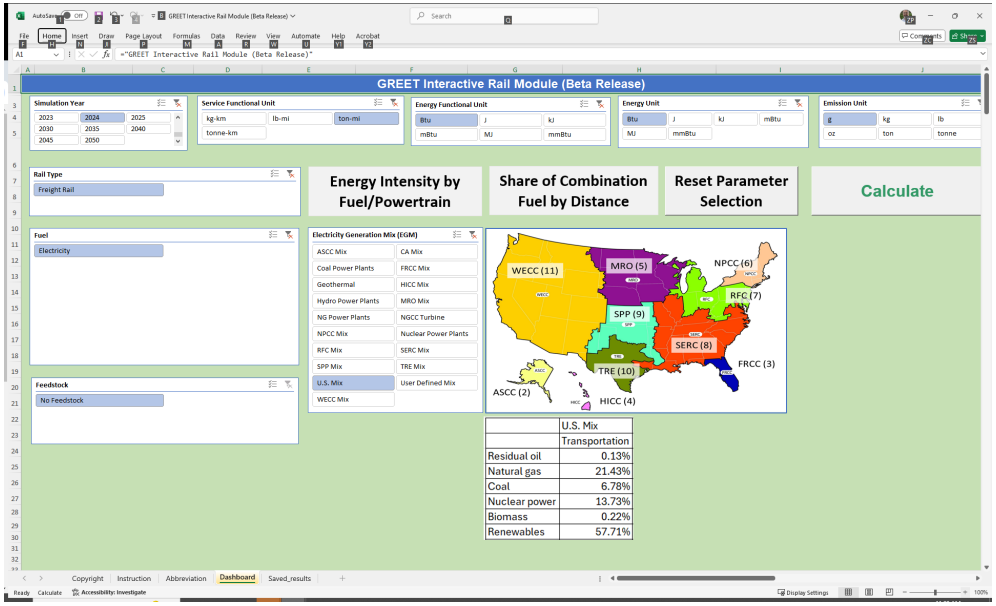


FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland@dot.gov

# GREET Model Rail Module Development

## PROJECT DESCRIPTION

- Evaluate emissions and energy use of alternative fuels in freight and passenger equipment.
- Update and maintain rail module in Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET) Model.
- Review and update the energy intensity of diesel locomotives using publicly available data to develop the baseline energy use in GREET.
- Calculate the well-to-pump fuel production and transportation energy use (by primary resource type; e.g., petroleum and hydrogen, etc.) and emissions (by category; e.g., greenhouse gases and air pollutants).
- Evaluate carbon intensity of alternative fuels and locomotive powertrain technologies (e.g., hybrid, fuel cell, and battery powertrain technologies).




## RAILROAD IMPACT

- Improve the state-of-the-art knowledge on emissions and efficiency of conventional and alternative fuels and powertrains such as diesel, hydrogen fuel cells, battery electric locomotives, and hybrid powertrains.
- Provide a public tool tailored to rail applications for assessment of emissions and engine efficiency based on fuel type and powertrain selection.

## PROJECT PARTNER

- Argonne National Laboratory

## COST & SCHEDULE

- Funding: $300,000
- Project Duration: August 2020 – December 2025



FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland@dot.gov

# Decision Framework for Lifecycle Assessment of Emissions Associated with Railway Track Infrastructure Maintenance

## PROJECT DESCRIPTION

- Perform a railroad life cycle assessment (LCA) framework of passenger and freight railway corridors.
- Include cradle-to-grave analysis, concentrating on track maintenance activities.
- Develop protocols for data collection, impact allocation, and assessment of total $CO_2$ emissions.
- Develop life cycle information models and data quality assessment.
- Create preliminary rail corridor LCA tool and guidance documents.
- Apply the methodology for selected passenger and freight rail corridor case studies.

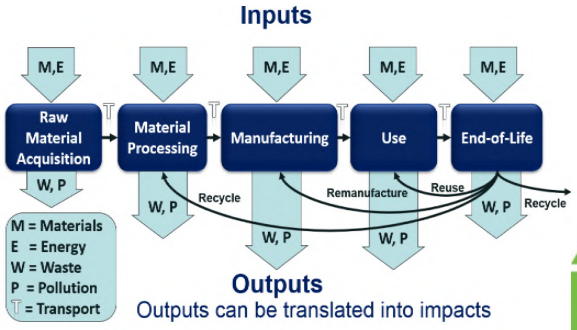
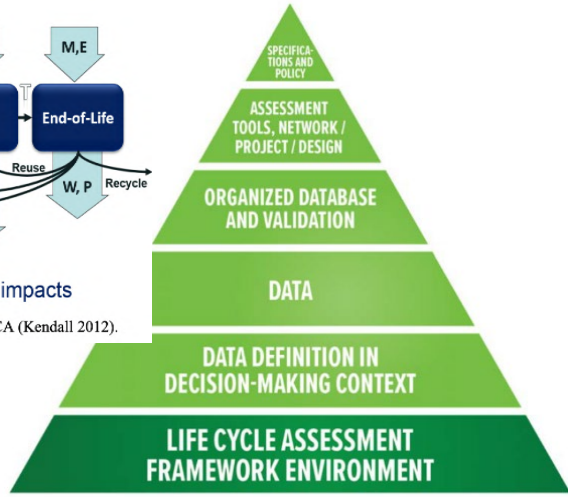



Figure 2-1. Generic life cycle of a production system for LCA (Kendall 2012).




## RAILROAD IMPACT

- Expand benefit-cost analysis to include construction and maintenance phases through LCA.
- Provide a framework for systematic and integrated application of LCA in railway track maintenance.
- Enhance capabilities to compare the environmental impact of railroad vs. other modes.
- Bring together railroad stakeholders to direct the process and contribute data for the LCA analysis.
- Develop first generation of inventory data and preliminary tools for conducting the LCA.

## PROJECT PARTNERS

- Michigan Technological University
- University of Texas at Austin
- WAP Sustainability
- AAR and AREMA Committees

## COST & SCHEDULE

- Funding: $611,964
- Project Duration: August 2022 – July 2025

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland@dot.gov

# Evaluation of Hazards Associated with Powering Rail Vehicles with Alternative Fuel Sources

## PROJECT DESCRIPTION

- Assess the risks associated with transitioning rail vehicle propulsion to clean technologies.
- Focus on Battery Energy Storage Systems (BESS) and hydrogen as fuel sources (i.e., targeting net-zero technologies).
- Review and define the hazards; identify and quantify through calculations and analyses.
- For example, use CFD analysis to simulate ventilation of off-gas from BESS, or the dispersion and build-up of hydrogen from small leaks with the potential for fire or vapour cloud explosion.
- Investigate mitigation systems.

1

Thermal Runaway (BESS)

Starts in a single cell,

2

if unchecked, will propagate

3

… catastrophic consequences.

## RAILROAD IMPACT

- Facilitate safe transition to clean fuels/technologies.
- Improve understanding of key hazards and mitigation measures associated with alternative fuel sources.
- Increase the safety of rail transport.
- Advance towards net-zero decarbonization target.
- Facilitate cross-industry experience.

## PROJECT PARTNERS

- Thornton Tomasetti (Lead)
- Union Pacific
- Anacostia Rail Holdings

## COST & SCHEDULE

- Funding: $232,491
- Project Duration: July 2024 – July 2026



FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland@dot.gov

# Material Longevity and Fire Performance

## PROJECT DESCRIPTION

- Support FRA in investigating potential decay in the fire performance of passenger railcar materials over time.
- Assess the performance of older, in-use materials and identify possible methods to ensure materials have not degraded in performance.
- Identify materials sourcing and document preliminary test specifications.
- Acquire new and in-situ aged railcar materials for ageing and fire performance tests.
- Analyze fire performance test results and provide recommendations for further research or updates to standards.

## RAILROAD IMPACT

- Inform industry and FRA on the expected longevity of material fire performance.
- Gain understanding on the difference in fire test results from the actual materials present in the passenger railcars and the original material composition.

## PROJECT PARTNER

- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding: $170,920
- Project Duration: October 2023 – September 2025



FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland@dot.gov

# Passenger Locomotive Fuel Tank Standards

## PROJECT DESCRIPTION

- Measure fuel tank behavior under common loading scenarios.
- Develop and validate finite element models of various types of fuel tanks.
- Disseminate technical results to industry.
- Collaborate with industry to revise and develop standards for passenger fuel tank.

Photo Credit: US DOT/FRA



Photo Credit: US DOT/FRA

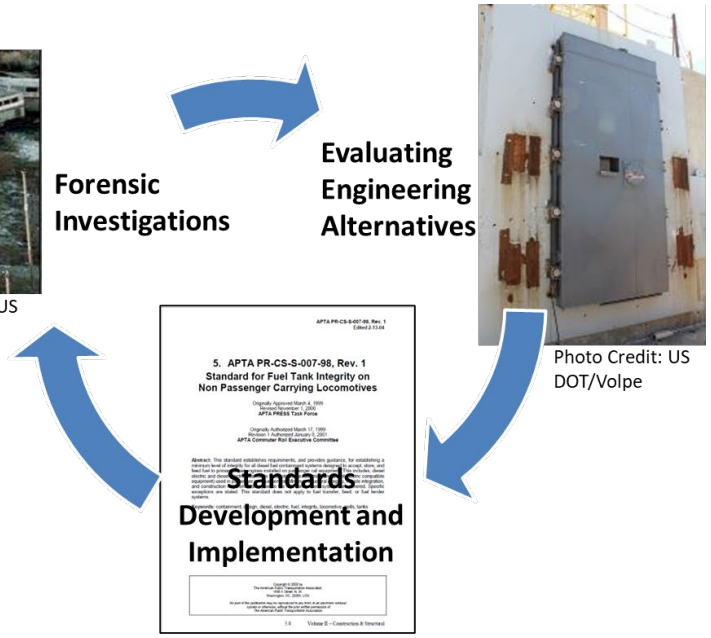



Photo Credit: US DOT/Volpe

## RAILROAD IMPACT

- Develop fuel tank standards applicable to conventional locomotive and non-locomotive fuel tanks.
- Update standard language that accounts for modern engineering analysis.

## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- American Public Transportation Association

## COST & SCHEDULE

- Funding: $200,000
- Project Duration: May 2021 – May 2025

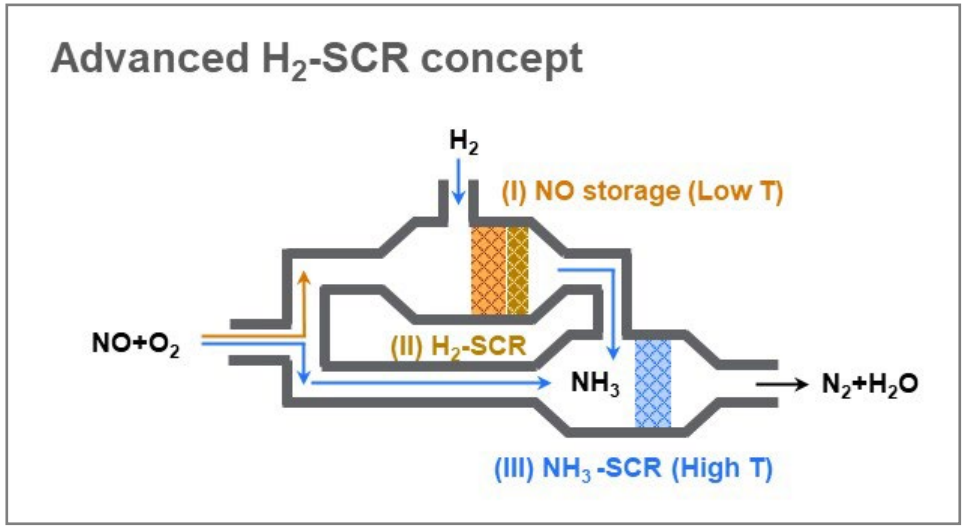


FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland@dot.gov

# Enabling $H_2$-ICE for Domestic Rail Transportation through Advanced Aftertreatment Development

## PROJECT DESCRIPTION

- Identify barriers to high NOx reduction efficiency that current SCR catalysts will face in $H_2$-ICE and $H_2$/diesel dual fuel rail transportation.
- Assess $H_2$-SCR as a complementary strategy to $NH_3$-SCR for broad SCR efficacy that achieves high NOx reduction in typical rail operating cycle.
- Evaluate feasibility of metal-oxide or composite SCR technology to address the limitations that zeolite $NH_3$-SCR catalysts face in rail applications.
- Develop novel architectures and new formulations of SCR catalysts to enhance NOx reduction efficiency and combat catalyst deactivation for $H_2$-ICE rail transport applications.




## RAILROAD IMPACT

- Meet decarbonization targets by enabling ICE shift to $H_2$ as low life-cycle-carbon fuel alternative.
- Meet future emission standards through advanced aftertreatment that addresses the barriers $H_2$-ICE exhaust present to current SCR catalysts.
- Reduce GHG impact by advanced aftertreatment to mitigate $N_2O$ during SCR of NOx.
- Enable advanced aftertreatment over a range of rail notch operating conditions.

## PROJECT PARTNERS

- Pacific Northwest National Laboratory
- Wabtec
- BASF
- Oak Ridge National Laboratory
- Cormetech

## COST & SCHEDULE

- Funding: $350,000
- Project Duration: July 2024 – June 2029

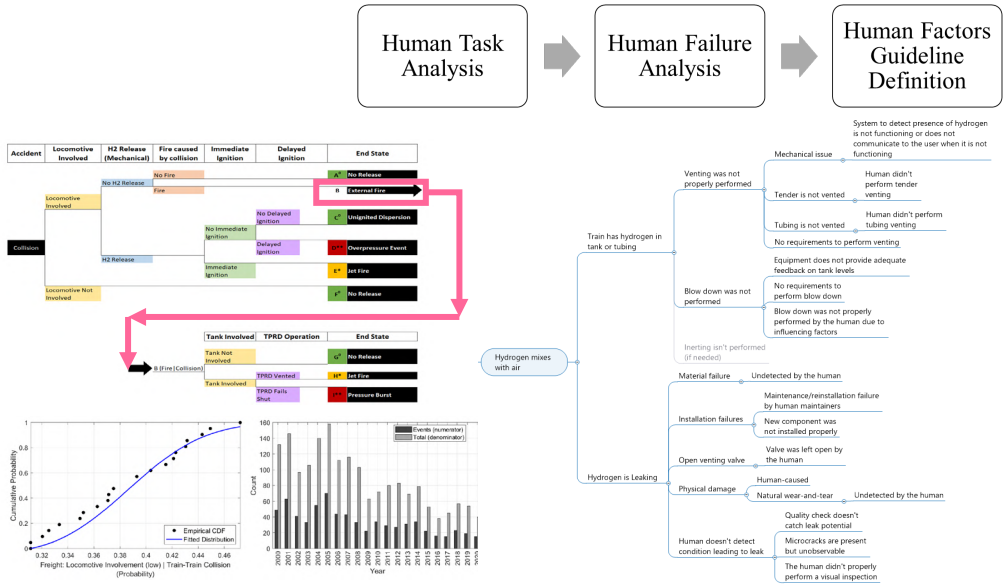


FRA PROJECT MANAGER: Melissa Shurland • (202) 253-6539 • melissa.shurland@dot.gov

# Post-Accident Release of Gaseous Fuels

## PROJECT DESCRIPTION

- Further understand the unknown risks surrounding the use of hydrogen in the rail environment.
- Use the latest available knowledge and technology (computer simulations, risk assessments, literature searches, small scale laboratory testing, etc.) to inform safety decision-makers.
- Undertake multiple tasks that will examine crashworthiness, fire safety, human interaction, and materials compatibility with hydrogen.




