

# Non-Contact Energy Harvesting for Rural Grade Crossings

Deliverables and Reporting Requirements for UTC Grants Awarded in 2023 (June 2023)

## Exhibit D

### Research Project Requirement Template

**Recipient/Grant (Contract) Number:** University of Texas Rio Grande Valley (UTRGV), University of Nebraska Lincoln (UNL)/Grant No. 69A3552348340

**Center Name:** University Transportation Center for Railway Safety (UTCRS)

**Research Priority:** Promoting Safety

**Principal Investigator(s):** Joseph Turner (PI, UNL), Carl Nelson (Co-PI, UNL), Mohsen Amjadian (Collaborator, UTRGV)

**Project Partners:** University of Texas Rio Grande Valley

**Research Project Funding:** \$86,063 (Federal), \$43,032 (Non-Federal Cost Share)

**Project Start and End Date:** 06/01/2023 to 08/31/2024

**Project Description:** The network of U.S. railroads often spans remote parts of the country that are sparsely populated. In these areas, rail grade crossings are much less likely to have warning lights or crossing gates primarily due to the lack of electricity. Such unprotected or passive crossings have the majority of the grade crossing fatalities and accidents. To reduce rail accidents, enhanced warning systems are needed at as many passive crossings as possible. We propose to create a new energy harvesting approach based on the motion of the wheels to generate sufficient power for an LED-based grade crossing warning system. Recent advances to create small and powerful magnets allow for the design of a non-contact power generation approach that is activated with each passing wheel. The goal will be to design and test multiple configurations in order to assess their potential for energy harvesting and to optimize them for grade crossing applications.

**US DOT Priorities:** This project aligns with the following USDOT strategic goals, as established in the USDOT Strategic Plan for FY2022-FY2026: **(a) Safety:** The project plans to address the safety of rural grade crossings which represent a large number of accidents. The ability to provide low-cost power near existing passive crossings would allow additional signaling to be added which will greatly enhance the visibility of the crossings to approaching vehicles. **(b) Economic Strength:** Accidents at rural grade crossings affect more than the economics of the railroads. The livability of rural populations is greatly impacted by safety issues and improvements to railroad crossings will provide a higher quality of life and stronger economies. **(c) Equity:** In the past decade, UNL has developed partnerships with minority serving institutions in order to grow the graduate enrollments of these groups. In particular, the UNL Mechanical and Materials Engineering Department has a cooperative PhD program with UTRGV which has enhanced underrepresented groups at UNL. This project will support one student who completed his MS degree at UTRGV to pursue his doctoral degree at UNL as part of expanding the pathways to doctoral studies for underrepresented Hispanic students.

**Outputs:** In the initial year of this project, expected results include:

- a. Computational models will be developed to understand the impact of the various design choices on power generation,
- b. Design implications for magnet arrays to modify the symmetry of the magnetic field will be quantified,

- c. Laboratory experiments will be created for several of the designs,
- d. Experimental data will be collected from the experiments to quantify the potential for maximum power generation, and
- e. General concepts for implementation in the field will be initiated.

Relevant products would include conference presentations, reports, journal articles, and patent disclosures. We will strive for at least one presentation during the first year at the ASME-IEEE Joint Rail Conference in Spring 2024 or other related conferences.

**Outcomes/Impacts:** The long term outcome of this project will be improved safety at grade crossings that are currently passive. Availability of low-cost power at existing passive crossings will enable the addition of sensors and signaling. The project will also contribute to a diverse workforce in advanced rail safety technology, through the cooperative agreement with UTRGV.

**Final Research Report:** Upon completion of the project, a URL link to the final report will be provided.