Research Problem Statement Title:
Investigation of the critical wind gusts for derailing of High Speed Rail (HSR) vehicles due to the presence of protection barriers

Problem Statement:
The U.S. currently does not have the technology to develop the HSR systems, the government will have to outsource the design of the HSR vehicles and systems to firms in countries with HSR systems such as Japan, China and France. In addition, one of the biggest challenges faced by designers of HSR systems is to prevent vehicles from derailing and overturning as a result of high crosswind gusts. In Japan, four years ago, train cars were derailed due to a crosswind gust of over 90 mph, with numerous deaths and injuries. The local meteorological observation station measured the maximum wind gust of only 45 mph at the time of the accident. This implies that more accurate prediction of the wind gust in extremely localized areas is necessary for the future safety. The accident occurred in countryside of flat terrain with no trees, very much like that of Oklahoma. Oklahoma wind gust frequently reaches 90 mph and beyond in west-central Oklahoma. A study showed that crosswind gusts in Oklahoma and other states are strong enough to derail HSR vehicles. Thus, disaster prevention from crosswind gusts is one of the most critical issues to be addressed for designing the HSR systems in the US. The success of the HSR project depends highly on the development of the HSR technology in the U.S. in the long-term with the safety of the HSR systems. Since Oklahoma has the best resource to investigate the wind gusts in the US, Oklahoma is well situated to be a driver to develop a HSR safety standards and to support the HSR technology in the US.

Proposed Research:
The objective for this research project would be to improve the design to reduce the risk of trains from derailing due to the high crosswind gusts by introducing protection barriers. Develop a design and determine the effect of the barrier dimensions and its setting locations on the flow behavior around the train and on the reduction of noises generated by the HSR through the use of CFD (Computational Fluid Dynamics) simulations. Experimentally validate the flow characteristics using wind tunnel experiments. Provide simulation and experimental data and parameters for future industry and the HSR safety guidelines. Thus, Oklahoma has a chance to lead the HSR technology and safety, which will benefit the future of Oklahoma industry to support HSR systems in the US.
**Suggested Tasks (to include but not limited to):**
- Perform literature search
- Perform necessary lab testing
- Evaluation of Climatic Data
- Statistical analysis of data

**Implementation:**
The Principal Investigator (PI) will provide an assessment of the results of the study which should include expected benefits and action needed for successful implementation. The PI should include draft specifications, if applicable, with final recommended implementation activities, methods or schedules to meet ODOT goals.

**Benefits:**
Develop a design and determine the effect of the barrier dimensions and its locations on the flow behavior around the HSR train thus reducing the potential for derailment.

**Deliverables:**
All projects require the submission of the following reports:
- Monthly Progress Reports
- Multi-Year Projects require a Year-end Annual Report
- Copies of the project Draft Final Report in Microsoft Word and ADA accessible Adobe Acrobat pdf electronic formats
- Copies of the project Final Report in Microsoft Word and ADA accessible Adobe Acrobat pdf electronic formats

The Year-end Annual Report, Draft Final Report, Final Report and Color Article should be submitted to satisfy all federal and state requirements pertaining to the accessibility of documents including but not limited to:
- Oklahoma State Statute 62 § 41.5e and the Americans with Disability Act (ADA) of 1990, 42 USC 12.01 et seq.

The PI must also participate in the following project meetings:
- New project initiation meeting
- Semi-annual project meeting
- Close-out project meeting
- Continuing project meeting

**Existing Research:**
The following information has been provided as a convenience only and does not constitute a thorough literature review.
Safety Standards for High-Speed Rail Transportation
Category of Derailment Mechanism and Prevention for High-Speed Vehicle
Active Control of Airspring Secondary Suspension to Improve Ride Quality and Safety Against Crosswinds
Safety and Security Best Practices for High-Speed Rail Systems
http://trid.trb.org/view/2010/P/1095386
On Minimizing Derailment Risks and Consequences for Passenger Trains at Higher Speeds
High Speed Rail: Track Construction Considerations
California’s HSR: first segment set: Fresno-Bakerfield link to benefit San Joaquin riders
High speed rail study: phase 1
http://trid.trb.org/view/2011/M/1118195
On High-Speed Rail’s Beaten and Blurry Path