## RAILROAD IMPACT

- Alternative fuels such as hydrogen provide clean and efficient propulsion for rail transportation.
- Complete research to identify potential safety issues regarding the use of gaseous or liquid hydrogen, and develop safety recommendations.
- Relevant domestic and global standards, lessons learned, and best practices for using hydrogen fuel and requirements for its use in railroad environment will be reviewed.

## PROJECT PARTNER

- Sandia National Laboratories

## COST & SCHEDULE

- Funding, total: $625,000
- Project Duration: January 2023 – September 2025

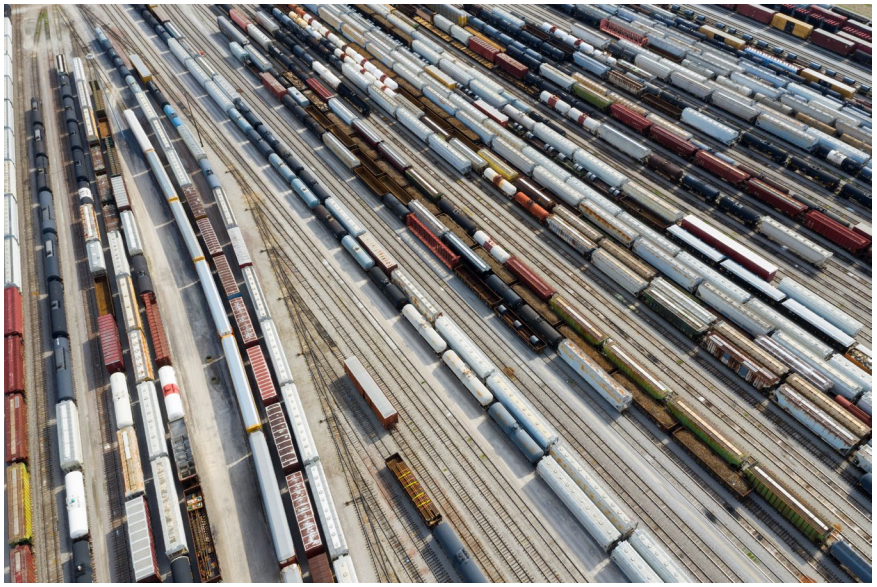

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Melissa Shurland • (202) 493-1316 • melissa.shurland@dot.gov

# Freight Train Pre-Departure Manual Inspection Time Study

## PROJECT DESCRIPTION

- Study the freight train pre-departure inspection process in a controlled and repeatable environment.
- Establish a realistic duration for a Qualified Mechanical Inspector to complete the tasks associated with federally required train inspections and Class I air brake tests.
- Consider the use of technology and wayside data in future phases based on lessons learned.
- Use lessons learned and stakeholder input for possible future phase work.



## RAILROAD IMPACT

- Build industry understanding of the pre-departure inspection process in a controlled, repeatable, and scientific manner.
- Allow for more efficient operational decision making through data gathering and analysis.
- Increase safety by better understanding the inspection resources required for adequate inspections.
- Increase safety by exploring technological advancements.

## PROJECT PARTNERS

- ENSCO, Inc.
- Transportation Communications Union
- Brotherhood of Railway Carmen

## COST & SCHEDULE

- Funding, FY25: $326,000
- Project Duration: October 2024 – March 2025



FRA PROJECT MANAGER: John Manutes • (202) 744-1030 • john.manutes@dot.gov

# Participation in International Standards Organization (ISO) Technical Committee 269 – Railway Applications

## PROJECT DESCRIPTION

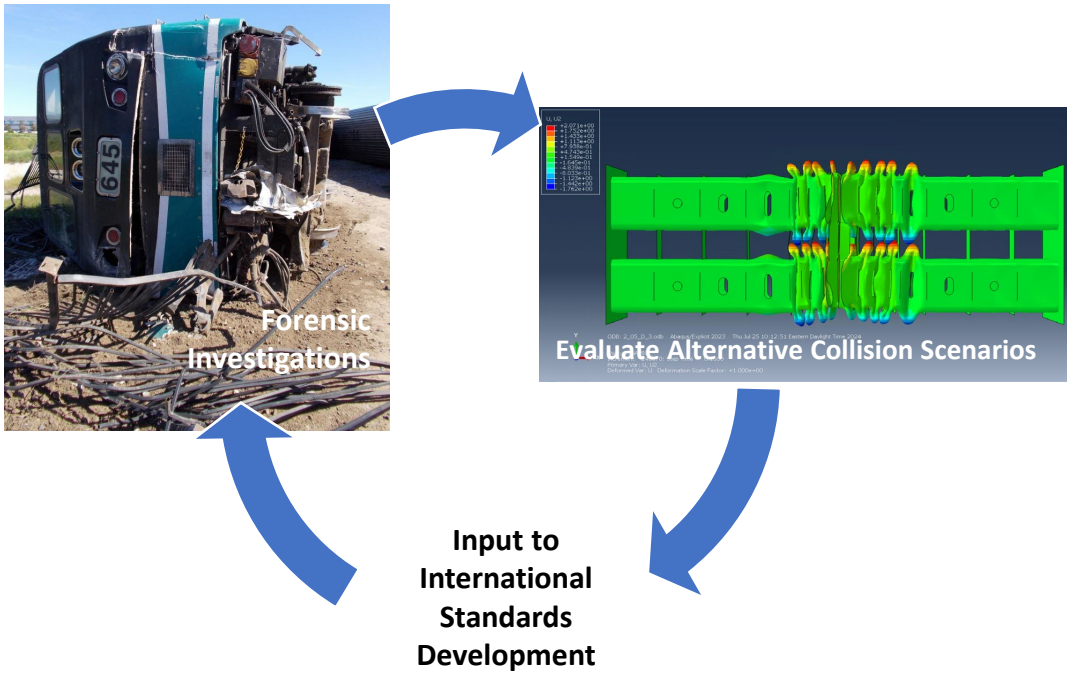
- Provide administrative support and leadership for the U.S. Technical Advisory Group (TAG) to ISO Technical Committee 269 – Railway Applications.
- Participate as subject matter experts in the working groups of ISO TC/269, Subcommittee (SC) 1 – Infrastructure and SC 2 – Rolling Stock.
- Represent U.S. rail safety interests in the development of international rail standards.

## RAILROAD IMPACT

- The establishment of the U.S. TAG permits U.S. participation in the development of international rail safety standards.
- U.S. participation also enhances understanding of the technical basis for proposed ISO standards, which could facilitate adoption of ISO standards, or development of more harmonious U.S. regulations and standards.

## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- American National Standards Institute




## COST & SCHEDULE

- Funding: $432,700
- Project Duration: May 2021 – May 2025



FRA PROJECT MANAGER: John Manutes • (202) 744-1030 • john.manutes@dot.gov

# Locomotive Structural Crashworthiness Program

## PROJECT DESCRIPTION

- Demonstrate effectiveness of crashworthy components in preventing override in collisions involving locomotives.
- Evaluate performance of the combination of a push-back coupler and deformable anti-climber under full-scale dynamic impact scenarios.
- Design combined crashworthy components as a crash energy management (CEM) system, which can be retrofit to existing locomotives.
- Perform individual component testing to demonstrate performance and develop technical information to inform finite element modeling.
- Perform routine coupling tests to develop range of expected impact forces and to demonstrate designed behavior.
- Perform full-scale vehicle-to-vehicle impact tests to assess the performance of the retrofit CEM system in a moderate-speed collision for a range of impacted equipment.
- Perform full-scale train-to-train impact test to demonstrate the performance of the retrofit CEM system within a consist in a moderate-speed collision.
- Development of locomotive crashworthiness standards.

## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- CAMX
- ENSCO, Inc.
- CANARAIL

Photo Credit: US DOT/FRA

## RAILROAD IMPACT

- Develop and demonstrate the effectiveness of the locomotive CEM system in improving locomotive crashworthiness by inhibiting override and lateral buckling and absorbing collision energy.
- Demonstrate that CEM features can be retrofit onto existing locomotives and are reparable, serviceable, and compatible with a range of impacting equipment.
- Mitigate the propensity for override reduces fatalities and serious injuries in rail accidents.
- Test program results and validated computer models inform the development of locomotive crashworthiness standards.

## COST & SCHEDULE

- Funding: $1.4M, ~$280K per year
- Project Duration: May 2020 – May 2025

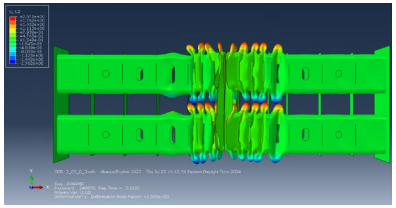


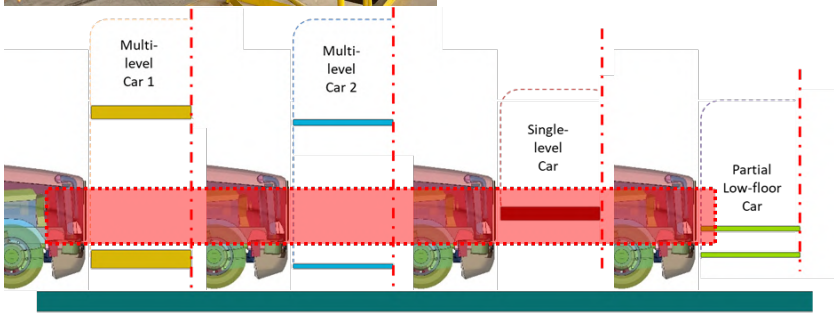
FRA PROJECT MANAGER: John Manutes • (202) 744-1030 • john.manutes@dot.gov

# Passenger Equipment Structural Integrity Research

## PROJECT DESCRIPTION

- Develop design strategies for improving the structural crashworthiness of passenger railcars over existing designs.
- Model common passenger car side structure designs under typical side impact load scenario.
- Develop and validate Arrow III passenger car finite element model through buff strength testing.
- Assess crash energy management designs for lateral stability.
- Assess pushback coupler compatibility.






## RAILROAD IMPACT

- Data and information resulting from this research are used in the development of specifications and regulations.
- Recent improvements to passenger car structural integrity based on this project reduce the fatalities associated with a variety of common accident scenarios.

## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- ENSCO, Inc.

## COST & SCHEDULE

- Funding: $625,000
- Project Duration: May 2020 – May 2025



FRA PROJECT MANAGER: John Manutes • (202) 744-1030 • john.manutes@dot.gov

# Technical Review of Vehicle Track Interaction in New Rail Equipment

## PROJECT DESCRIPTION

- Develop and apply regulations and industry standards to promote the safe interaction of rail vehicles with the track over which they operate.
- Provide technical review of rail equipment from the standpoint of derailment safety and performance evaluation based on the design and condition of the suspension and operating conditions.
- Provide technical support in evaluating and methods for measuring and characterizing the condition of wheel profiles.


## RAILROAD IMPACT

- Reduce the likelihood of derailment in passenger trains on the general railroad system.

## PROJECT PARTNERS

- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding: $580,000
- Project Duration: May 2020 – May 2025



FRA PROJECT MANAGER: John Manutes • (202) 744-1030 • john.manutes@dot.gov

# Forensics Trainings for FRA Inspectors

## PROJECT DESCRIPTION

- Conduct forensics investigations of major accidents on the general railroad system.
- Determine the causal mechanisms of injuries and fatalities.
- Develop curricula for FRA's forensics trainings.
- With the FRA Office of Railroad Safety, develop curricula for FRA's forensics training courses for FRA inspectors.

## RAILROAD IMPACT

- Document trends in passenger train accidents and incidents.
- Develop improvements through passenger train research programs to reduce the likelihood of fatalities and injuries in passenger train accidents, e.g.. glazing, rollover, side structure integrity, alternative propulsion equipment.
- FRA workforce development

## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- National Transportation Safety Board


## COST & SCHEDULE

- Funding: $255,000
- Project Duration: May 2023 – May 2025

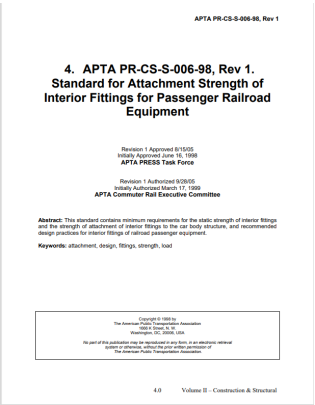


FRA PROJECT MANAGER: John Manutes • (202) 744-1030 • john.manutes@dot.gov

# Standards Development Support

## PROJECT DESCRIPTION

- Facilitate industry discussions, present technical research results related to standards, propose improvements to standards based on FRA research, incorporate comments, draft section analyses and briefing documents, as needed.
- Share the results of rail equipment safety research with industry through equipment reviews, regulatory development groups such as RSAC, and industry standard development working groups such as APTA, generating discussion and collaboration.
- Support FRA Office of Railroad Safety by reviewing documentation submitted by railroads to support compliance or waiver requests.


APTA PR-CS-S-006-98, Rev 1

4. APTA PR-CS-S-006-98, Rev 1. Standard for Attachment Strength of Interior Fittings for Passenger Railroad Equipment

Revision 1 Approved 8/15/05
Initially Approved June 16, 1998
APTA PRESS Task Force

Revision 1 Authorized 9/28/05
Initially Authorized March 17, 1999
APTA Commuter Rail Executive Committee

Abstract: This standard contains minimum requirements for the static strength of interior fittings and the strength of attachment of interior fittings to the car body structure, and recommended design practices for interior fittings of railroad passenger equipment.

Keywords: attachment, design, fittings, strength, load






## RAILROAD IMPACT

- Improve industry standards by incorporating research results.
- Implement safer equipment design and practices.

## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- FRA Office of Railroad Safety

## COST & SCHEDULE

- Funding: $600,000
- Project Duration: May 2020 – May 2025



FRA PROJECT MANAGER: John Manutes • (202) 744-1030 • john.manutes@dot.gov

# Evaluation of Passenger Car Coupler Strength in Rollover

## PROJECT DESCRIPTION

- Develop technical data to support the assessment of rollover in accidents.
- Create requirements for testing and analysis of Type-H Tightlock coupler under torsion load.
- Review the results of engineering analysis and testing of the torsional strength and critical failure locations of couplers.


## RAILROAD IMPACT

- Measurement of torsional coupler strength can be used in derailment and accident models.
- Technical data provided to railroad industry can inform technical specifications.

## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Sharma & Associates, Inc.

## COST & SCHEDULE

- Funding: $50,000
- Project Duration: May 2020 – May 2025



FRA PROJECT MANAGER: John Manutes • (202) 744-1030 • john.manutes@dot.gov

# Acquisition, Transportation, and Maintenance of Failed/Damaged Rail Tank Cars and Components

## PROJECT DESCRIPTION

- Acquire, transport, and store tank cars and tank car components which have been involved in accidents/incidents.
- Document the inventory.
- Maintain the storage location.
- Provide material testing support.


## RAILROAD IMPACT

- Training FRA Inspectors in proper techniques and procedures to perform damage assessment and casual factor evaluations will provide the Inspectors with the knowledge, skills, and abilities required to complete adequate evaluations and documentations.
- Support rail accidents/incidents investigation and analysis.

## PROJECT PARTNER

- ENSCO, Inc.

## COST & SCHEDULE

- Funding: $330,000
- Project Duration: July 2024 – July 2026



FRA PROJECT MANAGER: Brian Won • (202) 893-6468 • brian.won@dot.gov

# Full-Scale Tank Car Crash Testing

## PROJECT DESCRIPTION

- Conduct full-scale tank car impact tests and corresponding data analysis to evaluate the crashworthiness performance of tank cars used in the transportation of hazardous materials, including those transporting toxic by inhalation materials (TIH) and cryogenic liquids.
- The current scope of work includes three tests:
  - Acquire and inspect tank car for testing.
  - Develop the test plans and prepare the tank car for testing.
  - Install the instrumentation.
  - Conduct the test.
  - Analyze the data.
  - Conduct post-test activities (material testing, inspections and measurements, etc.)


## RAILROAD IMPACT

- Increase knowledge of tank car performance in derailment load conditions.
- Provide experimental data for tank car manufacturers for development and design improvements.
- Provide data for the verification and refinement of computational models expanded talent pool of rail professionals.
- Provide technical information to inform regulatory activities.

## PROJECT PARTNERS

- ENSCO, Inc.
- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding: $700,000
- Project Duration: September 2022 – March 2026

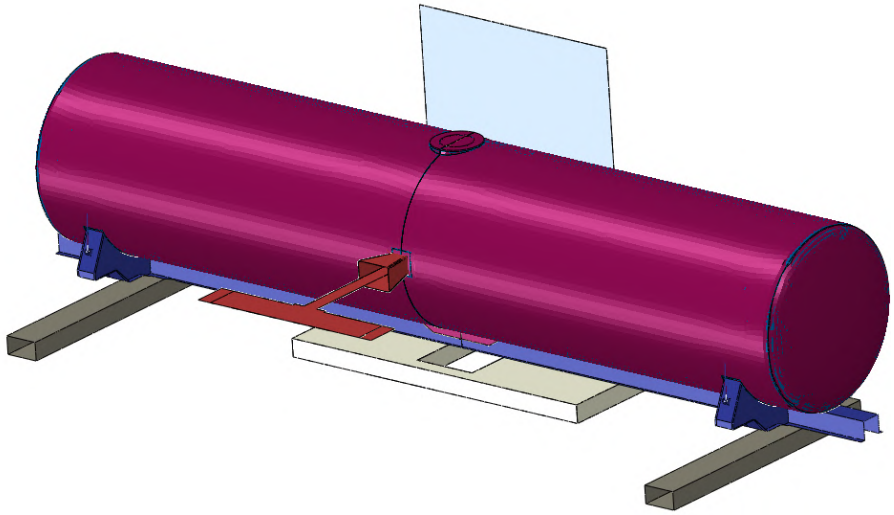


FRA PROJECT MANAGER: Brian Won • (202) 893-6468 • brian.won@dot.gov

# Tank Car Impact and Puncture Analysis

## PROJECT DESCRIPTION

- Evaluate the puncture resistance of tank cars with various specifications in standardized shell impact scenarios.
- Validate computational models so they can reliably be used to study service conditions with HazMat.
- Study the effects of cryogenic temperature on puncture behavior of DOT 113 tank cars.
- Study the effects of liquid $CO_2$ temperature on the puncture resistance of DOT 105 tank cars.
- Study the effects of anhydrous ammonia at its anticipated volume and pressure inside DOT 112 tank cars and the resulting effects on puncture resistance.
- Develop computational models of tank car designs under impact conditions, including cryogenic conditions.
- Compare test data with model results to validate models and improve modeling techniques.
- Analyze the effectiveness of “breakaway” tank car stub sill attachment design practice.



## RAILROAD IMPACT

- Develop methods to evaluate and compare the crashworthiness and structural integrity of different tank car design features (e.g., different materials and material thicknesses).
- Evaluate the crashworthiness performance of tank cars used in the transportation of hazardous materials.
- Develop objective methods for demonstrating the validation of computational models.

## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- ENSCO, Inc.
- U.S. Pipeline and Hazardous Materials Safety Administration

## COST & SCHEDULE

- Funding, FY24: $250,000
- Project Duration: May 2020 – May 2025

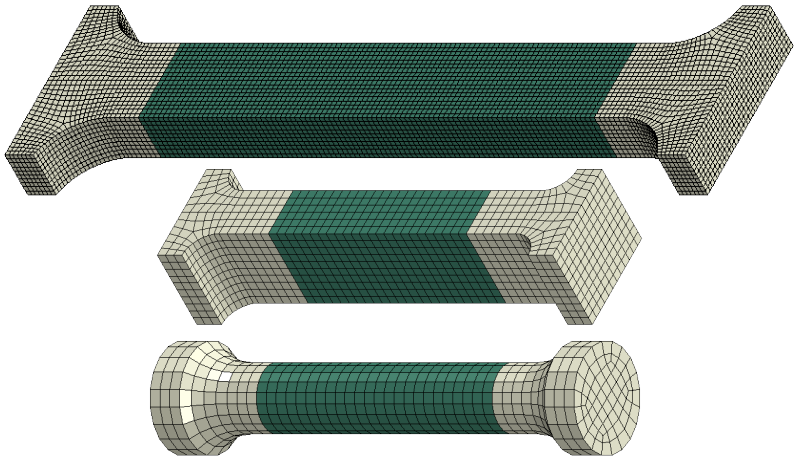


FRA PROJECT MANAGER: Brian Won • (202) 893-6468 • brian.won@dot.gov

# Behavior of Tank Car Construction Materials

## PROJECT DESCRIPTION

- Conduct material testing to determine the mechanical properties and fracture behavior of tank car steels.
- Examine the properties of and develop computation models for stainless steel(s) used in cryogenic tank cars (DOT 113).
- Examine the properties of and develop computational models for TC128-B tank car steel in different welded conditions.



## RAILROAD IMPACT

- Understand the range of material behaviors in tank car fleet needed to determine baseline tank car fleet structural performance.
- Develop computational models of these materials supports parametric studies of material variations.
- Previous research has focused on mechanical properties of carbon steels (e.g., TC128).
- DOT 113 tank cars use a carbon steel outer tank/stainless steel inner tank at cryogenic temperature.
- Understand stainless steel behaviors under cryogenic operating conditions is necessary to determine baseline DOT 113 structural performance; examine alternative designs.
- Understand the performance of unique TC128-B welds found on DOT 113 tank cars improves puncture models over a range of scenarios.

## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- ENSCO, Inc.
- Sharma & Associates
- National Institute of Standards & Technology

## COST & SCHEDULE

- Funding, FY24: $400,000
- Project Duration: May 2020 – September 2025



FRA PROJECT MANAGER: Brian Won • (202) 893-6468 • brian.won@dot.gov

SECTION THREE

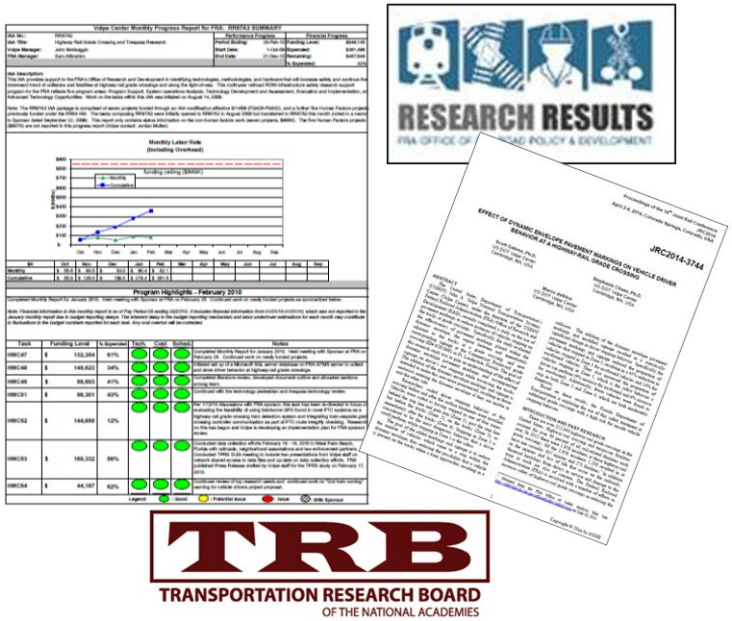
# TRAIN CONTROL & COMMUNICATION

U.S. Department of Transportation
Federal Railroad Administration

# Grade Crossing and Trespass Research Program Support

## PROJECT DESCRIPTION

- Provide program management and quick response, conduct special studies not covered in any existing task, and provide support for other requests requiring immediate attention.
- Participate in professional activities within the scope of research topic which are not specifically funded under another task (e.g., TRB AHB60 Committee, AREMA, ITE, technical papers).
- Exchange information on cutting edge technologies and/or strategies for grade crossing safety and trespass prevention (including outreach to FRA grade crossing managers).
- Provide reports to define and track, on a periodic basis, key activities in support of the research program.




## RAILROAD IMPACT

- Provide for information exchange with State DOTs and railroads on cutting edge technologies and/or strategies for grade crossing safety and trespass prevention.
- Provide quick response capability in support of FRA R&D.
- Provide support to FRA R&D on studies requiring immediate action not covered in any existing task.

## PROJECT PARTNER

- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding: $462,619
- Project Duration: July 2021 – July 2026



FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

# Grade Crossing Lights Flash Rate Research

## PROJECT DESCRIPTION

- Research the effectiveness of changing the flash rate of grade crossing flashers on driver compliance with grade crossing warning devices.
- The Massachusetts Dept. of Transportation (MassDOT), in collaboration with the FRA Office of Railroad Safety (RRS), has submitted a request for experimentation to the FHWA for this technology.
- FRA RRS requested R&D support with evaluation of the technology and effect on driver compliance at a grade crossing on the MBTA system in Canton, MA (Crossing ID 546729P).
- Volpe National Transportation Systems Center researchers will collect data at the crossing before and after the installation of rapid flashing LED flashers and evaluate driver compliance.


## RAILROAD IMPACT

- Develop, implement, and evaluate techniques or technologies that reduce violations of grade crossing traffic control devices that may lead to incidents and casualties (2,197 incidents and 274 fatalities at crossings in 2022).
- Facilitate implementation and evaluation of innovative safety technologies.
- Provide FRA partners with information on cutting-edge technologies and/or strategies for grade crossing safety.
- Partner with State DOTs and railroads.

## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- MassDOT
- MBTA
- Keolis Rail Services America

## COST & SCHEDULE

- Funding: $200,000
- Project Duration: February 2023 – September 2025



FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

# Enhanced ENS Signage Research

## PROJECT DESCRIPTION

- To evaluate the effectiveness of adding a “NOTICE” sign (MUTCD W16-18P) to the existing Emergency Notification System (ENS) sign at highway-rail grade crossings.
- Addition of the NOTICE sign may increase ENS sign visibility to the public. To this end, Volpe is supporting FRA in partnering with a transit agency to evaluate the impact of adding these signs on ENS sign visibility.
- The Massachusetts Dept. of Transportation (MassDOT), in collaboration with FRA RRS, has submitted a request for experimentation to the Federal Highway Administration for this signage combination.
- Anticipated activities: site selection, baseline data collection, installation, post data collection, analysis/report.


## RAILROAD IMPACT

- Identify and evaluate potential location and enhancements of current ENS signs to increase visibility/conspicuity to the public.
- Potentially provide incident-preventing warning to an operating railroad ahead of potential crash at a crossing due to a stalled or stuck vehicle.
- Provide supported analysis for potential legislative processes.
- Provide partnerships with State DOTs and railroads.

## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- MassDOT
- MBTA
- METRA (anticipated)

## COST & SCHEDULE

- Funding: $100,000
- Project Duration: March 2023 – December 2025



FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

# Innovative Pedestrian Crossing Technologies

## PROJECT DESCRIPTION

- Review, select, and evaluate emerging technologies and application for detecting and warning pedestrians violating grade crossing protection devices.
- Develop and field test a pedestrian detection and warning prototype system for grade crossing applications.
- New technologies or approaches to mitigate this problem, such as pedestrian warning boxes currently operational in Belgium, will be investigated for possible demonstration at high-risk locations.
- Further development and evaluation of artificial intelligence tools for pedestrian trespass detection will also be investigated.

## RAILROAD IMPACT

- Demonstrate and evaluate new technologies and strategies that increase pedestrian safety at grade crossings. There were 163 pedestrian incidents at grade crossings in 2022 (about 7% of the total crossing incidents).
- Provide partnerships with State DOTs and railroads.
- Facilitate implementation and evaluation of innovative safety technologies.
- Provide information exchange with rail safety partners on cutting edge technologies and/or strategies.

## PROJECT PARTNER

- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding: $200,000
- Project Duration: March 2023 – September 2025

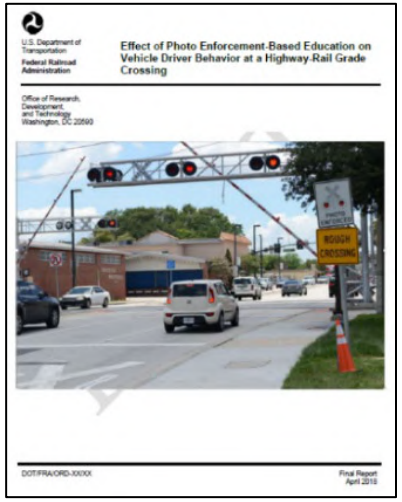


FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

# Grade Crossing Toolkit

## PROJECT DESCRIPTION

- Support the development of a highway-rail grade crossing safety measures toolkit, like the rail ROW trespass mitigation measures toolkit currently under development by FRA Research, Development, and Technology.
- This toolkit will contain guides, noteworthy practices, and research results on implementation of a wide range of grade crossing safety treatments.
- Such a resource has been developed in Europe and is widely used: SAFER-LC Toolbox (https://safer-lc.eu/).
- FRA has developed a toolkit for rail trespass and suicide treatments (https://trespasstoolkit.fra.dot.gov/) and has identified the need for a similar resource repository for grade crossing safety countermeasures for U.S. stakeholders.

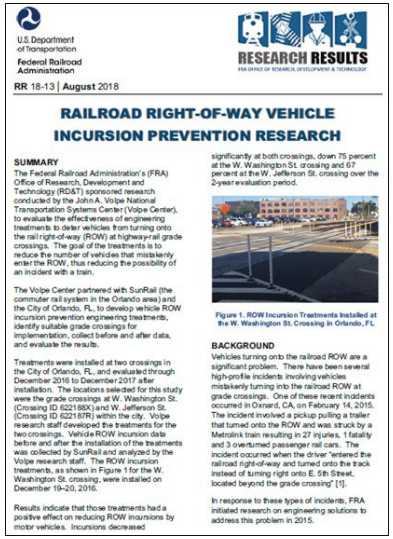

U.S. Department of Transportation
Federal Railroad Administration

Effect of Photo Enforcement-Based Education on Vehicle Driver Behavior at a Highway-Rail Grade Crossing

Office of Research, Development, and Technology
Washington, DC 20590

DOT/FRA/ORD-XX/XX

Final Report
April 2018


U.S. Department of Transportation
Federal Railroad Administration

RESEARCH RESULTS

RR 18-13 | August 2018

RAILROAD RIGHT-OF-WAY VEHICLE INCURSION PREVENTION RESEARCH

SUMMARY

The Federal Railroad Administration's (FRA) Office of Research, Development and Technology (RD&T) sponsored research conducted by the John A. Volpe National Transportation Systems Center (Volpe Center), to evaluate the effectiveness of engineering treatments to deter vehicles from turning onto the rail right-of-way (ROW) at highway-rail grade crossings. The goal of the treatments is to reduce the number of vehicles that mistakenly enter the ROW, thus reducing the possibility of an incident with a train.

The Volpe Center partnered with SunRail (the commuter rail system in the Orlando area) and the City of Orlando, FL, to develop vehicle ROW incursion prevention engineering treatments, identify suitable grade crossings for implementation, collect before and after data, and evaluate the results.

Treatments were installed at two crossings in the City of Orlando, FL, and evaluated through December 2016 to December 2017 after installation. The locations selected for this study were the grade crossings at W. Washington St. (Crossing ID 622188X) and W. Jefferson St. (Crossing ID 622187R) within the city. Volpe research staff developed the treatments for the two crossings. Vehicle ROW incursion data before and after the installation of the treatments was collected by SunRail and analyzed by the Volpe research staff. The ROW incursion treatments, as shown in Figure 1 for the W. Washington St. crossing, were installed on December 19–20, 2016.

Results indicate that those treatments had a positive effect on reducing ROW incursions by motor vehicles. Incursions decreased significantly at both crossings, down 75 percent at the W. Washington St. crossing and 67 percent at the W. Jefferson St. crossing over the 2-year evaluation period.

Figure 1. ROW Incursion Treatments Installed at the W. Washington St. Crossing in Orlando, FL

BACKGROUND

Vehicles turning onto the railroad ROW are a significant problem. There have been several high-profile incidents involving vehicles mistakenly turning into the railroad ROW at grade crossings. One of these recent incidents occurred in Oxnard, CA, on February 14, 2015. The incident involved a pickup pulling a trailer that turned onto the ROW and was struck by a Metrolink train resulting in 27 injuries, 1 fatality and 3 overturned passenger rail cars. The incident occurred when the driver "entered the railroad right-of-way and turned onto the track instead of turning right onto E. 5th Street, located beyond the grade crossing" [1].

In response to these types of incidents, FRA initiated research on engineering solutions to address this problem in 2015.

## RAILROAD IMPACT

- Provides FRA partners with information on cutting-edge technologies and/or strategies for grade crossing safety.
- Fosters an exchange of information on grade crossing safety countermeasures between all stakeholders.
- Facilitate implementation and evaluation of innovative safety technologies.
- Facilitates development of site-specific strategies for grade crossings, thereby improving rail safety.

## PROJECT PARTNER

- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding: $225,000
- Project Duration: July 2021 – June 2025



FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

# SSM/ASM Effectiveness in Quiet Zones

## PROJECT DESCRIPTION

- Study the effectiveness of Supplementary Safety Measures (SSMs) and Alternative Safety Measures (ASMs) implemented at quiet zones.
- Collect incident data at grade crossing before and after the installation of SSMs and ASMs to determine the effects of implementation of those measures.
- Localities wanting to establish a quiet zone must first mitigate the increased risk at grade crossings caused by the absence of a horn. This is typically done through SSMs such as gates with channelization or medians, four-quadrant gates, one-way streets with gates, and crossing closures.
- SSMs are engineering improvements, which when installed at highway-rail grade crossings within a quiet zone, would reduce the risk of a collision at the crossing.


## RAILROAD IMPACT

- Provides updated safety measures effectiveness ratings. Current effectiveness ratings were developed 15+ years ago and need to be updated.
- Provide supported analysis for potential legislative processes.

## PROJECT PARTNER

- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding: $250,000
- Project Duration: March 2023 – September 2024

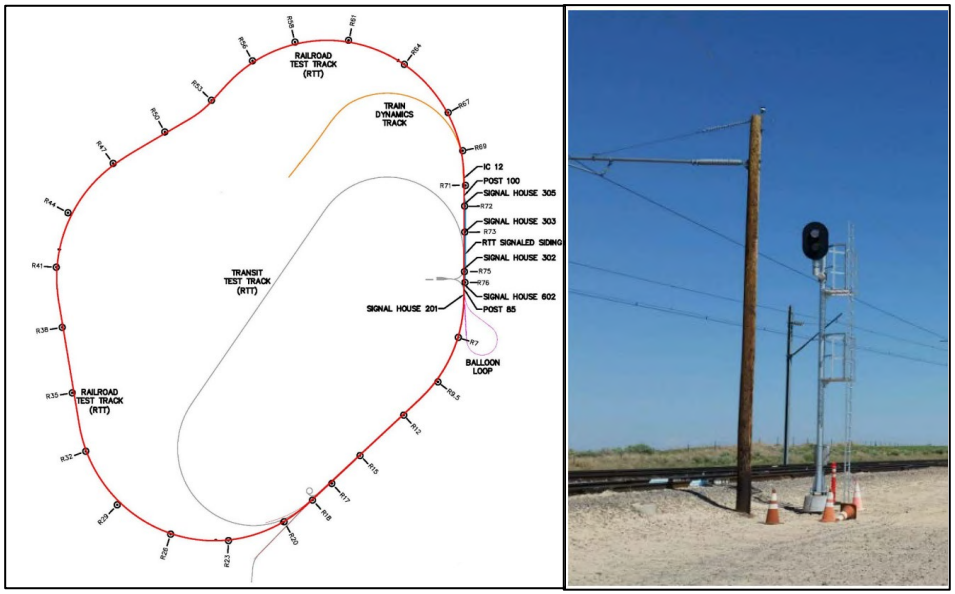


FRA PROJECT MANAGER: Francesco Bedini Jacobini • (202) 493-0800 • Francesco.Bedini@dot.gov

# TTC Signaling and PTC Systems Rehabilitation and Configuration Management

## PROJECT DESCRIPTION

- Survey and inventory existing signaling and Positive Train Control (PTC) systems on the Railroad Test Track (RTT) and Transit Test Track (TTT) at FRA's Transportation Technology Center (TTC).
- Develop upgraded designs of signaling and PTC systems to accurately represent rail revenue service environments.
- Implement the upgraded designs and recommission the signaling and PTC systems at TTC.
- Develop a configuration management plan for the systems to support operation and testing.
- Develop a long-term maintenance plan of the infrastructure.




## RAILROAD IMPACT

- Enhance testing capabilities of TTC.
- Provide safety to operations and testing on the RTT and TTT tracks at TTC.
- Provide a modern platform to support testing of new signaling and PTC equipment.

## PROJECT PARTNER

- ENSCO, Inc.

## COST & SCHEDULE

- Funding: $5,023,697
- Project Duration: August 2023 – February 2025



FRA PROJECT MANAGER: Jared Withers • (202) 450-0808 • jared.withers@dot.gov

# TTC Grade Crossing Protection System Upgrade

## PROJECT DESCRIPTION

- Survey and inventory existing active grade crossing protection systems at Post 100 and Post 85 of the FRA Transportation Technology Center (TTC).
- Develop active grade crossing protection systems designs to accurately represent the current state of the technology.
- Implement the designs and recommission the active grade crossing protection systems at Post 100 and Post 85 of TTC.
- Develop a configuration management plan for the systems to support operation and testing.
- Develop a long-term maintenance plan of the infrastructure.

## RAILROAD IMPACT

- Improve safety to railway and road operations during testing on the railroad tracks that cross Post 85 and Post 100 at TTC.
- Provide a modern platform to support testing of new grade crossing protection systems.
- Enhance grade crossing capabilities to support potential testing of the other transportation modes involved in the grade crossing safety.


## PROJECT PARTNER

- ENSCO, Inc.

## COST & SCHEDULE

- Funding: $1,587,684
- Project Duration: August 2023 – March 2025

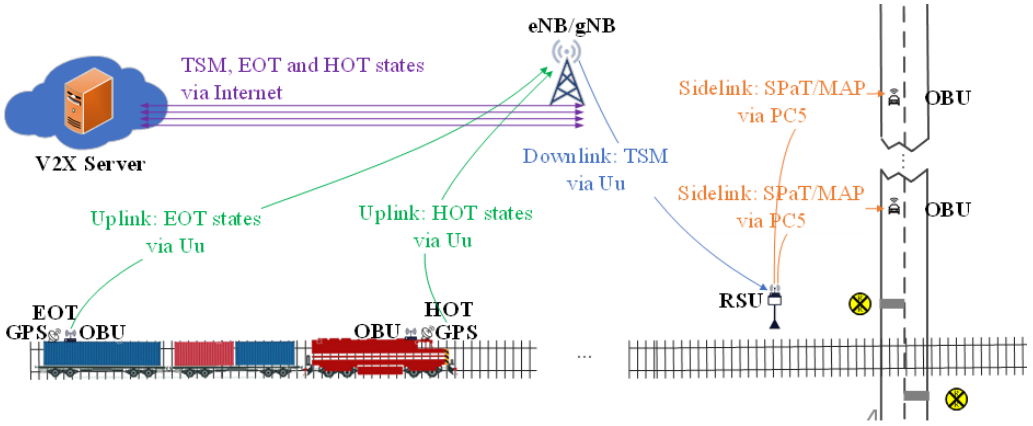


FRA PROJECT MANAGER: Jared Withers • (202) 450-0808 • jared.withers@dot.gov

# C-V2X Train Arrival and Departure Information at Grade Crossings – Assessment

## PROJECT DESCRIPTION

- Evaluate the performance and analyze the feasibility of C-V2X (cellular vehicle-to-everything) communication to provide real-time train status (i.e., position, speed, and heading information) and predicted train approaching and departure information to connected vehicles at grade crossings via field testing.
- Design, build, and test C-V2X 4G/5G-based rail crossing violation warning (RCVW) architecture to support passive grade crossing warning.
- Evaluate a cloud-based solution for predicted signal, phase, and timing (SPAT) for grade crossings.
- Develop train-specific messaging requirements and advocate for their inclusion in SAE/IEEE communication standards.




## RAILROAD IMPACT

- Propose and analyze a solution to expand the RCVW architecture to support passive grade crossings which enhances the applicability of the architecture.
- The proposed solution and feasibility assessment will provide guidance on future research needs and/or prototypes that improve safety of connected vehicles at grade crossings.
- Improve grade crossing safety.

## PROJECT PARTNERS

- ENSCO, Inc.
- Michigan Technological University

## COST & SCHEDULE

- Funding: $1,258,514
- Project Duration: August 2023 – August 2025

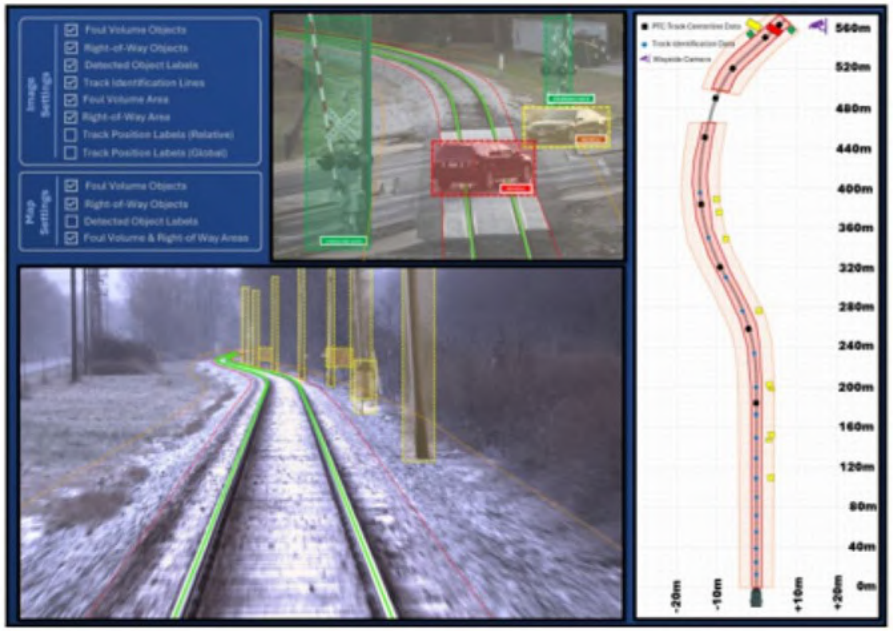


FRA PROJECT MANAGER: Jared Withers • (202) 450-0808 • jared.withers@dot.gov

# Integrating PTC and Automotive Technology for Robust Foul Volume Object Detection

## PROJECT DESCRIPTION

- Use perception technology from the automotive sector to enhance foul volume hazard detection and classification.
- Integrate wayside camera data into existing onboard perception capabilities.
- Integrate both wayside camera and onboard sensing outputs into PTC track database map.
- Develop and evaluate engineer point protection, assist user interface, and evaluate with subject matter experts.




## RAILROAD IMPACT

- Provide locomotive engineer assist system for object detection.
- Establish baseline for object classification based on ATO specifications.
- Evaluate the feasibility of relevant AAR functional specifications for ATO Sensor Package and Support System.

## PROJECT PARTNERS

- Wabtec Corporation
- FEV Group
- Clover Crest Technology

## COST & SCHEDULE

- Funding, FY24: $1,022,659
- Project Duration: October 2024 – September 2025

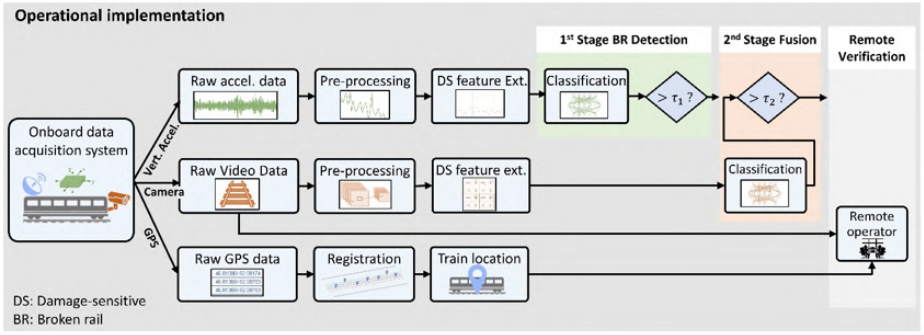


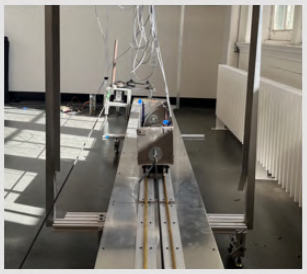
FRA PROJECT MANAGER: Jared Withers • (202) 450-0808 • jared.withers@dot.gov

# Real-Time Broken Rail Detection Using Onboard Monitoring Capabilities

## PROJECT DESCRIPTION

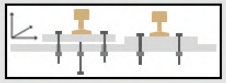
- Create an onboard technology that automatically detects broken rails as they occur (i.e., upon first pass).
- Use the existing TRL 5, laboratory-scaled, railcar-track system (controllable with modular rail break patterns) and algorithms to develop broken rail detector.
- Detector comprises a two-stage algorithmic approach (fusing indirect accelerometer monitoring and computer vision) coupled with automated, remote visual confirmation.
- Develop hardware enabling coupling with distributed-power (DP) locomotive or end-of-train (EOT) in operational tests
- Refine detection algorithms using operational service railroads.
- Develop and integrate wireless communication and GPS protocol to incorporate humans in the loop.




Robust preliminary evaluation

| | | Non-damaged features | | | Damaged features | | |
|---|---|---|---|---|---|---|---|
| | | | | | Crack features | | |
| | Features | Total mass | Added mass | Speed | Longitudinal | Transverse back rail | Vertical Front rail |
| Downscaled values | Units | kg | kg | m/s | mm | mm | mm |
| | Cases | 3.50<br>5.00<br>7.50 | 1.00<br>2.50<br>5.00 | 0.9<br>1.13<br>1.35 | 0<br>1.42<br>2.55 | 0<br>0.20<br>0.40 | 0<br>0.30<br>0.45 |
| Upscaled values | Units | lbs | lbs | mph | in | in | in |
| | Cases | 103754<br>148220<br>222330 | 29644<br>74110<br>148220 | 47.6<br>59.8<br>71.4 | 0<br>1.32<br>2.37 | 0<br>0.19<br>0.37 | 0<br>0.28<br>0.42 |



## RAILROAD IMPACT

- **Short term**: Produce a prototype system to reasonably meet the form factor and power requirements enabling its future integration into DP locomotives or EOTs.
- Robust performance data associated with design.
- Automatic broken rail detection (urgently needed)
- **Medium term**: Commercialization into an EOT product to support industry adoption.
- **Long term**: Decreased derailments and cost savings (e.g., maintenance costs, damage costs).
- Safe and efficient operation of quasi-moving and full block control systems, increasing rail network capacity.

## PROJECT PARTNERS

- Carnegie Mellon University
- Wabtec Corporation

## COST & SCHEDULE

- Funding, FY23 – 25: $498,476
- Project Duration: October 2023 – September 2025



FRA PROJECT MANAGER: Jared Withers • (202) 450-0808 • jared.withers@dot.gov


SECTION FOUR

# HUMAN FACTORS

# Ensuring the Safe Operation of Automated or Partially Automated Locomotives: The Role of Driver-State Monitoring (DSM) Systems

## PROJECT DESCRIPTION

- Use a locomotive simulator to set up and validate two automotive DSM systems.
- Determine roles and requirements for DSM systems by monitoring alertness and developing criteria for human intervention when automation fails.

## RAILROAD IMPACT

- Offer an alternative to the current alerter-system found in locomotives to affect operator alertness.
- Help determine whether automobile driver state monitoring systems can be used effectively in locomotives.
- Help determine design requirements for vehicle operator alerter systems.

## PROJECT PARTNERS

- Virginia Tech Transportation Institute
- TrueSafety Evaluation, LLC


## COST & SCHEDULE

- Funding, FY24: $338,290
- Project Duration: June 2022 – December 2024

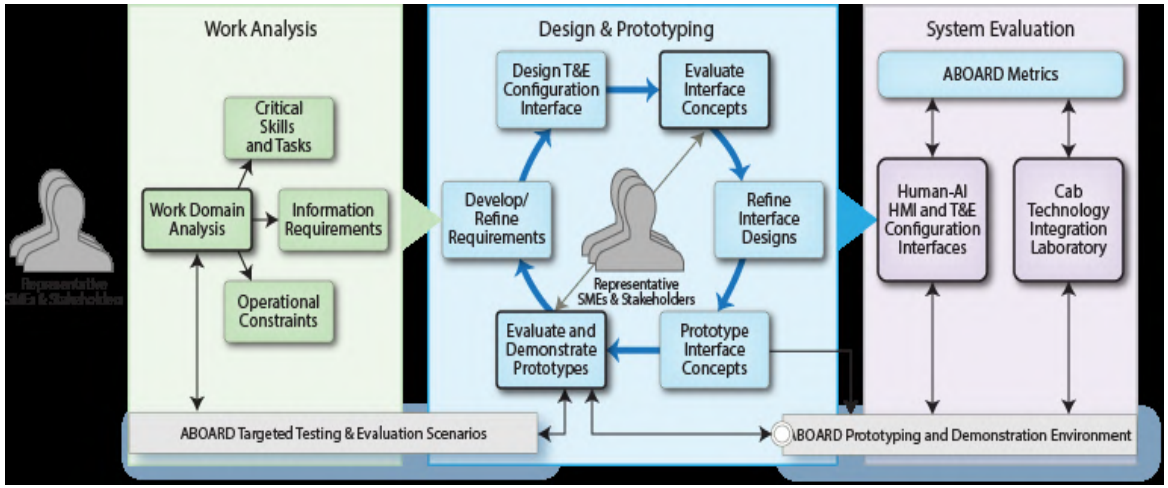


FRA PROJECT MANAGER: Michael Jones • (202) 493-6106 • michael.e.jones@dot.gov

# Assessments for Better Operator Artificial Intelligence-Centered Research and Development

## PROJECT DESCRIPTION

- Develop a test and evaluation (T&E) framework for assessing human-autonomy/AI interactions in intelligent rail software applications.
- Determine requirements for a T&E software architecture for assessing human-autonomy/AI performance issues when introducing new AI in rail operations.
- Demonstrate and evaluate human-AI T&E capability.




## RAILROAD IMPACT

- T&E requirements for intelligent rail applications in actual, simulated, or real-world settings.
- Provides methodology and scientifically principled basis to anticipate human role changes with the introduction of intelligent rail systems.
- Helps develop safer rail systems that use AI by addressing potential human-AI interaction operational risks.

## PROJECT PARTNERS

- Charles River Analytics, Inc.
- SA Technologies
- Roth Cognitive Engineering
- Wabtec Corp.

## COST & SCHEDULE

- Funding, Phase I: $424,977
- Project Duration, Phase I: July 2024 – July 2025
- Funding, Phase II: $199,961
- Project Duration, Phase II: August 2025 – August 2026

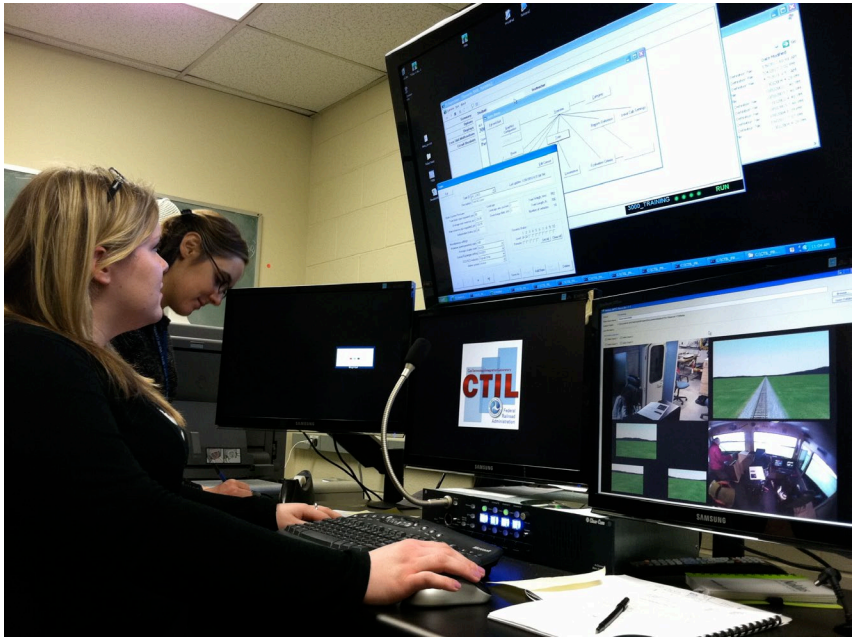


FRA PROJECT MANAGER: Michael Jones • (202) 493-6106 • michael.e.jones@dot.gov

# Lightweight Evaluation, Training, and User Collaboration for Human-AI Work Systems in Rail Operations

## PROJECT DESCRIPTION

- Provide guidelines for improving intelligent systems in rail operations.
- Make recommendations on employing current human-centered approaches to AI system development.
- Provide evaluation methods to assess effectiveness of AI-embedded systems.
- Provide guidelines for AI system user training and support (e.g., tutorials, user guides, collaborative explanations).




## RAILROAD IMPACT

- Methodology developed in this study may improve the efficacy of AI-embedded rail systems and tools.
- This research will allow FRA to better evaluate how automation and intelligent systems can be used in rail operations to improve performance and safety.

## COST & SCHEDULE

- Funding, FY24: $326,237
- Project Duration: September 2024 – September 2026

## PROJECT PARTNERS

- Michigan Tech Rail Transportation Program
- Michigan Tech Department of Cognitive and Learning Sciences

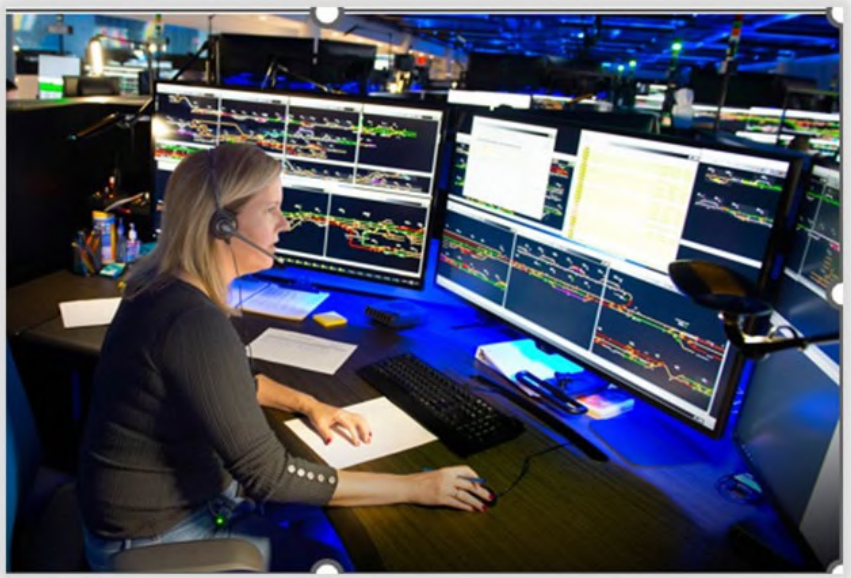


FRA PROJECT MANAGER: Michael Jones • (202) 493-6106 • michael.e.jones@dot.gov

# Human Factors Assessment of the Dispatcher Role to Develop Requirements for Artificial Intelligence (AI)

## PROJECT DESCRIPTION

- Conduct in-depth human factors analyses of the dispatcher role, including cognitive work and workflow, tools and technology used, and areas of inefficiency and error vulnerability.
- The analysis will identify requirements for AI tools to enhance efficiency and reduce human error potential in rail operations.



## RAILROAD IMPACT

- This work provides a research foundation for integrating AI to support dispatcher assessments, planning, and decision-making.
- It also provides direction for dispatcher role design, work processes, and dispatcher training.

## COST & SCHEDULE

- Funding: $297,699
- Project Duration: August 2024 – August 2025
- Option: August 2025 – February 2026

## PROJECT PARTNER

- TiER1 Performance Solutions



FRA PROJECT MANAGER: Michael Jones • (202) 689-4315 • michael.e.jones@dot.gov

# Switching Operations Fatalities Analysis (SOFA) Working Group Support

## PROJECT DESCRIPTION

- FRA provides ongoing support for the SOFA stakeholder committee by supporting communication, outreach, and database maintenance and analysis.
- SOFA is a voluntary, non-regulatory, workplace-safety partnership.
- SOFA looks for commonalities among fatalities that occur during switching operations and develops findings and recommendations to aid in preventing railroad employee deaths.


## RAILROAD IMPACT

- SOFA's findings and recommendations provide educational information intended to help reduce the risk of switching-related fatalities and improve railroad worker safety in switching yards.

## PROJECT PARTNERS

- FRA Office of Railroad Safety
- Labor Unions
- Association of American Railroads
- American Short Line and Regional Railroad Association

## COST & SCHEDULE

- Funding: N/A
- Project Duration: 1998 – present

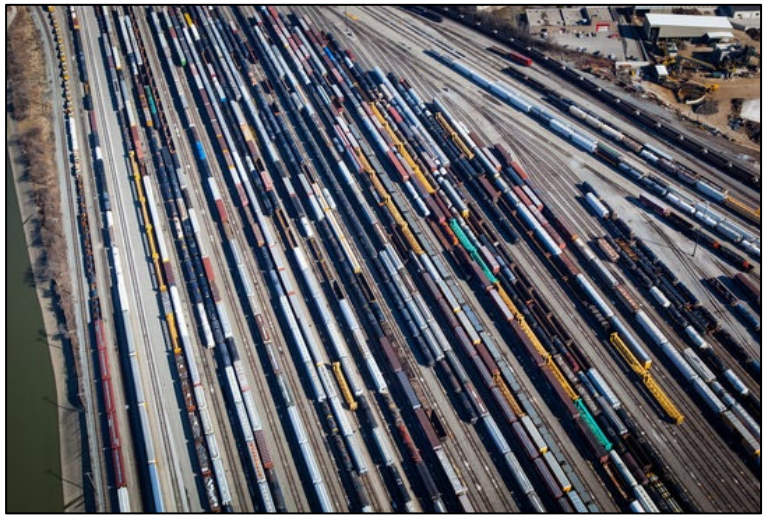


FRA PROJECT MANAGER: Jason Wornoff, Ph.D. • (202) 744-6057 • jason.wornoff@dot.gov

# Railroad Worker Safety During Switching and Shoving Movements and Yardmaster Workload Assessment

## PROJECT DESCRIPTION

- This project originates from the Transportation Research Board (TRB) AR070 Committee Research Needs Statement, which stated the need for railroad worker safety research on switching and shoving movement in rail yards.
- This project will also conduct exploratory research into roles and responsibilities of yardmasters.
- The objectives of this project are to develop an outline of research for (a) switching and shoving training and (b) conducting focus groups related the roles and responsibilities of a yardmaster.
- The project aims to develop a training course for switching and shoving movements. A pilot training course will be executed.



## RAILROAD IMPACT

- Findings may inform new trainings for switching and shoving movements in rail yards and help FRA identify future training and research in railroad worker safety in classification (switching) yards.
- Input gathered from the training course will inform future training regimens developed by FRA.
- Findings from this study will identify potential safety issues associated with recent changes in switching activities and the duties of yardmasters.

## PROJECT PARTNERS

- ENSCO, Inc.
- TrueSafety Evaluation, LLC
- Labor Unions

## COST & SCHEDULE

- Total Funding: $479,968
- Project Duration: June 2024 – December 2025

FRA PROJECT MANAGER: Donald Tweedie • (202) 475-5102 • donald.tweedie@dot.gov

FRA PROJECT MANAGER: Jason Wornoff, Ph.D. • (202) 744-6057 • jason.wornoff@dot.gov

U.S. Department of Transportation
Federal Railroad Administration

# Railroad Information Sharing Environment (RISE)

## PROJECT DESCRIPTION

- RISE is a data trust: a voluntary, non-regulatory, data-informed safety partnership between FRA and railroad industry stakeholders.
- Railroad stakeholders identify complex railroad safety challenges that can be informed by data.
- The goal of this public-private partnership is to use data for safety improvements that would be difficult for individual railroad stakeholders to achieve on their own.
- University of Maryland Center for Advanced Transportation Technology Laboratory (CATT Lab) serves as the third-party vendor and manages the data.

RISE
Railroad Information Sharing Environment

## RAILROAD IMPACT

- Participation in RISE provides stakeholders with the ability to collaboratively address safety-critical topics.
- RISE is an opportunity for railroad stakeholders to use multiple sources of data and expertise to solve complex railroad issues.
- By combining data across multiple sources, stakeholders can identify trends that are difficult to detect in the data from any single stakeholder.
- Data aggregation makes it possible to identify emerging issues and propose solutions to those problems earlier.

## PROJECT PARTNERS

- The MITRE Corporation
- University of Maryland's CATT Lab
- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding, FY24: $133,000
- Funding, FY25: $1,000,000 (estimated)
- Project Duration: Ongoing



FRA PROJECT MANAGER: Jason Wornoff, Ph.D. • (202) 493-1316 • jason.wornoff@dot.gov

# Confidential Close Call Reporting System ($C^3RS$) Pilot Project(s)

## PROJECT DESCRIPTION

- The Volpe National Transportation Systems Center is conducting a process and outcome evaluation of at least one Class I railroad's implementation of the $C^3RS$ program. The evaluation will:
  - Assess the efficiency and sustainability of the program's processes.
  - Quantify program benefits.
  - Identify potential process improvements to support a sustainable, successful program.
- $C^3RS$ is an FRA-funded, voluntary, confidential reporting program that enables railroad carriers and their employees to report "close calls" with the goal of learning about safety risks and implementing corrective actions before incidents or accidents occur.
- The evaluation employs a mixed-methods approach, including literature and document reviews, stakeholder interviews and focus groups, workshops, case studies, surveys, and analysis of quantitative data.


## RAILROAD IMPACT

- Evaluation findings can be used to:
  - Identify program process improvements.
  - Support programmatic decision-making and accountability reporting to oversight organizations.

## PROJECT PARTNERS

- FRA Office of Railroad Safety
- NASA
- $C^3RS$ Participating Railroads
- Labor Unions
- Class I Railroads

## COST & SCHEDULE

- Funding, FY25: $250,000
- Project Duration: Ongoing

U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Jason Wornoff, Ph.D. • (202) 493-1316 • jason.wornoff@dot.gov

# Transportation Research Board AR070 and AR080 Committee Support

## PROJECT DESCRIPTION

- Provides administrative support to:
  - TRB AR080, Highway/Rail Grade Crossings
  - TRB AR070, Rail Operational Safety
- Each committee has a Chair who is a subject matter expert in the specialty associated with the committee.
- Each committee also has a Committee Research Coordinator (CRC) who is the point person for a committee's research activities and assists in identifying research needs and developing research needs statements.
- Volpe personnel serve as committee Secretary and assist the Chair and CRC with administrative tasks that help the committee achieve its mission.


## RAILROAD IMPACT

- These committees draw upon the expertise of stakeholders and operating personnel to define, encourage, and disseminate the research results that will enhance safety, performance, and efficiency.
- Volpe support helps these committees advance their railroad research portfolios and goals.

## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- TRB AR070
- TRB AR080

## COST & SCHEDULE

- Funding, FY25: $45,000
- Project Duration: April 2022 – Ongoing



FRA PROJECT MANAGER: Jason Wornoff, Ph.D. • (202) 744-6057 • jason.wornoff@dot.gov

# Tools Supporting Bipartisan Infrastructure Law Crew Training Programs

## PROJECT DESCRIPTION

- FRA's Office of Safety is collecting data related to the requirements in 49 CFR Part 240 and 242 for locomotive engineers and conductors.
- Develop tools (e.g., surveys, checklists) for FRA auditors to use in evaluating training for new employees in the classroom and on the job.
- Analyze auditor responses.
- Identify best practices for evaluating training programs.

## RAILROAD IMPACT

- Information about the extent to which current Class I railroads' training programs comply with 49 C.F.R. § 240 and 242.
- Findings will identify where training programs may need revision to improve safety and effectiveness on the job.

## PROJECT PARTNERS

- FRA Office of Railroad Safety
- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Anticipated FY25 Funding: $80,000
- Project Duration: Ongoing



FRA PROJECT MANAGER: Jason Wornoff, Ph.D. • (202) 493-1316 • jason.wornoff@dot.gov

# Railroad Safety Advisory Committee (RSAC) Working Group Support

## PROJECT DESCRIPTION

- RSAC is a forum for railroad stakeholders and the public to discuss railroad safety issues.
- FRA's Human Factors Division and the Volpe National Transportation Systems Center are assisting FRA's Office of Railroad Safety with the following RSAC working groups:
  - $C^3RS$
  - Critical Incident Stress Plans
- FRA Human Factors' and Volpe's participation in RSAC working groups provides subject matter expertise and contributes institutional knowledge to these discussions.


## RAILROAD IMPACT

- RSAC provides railroad stakeholders with different interests an opportunity to address complex safety issues.

## COST & SCHEDULE

- Anticipated FY25 Funding: $50,000
- Project Duration: Ongoing

## PROJECT PARTNERS

- FRA Office of Railroad Safety
- Association of American Railroads
- American Short Line and Regional Railroad Association
- American Public Transportation Association
- Class I Railroads
- NASA
- Labor Unions:
  - BLET
  - SMART
  - ATDA
  - BRS
  - BMWE



FRA PROJECT MANAGER: Jason Wornoff, Ph.D. • (202) 493-1316 • jason.wornoff@dot.gov

# Short Line Safety Institute (SLSI): Annual Grant Program Oversight

## PROJECT DESCRIPTION

- FRA's Human Factors Division provides program monitoring and support for SLSI.
- Officially established as a non-profit organization in 2016, SLSI conducts voluntary, non-punitive, confidential Safety Culture Assessments (SCAs) for shortline and regional railroads across the U.S.
- SCAs provide a diagnostic appraisal of a railroad's safety culture at a given point in time, with documented Opportunities for Improvement across the USDOT Safety Council's *Ten Core Elements of a Strong Safety Culture* (adapted for a railroad setting).
- SLSI funding is an earmark grant provided annually by Congress.

## RAILROAD IMPACT

- SLSI enhances the safety culture and safety performance of railroads through meaningful and productive partnerships.
- Impacts include:
  - Conducting SCAs and providing recommendations on how to improve safety culture.
  - Serving as a research center that compiles and disseminates information on safety needs and trends.
  - Communicating research findings to stakeholders about safety culture improvement efforts.

## PROJECT PARTNER

- Short Line Safety Institute

## COST & SCHEDULE

- Funding, FY25: $2,425,000 (anticipated)
- Project Duration: Ongoing



FRA PROJECT MANAGER: Starr Kidda, Ph.D. • (202) 306-2011 • starr.kidda@dot.gov

# Short Line Safety Institute (SLSI): Program Evaluation

## PROJECT DESCRIPTION

- The Volpe Center conducts a program evaluation of the effectiveness and fidelity of SLSI's program and outreach activities.
  - SLSI activities include Safety Culture Assessments (SCAs) and Leadership Development Trainings.
- This evaluation:
  - Identifies strengths and opportunities for improvement in SLSI processes (e.g., developing SCA reports).
  - Provides tools (e.g., fidelity assessment tool) for SLSI to assess its internal processes.
  - Helps ensure effective and consistent delivery of SLSI services to short line and regional railroads.


## RAILROAD IMPACT

- SLSI provides free training and SCAs to interested railroads. The evaluation of SLSI's safety outreach activities provides SLSI with opportunities to improve the effectiveness and fidelity of their processes, tools, and SCA and training delivery.
- Objective, third-party, evaluative feedback allows SLSI to grow and improve its offerings to the industry, which is intended to strengthen safety culture and improve safety outcomes.

## PROJECT PARTNERS

- Short Line Safety Institute
- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Anticipated FY25 Funding: $150,000
- Project Duration: Ongoing



FRA PROJECT MANAGER: Starr Kidda, Ph.D. • (202) 306-2011 • starr.kidda@dot.gov

# Short Line Safety Institute (SLSI): Demonstration of C³RS with SLSI

## PROJECT DESCRIPTION

- FRA's Human Factors Division is sponsoring a pilot project that allows small railroads to participate in C³RS.
- C³RS is a voluntary, confidential reporting system for learning about events or conditions that affect railroad safety.
- Some railroads are too small to have their own peer review teams. In this pilot project, SLSI assessors serve as the peer review team for very small railroads.
  - SLSI receives reports from NASA and identifies corrective actions that may prevent re-occurrence of the close call.



## RAILROAD IMPACT

- This pilot project allows very small railroads to participate in C³RS, benefiting from the program without compromising employee confidentiality.
- Employees may be more likely to share safety-sensitive information in the C³RS program, which enables the railroad to learn from close calls.
- Close call reporting helps railroads learn about safety issues before they result in harm or unsafe conditions.

## PROJECT PARTNERS

- SLSI
- NASA
- FRA Office of Railroad Safety
- Short Line Railroads

## COST & SCHEDULE

- Anticipated FY25 Funding: $100,000
- Project Duration: Ongoing

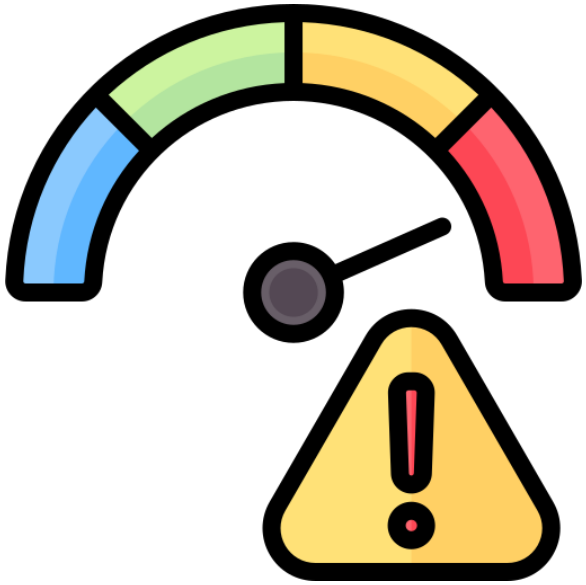


FRA PROJECT MANAGER: Starr Kidda, Ph.D. • (202) 306-2011 • starr.kidda@dot.gov

# Railway Worker and Operator Performance Program Development

## PROJECT DESCRIPTION

- Work with FRA's Office of Railroad Safety and industry stakeholders to better understand human factors issues around safety, safety programs, safety culture, and industry regulations (e.g., Fatigue Risk Management Program).
- Review and communicate research needs, provide subject matter expertise, and facilitate discussions with other researchers.
- Develop research studies on total worker health, work performance, and factors contributing to railroad worker fatigue.



## RAILROAD IMPACT

- Improve the safety and well-being for railroad workers.
- Evaluate safety programs to mitigate the risk of accidents and reduce injuries and fatalities.
- Facilitate a safer workplace environment which can boost employee morale, reduce turnover, maintain consistent service, reduce costs, and increase employee productivity and engagement.
- Encourage employees to report safety hazards and concerns.

## PROJECT PARTNERS

- FRA Office of Railroad Safety
- Volpe National Transportation Systems Center

## COST & SCHEDULE

- Funding Total: $298,450
- Project Duration: Ongoing

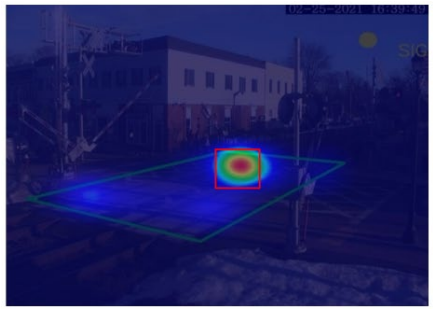


FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 819-2825 • shala.blue@dot.gov

# Understanding Railroad Trespassing Social and Community Factors from Trespassing Behavioral Data at Grade Crossings and on Rights-of-Way

## PROJECT DESCRIPTION

- Develop a methodological framework for understanding social and community factors contributing to pedestrian trespass behaviors and motorist incursions on railroad systems.
- Develop a repeatable process for collecting, analyzing, and understanding social and community factors. Develop a railroad trespassing behavioral database.
- A case study application of this framework will be applied to several locations in the U.S.
- Interview DOTs, railroad police, Operation Lifesaver volunteers, and academics to understand the state of practice for using contextual information for trespassing mitigation.





## RAILROAD IMPACT

- Increase safety through targeted and informed trespassing prevention strategies.
- The analysis could inform more effective trespassing mitigation education, enforcement, and engineering solutions.

## COST & SCHEDULE

- Funding Total: $250,000
- Project Duration: January 2024 – December 2025

## PROJECT PARTNERS

- Redstone Technologies, LLC
- Departments of Transportation: NJDOT, LaDOTD, FDOT
- Freight Railroads: C&D Railroad, Conrail, Norfolk Southern
- Passenger Rail: SunRail, Metra, Metro-North, NJ Transit

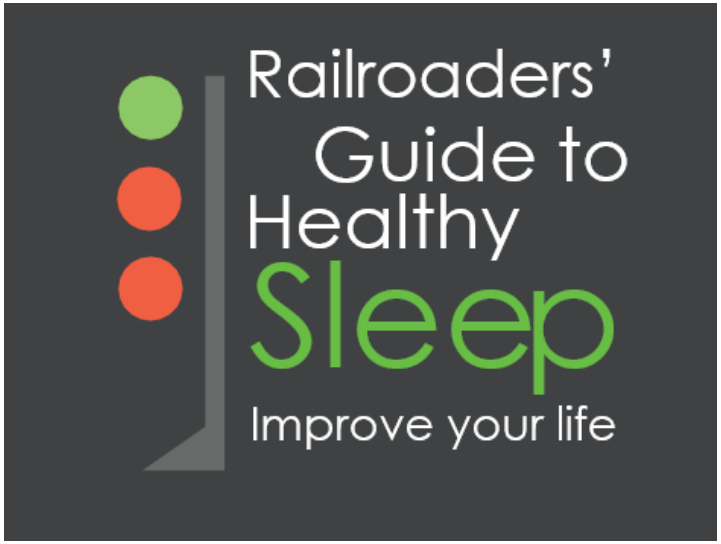
U.S. Department of Transportation
Federal Railroad Administration

FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • shala.blue@dot.gov

# Railroaders' Guide to Healthy Sleep: Website Update

## PROJECT DESCRIPTION

- FRA worked with Harvard Medical School to update the content on the *Railroaders' Guide to Healthy Sleep* (RGHS) website.
- The RGHS website is a non-regulatory educational resource that provides scientific information on sleep and sleep hygiene for railroad workers.




## RAILROAD IMPACT

- RGHS provides tailored educational information to railroad workers about how to obtain sufficient and adequate sleep, risks associated with sleep disorders, and health and well-being.

## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- Harvard Medical School
- FRA IT/Public Affairs
- Labor Unions

## COST & SCHEDULE

- Funding Total: $500,000
- Project Duration: September 2021 – December 2024



FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 819-2825 • shala.blue@dot.gov

# Operator Safety and Well-Being Related to Critical Incidents and Close Calls

## PROJECT DESCRIPTION

- This work documents the ways in which critical incidents and close calls experienced by railroaders are related to operator safety, fatigue, and well-being.
- Railroaders are likely to experience a "critical incident" (per 49 CFR § 272.9) at least once during their job tenure. "Close calls" are even more prevalent.
- Mixed-methods research efforts include a literature scan across domains regarding the nature of potentially traumatic events, stress responses, and promising mitigations, and a qualitative and quantitative review, inventory, and categorization of 41 FRA-approved Critical Incident Stress Plans (CISP) from passenger and freight railroads.

## RAILROAD IMPACT

- Providing science-based information that helps railroads improve their CISPs, and/or critical incident stress program content, processes, and implementation will allow railroads to make positive changes in their CISPs and employee programs.
- The health and wellbeing of employees affected by critical incidents is expected to improve through industry adopting better CISPs and critical incident stress programs.

## PROJECT PARTNERS

- FRA Office of Railroad Safety
- Partner Railroads

## COST & SCHEDULE

- Funding Total: $348,450
- Project Duration: Ongoing

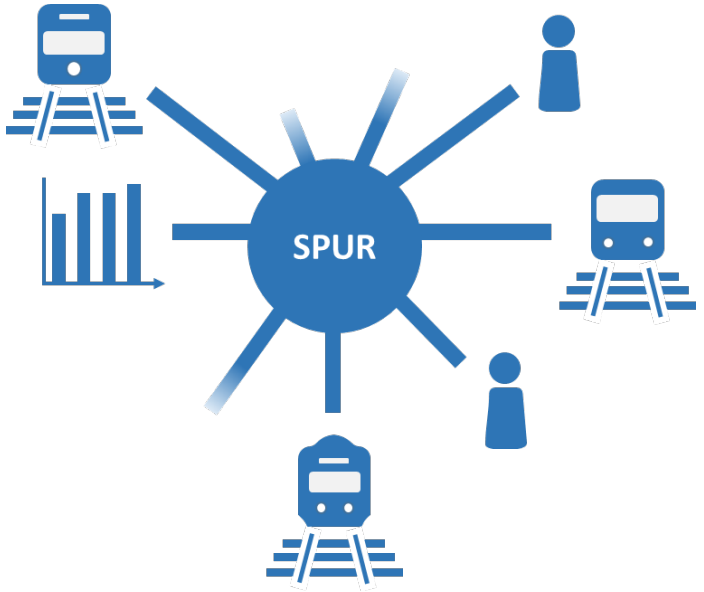


FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 819-2825 • shala.blue@dot.gov

# Suicide Prevention for U.S. Rail (SPUR)

## PROJECT DESCRIPTION

- SPUR is a trespass and suicide prevention working group for U.S. railroad stakeholders that provides an opportunity to discuss emerging and proven trespass and suicide prevention practices.
- FRA and Volpe coordinate, host, and document quarterly SPUR working group meetings and maintain a shared space for meeting notes and documents.
- Past meeting topics:
  - Training employees to recognize warning signs of suicide and intervene
  - Establishing effective partnerships with outside groups
  - Public messaging and the 988 Suicide and Crisis Lifeline
  - Mobile Crisis Units/Quality of Life Teams




## RAILROAD IMPACT

- SPUR is a forum for U.S. railroads to collaborate and candidly discuss successes and challenges related to suicide prevention. This collaboration helps to reduce barriers to implementation and aid knowledge transfer.

## PROJECT PARTNERS

- FRA Office of Railroad Safety
- Volpe National Transportation Systems Center
- Commuter Railroads

## COST & SCHEDULE

- Anticipated FY25 Funding: $30,000
- Project Duration: Ongoing

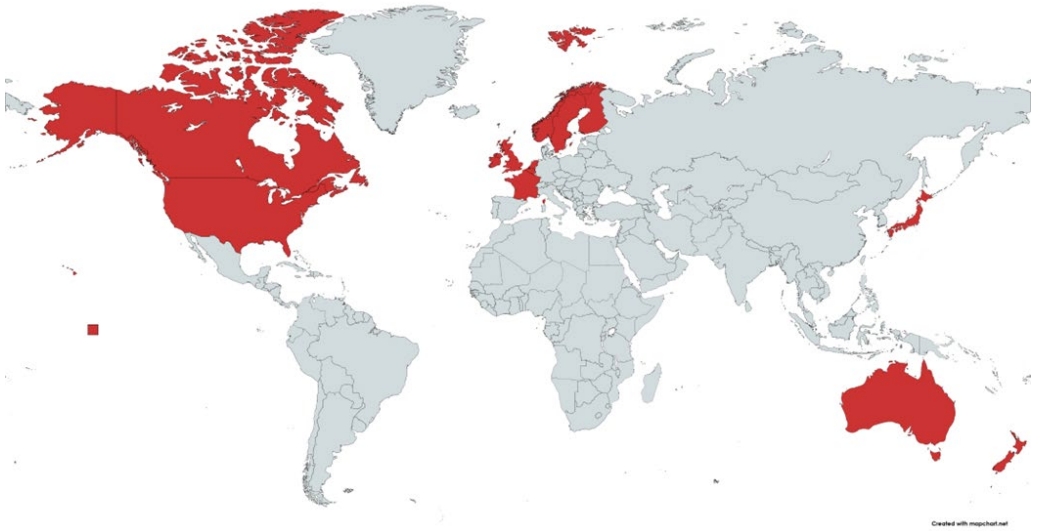


FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • shala.blue@dot.gov

# Trespass and Suicide Prevention: Global Railway Alliance for Suicide Prevention (GRASP)

## PROJECT DESCRIPTION

- GRASP is an international working group of subject matter experts who specialize in suicide prevention on rail systems.
- Since 2013, GRASP has met at least twice per year to share research and best practices related to suicide prevention.
- During GRASP meetings, participants learn about how different railroads around the world prevent railroad trespassing and suicide.



## RAILROAD IMPACT

- Sharing railroad suicide information with international stakeholders allows the identification and implementation of effective strategies and countermeasures.
- Participating countries include Australia, Canada, Finland, France, Germany, Ireland, Japan, the Netherlands, Sweden, the United Kingdom, New Zealand, and the U.S.

## PROJECT PARTNERS

- FRA Office of Railroad Safety
- Volpe National Transportation Systems Center
- U.S. Railroad stakeholders
- International railroad stakeholders

## COST & SCHEDULE

- Anticipated FY25 Funding: $20,000
- Project Duration: Ongoing



FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • shala.blue@dot.gov

# Trespass and Suicide Prevention: Countermeasure Evaluation

## PROJECT DESCRIPTION

- FRA seeks to add to the body of evidence-based best practices related to trespass and suicide prevention and document how stakeholders can adopt these practices to meet their needs.
- Trespass and suicide are the two leading causes of rail-related death in the U.S.
- FRA and Volpe will coordinate with U.S. railroad partners to identify opportunities to evaluate novel countermeasure implementations.

## RAILROAD IMPACT

- This project seeks to identify emerging practices that lack empirical evidence; then identify railroad partners to study these strategies.
- FRA and Volpe will also serve as subject matter experts who can assist railroads and railroad stakeholders with trespass and suicide prevention.

Adobe Stock Images - Diane

## COST & SCHEDULE

- Approximate Funding, FY25: $150,000
- Project Duration: Ongoing

## PROJECT PARTNERS

- FRA Office of Railroad Safety
- FRA Office of Public Affairs
- Volpe National Transportation Systems Center
- Railroad Stakeholders



FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • shala.blue@dot.gov

# Trespass and Suicide Prevention: Community Outreach

## PROJECT DESCRIPTION

- FRA and the Volpe Center are collaborating with railroad stakeholders and community members (e.g., railroads, law enforcement, social services, local government) in Palm Beach County, Florida to develop a good practices guide that will help communities address trespass and suicide risk on rail rights-of-way.
- This objective of this project is to better understand the root causes of trespassing, including acts of suicide, and develop strategies to prevent future incidents or mitigate their consequences.

## RAILROAD IMPACT

- Communities will be able to use the comprehensive, community-based good practices guide to help understand railroad trespass and suicide incidents and reduce their occurrences.

## PROJECT PARTNERS

- Volpe National Transportation Systems Center
- FRA Office of Railroad Safety
- Palm Beach County, Florida

## COST & SCHEDULE

- Approximate Funding, FY25: $150,000
- Project Duration: August 2023 – March 2025

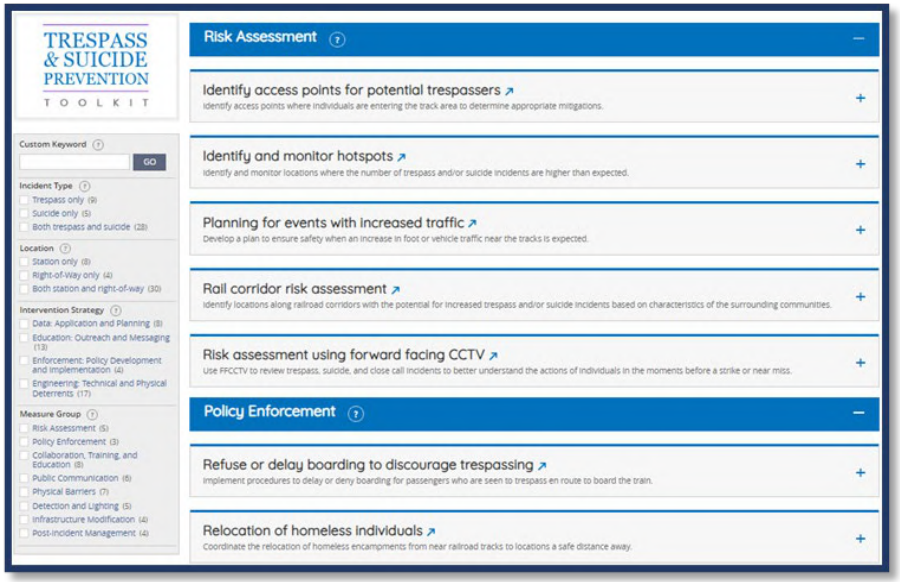


FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • shala.blue@dot.gov

# Trespass and Suicide Prevention: Trespass Prevention Toolkit

## PROJECT DESCRIPTION

- In spring 2022, FRA launched the Trespass & Suicide Prevention (TSP) Toolkit, an interactive resource to identify effective railroad trespass prevention strategies and suicide prevention measures.
- Trespass and suicide on railroad property are the two leading causes of rail-related deaths in the U.S.
- The TSP Toolkit is useful for individuals who work in railroad safety and for researchers, community members, suicide prevention groups, or other individuals or organizations with an interest in preventing trespassing and suicide.
- The TSP Toolkit was developed to help share railroad trespass and suicide prevention strategies.
- The TSP Toolkit is a user-friendly repository of mitigation strategies and data to help railroad stakeholders identify effective solutions.




## RAILROAD IMPACT

- The TSP Toolkit is a resource for railroads and other stakeholders to identify strategies to prevent trespass and suicide.
- The TSP Toolkit empowers railroads to make safety decisions based on their specific challenges.

## PROJECT PARTNERS

- FRA Office of Railroad Safety
- FRA Office of Public Affairs
- Volpe National Transportation Systems Center
- Railroad Stakeholders

## COST & SCHEDULE

- Funding, FY24: $100,000
- Project Duration: Ongoing



FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • shala.blue@dot.gov

# Social and Community Factors Contributing to Pedestrian Trespass Behaviors and Motorist Incursions on Railroad Systems

## PROJECT DESCRIPTION

- Identify and summarize the significant social and community-related factors associated with pedestrian trespassing and motorist incursions onto rail rights-of-way.
- Apply multi-source data fusion using machine-readable datasets, build artificial intelligence-based computer vision models, and develop and test advanced technologies to provide actionable insight to enhancing railroad safety.
- Develop and install a prototype trespass prevention interactive tool with advanced AI for detection at multiple locations.

## RAILROAD IMPACT

- Improve safety at highway-rail grade crossings.
- Use data-driven tools to identify causal factors of trespassing and motorist incursions onto rail rights-of-way.
- Improve decision making capability for railroad stakeholders.
- Identify locations of interest and apply treatments based on the interactive tool analysis.

## PROJECT PARTNERS

- Texas State University
- Texas A&M Transportation Institute

## COST & SCHEDULE

- Total Funding: $264,000
- Project Duration: 18 months

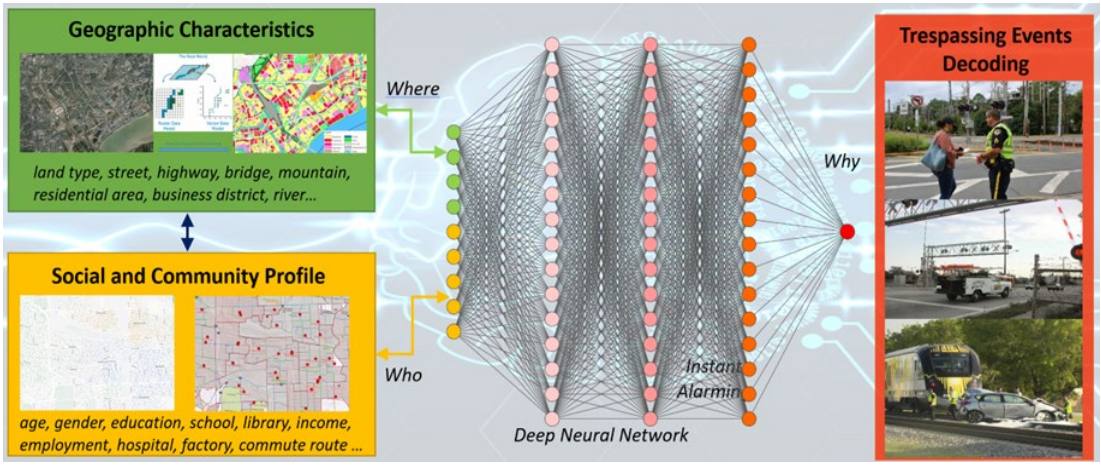


FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • shala.blue@dot.gov

# Discover Influential Geosocial Factors Aggravating Crossing Trespassing (DIGFACT)

## PROJECT DESCRIPTION

- Identify the geosocial factors that influence pedestrian and motorist incursions on railroad tracks.
- Reconstruct geographic characteristics:
  - Where does trespassing happen?
  - What geographic factors contribute?
- Develop a social and community profile:
  - Who tends to trespass?
  - What social factors contribute to trespassing?
- Analyze correlates of trespassing:
  - How does each geosocial factor contribute?
  - What is the sensitivity of each factor?
  - What is the weight of each factor?
  - How do trespassers make decisions that risk their lives?




## RAILROAD IMPACT

- Quantify the factors that influence trespassing decisions and their weights and sensitivities.
- Classify the risk level of different grade crossings.
- Better allocate recourses to monitor risky grade crossings.
- Optimize crossing configurations to reduce risk.
- Connect communities with railroads and Federal, State, and local governments.

## PROJECT PARTNERS

- University of South Carolina
- TRAINFO Corp.
- Brightline

## COST & SCHEDULE

- Total Funding: $455,000
- Project Duration: 36 months

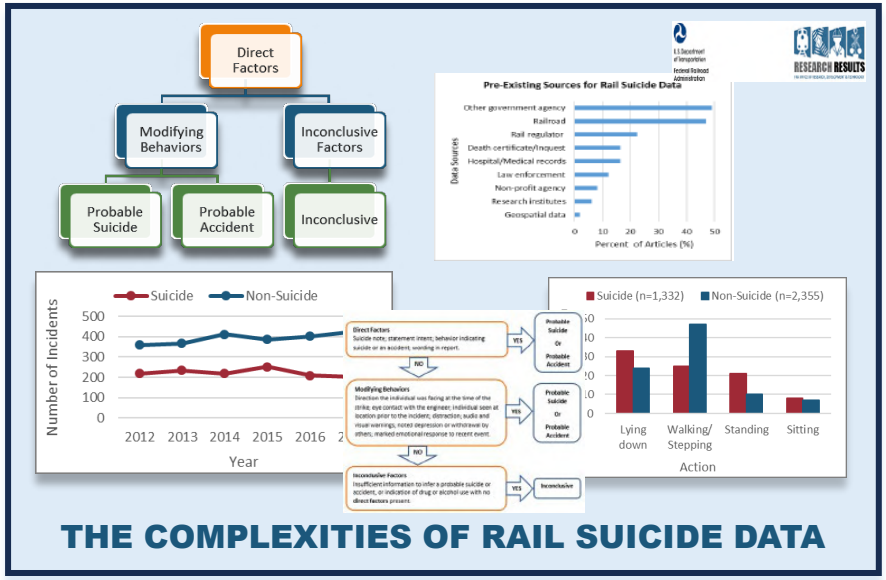


FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • shala.blue@dot.gov

# Trespass and Suicide Prevention: Data Quality

## PROJECT DESCRIPTION

- Analyze data from past incidents related to trespass, suicide, and grade crossing to:
  - Identify who is at risk for rail trespass and suicide and develop effective mitigation strategies.
  - Improve data reliability and validity.
- Highlight the importance of data quality, its limitations, and gaps in data collection relating to railroad trespass and suicide.
- Maintain contact with railroad carriers and develop new relationships with others to identify new data sources of railroad trespass and suicide incidents.




## RAILROAD IMPACT

- This research seeks to understand where data gaps exist to better support railroads in understanding who is their vulnerable population, including their employees.
- Disseminate findings on suicide and trespass incidents and the data quality limitations; serve as a resource for railroads and other stakeholders to identify strategies to prevent railroad trespass and suicide.
- Provide subject matter expertise within FRA and across industry to help mitigate trespass and suicide incidents rail rights-of-way.

## PROJECT PARTNERS

- FRA Office of Railroad Safety
- FRA Office of Public Affairs
- Volpe National Transportation Systems Center
- Railroad Partners
- Centers for Disease Control and Prevention

## COST & SCHEDULE

- Funding, FY20–25: $695,000
- Project Duration: Ongoing



FRA PROJECT MANAGER: Shala Blue, Ph.D. • (202) 493-0168 • shala.blue@dot.gov

# Web-Based Human Presence Detection on Railroad Corridors

## PROJECT DESCRIPTION

- Follow-up to previous research to further develop proof-of-concept system that identifies areas with possible trespasser activity. System analyzes geolocation information from smart devices in designated rail corridors.
- Current effort aims to develop and implement methods to accurately predict trespassing hotspots along rail rights-of-way using mobile device data.

## RAILROAD IMPACT

- Software suite can be used to identify trespassing hot spots and tailor outreach and community engagement methodologies to address those hot spots.
- Enhance safety by reducing instances of trespassing along rail corridors with higher trespassing occurrences.

## PROJECT PARTNERS

- ENSCO, Inc.
- Mobile device data industry

## COST & SCHEDULE

- Funding, FY24: $278,961
- Funding, FY25: $169,241
- Project Duration: July 2024 – July 2026



FRA PROJECT MANAGER: Donald Tweedie, III • (202) 475-5102 • Donald.Tweedie@dot.gov

# Web-Based Simulator Training and Skill Transfer

## PROJECT DESCRIPTION

- Identify a set of criteria for a data-based safety case that objectively demonstrates an equivalent (or improved) level of safety through use of the simulation during brake system refresher training.
- FRA currently issues waivers to industry on a case-by-case basis to permit virtual simulator brake system refresher training to satisfy the hands-on training required by 49 CFR § 232.203(b)(8).
- FRA sponsored a literature review to assess the impact of virtual and/or simulator-based refresher trainings on skill acquisition and training transfer.

## RAILROAD IMPACT

- Aid industry in identifying data-based safety cases to enhance virtual and simulator-based refresher trainings.
- Provide FRA with literature that aids in decision-making for waivers.
- Enhance training for already skilled employees and provide guidance for simulator training developers.

## PROJECT PARTNERS

- Center for Urban Transportation Research (CUTR)
- ENSCO, Inc
- FRA Office of Railroad Safety

## COST & SCHEDULE

- Funding, FY24: $75,000
- Project Duration: January 2024 – October 2024

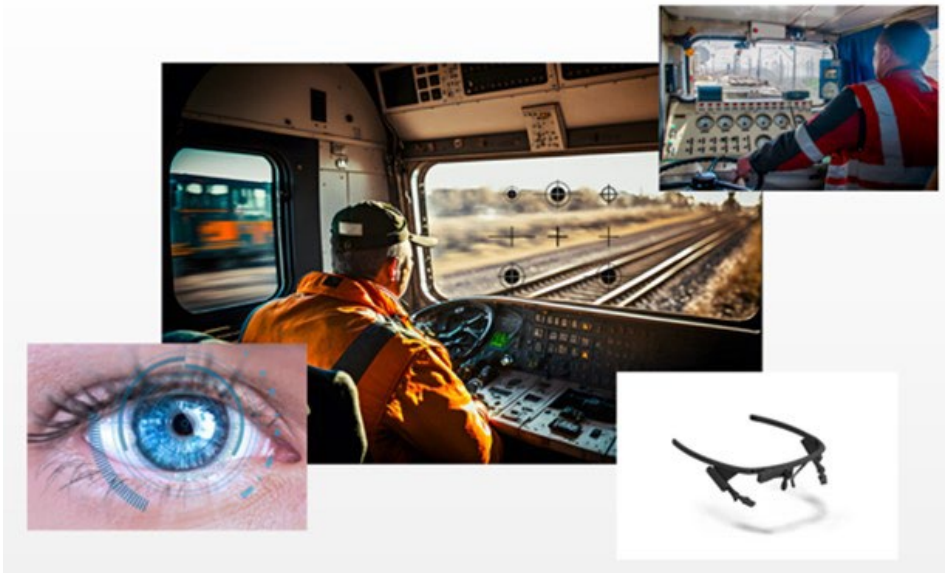


FRA PROJECT MANAGER: Donald Tweedie, III • (202) 475-5102 • Donald.Tweedie@dot.gov

# Impact of System-Driven Workload on Rail Vehicle Operator Glance Times

## PROJECT DESCRIPTION

- Develop recommendations on glance duration during rail vehicle operation to inform safety plans and research. The project will inform:
  - Tolerable limits of train operator's attention focused away from track monitoring.
  - Tolerable limits of the impact of new Intelligent Rail System technologies on glance duration.
- Generate a track monitoring performance test protocol to assess the impact and acceptability of new Intelligent Rail System technologies on glance duration.



## RAILROAD IMPACT

- This project will inform industry on the safe integration of new in-cab technology into rail vehicle operations by:
  - Introducing a standardized testing protocol to assess system-driven workload and its impact on engineer performance, especially in track monitoring.
  - Establishing workload thresholds to ensure new technologies enhance engineer performance and rail safety.

## PROJECT PARTNER

- AtkinsRealis USA, Inc.

## COST & SCHEDULE

- Funding, FY24: $164,410
- Project Duration: August 2024 – August 2025



FRA PROJECT MANAGER: Michael Jones • (202) 493-6106 • michael.e.jones@dot.gov

# Rail Crossing Violation Warning and In-Vehicle Auditory/Visual Alert

## PROJECT DESCRIPTION

- Using driving simulators, examine the effects of intelligent audio-visual grade crossing warnings on driver behavior at different highway-rail grade crossings.
- In-vehicle warnings will be created by integrating the Rail Crossing Violation Warning system with audio-visual warnings developed and tested at Virginia Tech and Michigan Tech.


## RAILROAD IMPACT

- Provide a data-based approach to designing in-vehicle audio-visual alerts for highway-rail grade crossings.

## PROJECT PARTNERS

- Virginia Tech
- Michigan Tech

## COST & SCHEDULE

- Funding, FY24: $550,000
- Project Duration: August 2022 – February 2025



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