TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

INSTRUCTIONS:
Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.

Transportation Pooled Fund Program Project # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(193) Supplement #64	☐ Quarter 1 (January 1 – March 31) ☐ Quarter 2 (April 1 – June 30) ☐ Quarter 3 (July 1 – September 30) ☑ Quarter 4 (October 4 – December 31)

Project Title:		
Continued Development of the Midwest Four-Cable, High-Tension, Median Barrier (Continuation Funding)		
Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Faller, Lechtenberg, Bielenberg	402-472-9070	kpolivka2@unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211096001	RPFP-14-CABLE1	7/1/13
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
6/30/16	6/30/17	1

Project schedule status:

☐ On schedule ☑ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
$375,513 (+$264,372 from Yrs 20 & 22)	$600,187 (+$294,745 R&D/Reporting	20

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$63,397	

Project Description:

The Midwest Roadside Safety Facility (MwRSF) has been conducting research for the Midwest States Regional Pooled Fund Program to develop a non-proprietary, high-tension, four-cable, median barrier that is capable of being used anywhere in a V-ditch with 4H:1V side slopes. Three tests still remain to complete the test matrix of the cable barrier system in a V-ditch. In addition, the four-cable, high-tension, median barrier has never been tested on level terrain. There is a concern that FHWA may not approve this design without testing on flat ground, especially when considering the wide cable spacing and increased cable heights. Further, the barrier deflections observed in crash tests performed in a 4H:1V V-ditch are likely higher than would be observed on flat ground. Crash testing of the barrier installed on level terrain would identify barrier deflections and working widths that can be expected when the barrier is used in narrow medians with gentle slopes and would allow for better performance comparisons between the Midwest four-cable barrier and other proprietary systems.

Objective: To complete the development, testing, and evaluation of the four-cable, high-tension, median barrier system for use on level terrain.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

Internal review of the draft report containing the evaluation of floorpan tearing and cable splices continued.

Internal review of the draft report containing the full-scale crash test no. MWP-8 continued.

Initiated draft report of the final 5 component tests evaluating the addition of a cap to the top of the post to prevent cutting of the floorboard.

Construction of the redesigned high-tension 4-cable median barrier with the modified MWP which consisted of a cap attached to the top was completed. On October 19th, 2016, MwRSF conducted one small car test (test no. MWP-9) into the modified Midwest Weak Post containing a cap attached to the top of the post and weakening holes at groundline using a 1100-kg Kia Rio according to the TL-3 safety performance guidelines of MASH, specifically test designation no. 3-10. In test no. MWP-9, the system adequately contained and safely redirected the small car. During test no. MWP-9, the two-part cap with a single retainer bolt shielded the free edges of the MWP during post-to-vehicle contact and mitigated floor pan tearing and post penetration into the occupant compartment. However, cable no. 3 (second from the top) snagged on the cap retainer bolt and nut and induced an increased downward and lateral force to the A-pillar. Consequently, cable nos. 3 and 4 (top two cables) became interlocked with the A-pillar on the impact side and resulted in excessive A-pillar crush (≥3.4” which is greater than the 3” MASH limit). Thus, the two-part cap design used in test no. MWP-9 mitigated floor pan tearing and post penetration, but the test results were deemed unacceptable due to excessive A-pillar crush.

The mid-year Pooled Fund meeting was held on November 17th, 2016 with a significant discussion on the results of test no. MWP-9 as well as the observations and results from the existing R&D program. As a summary, there has been overall

Anticipated work next quarter:

Internal review of the draft report containing the evaluation of floorpan tearing and cable splices will continue. There is a potential the draft report may be sent to the member states for review during the next quarter.

Internal review of the draft report containing the full-scale crash test no. MWP-8 will continue. There is a potential the draft report may be sent to the member states for review during the next quarter.

Continue writing draft report of the final 5 component tests evaluating the addition of a cap to the top of the post to prevent cutting of the floorboard.

Initiate draft report of test no. MWP-9.

Initiate brainstorming for design concepts for the clean-slate high-tension cable median barrier. Potential to have refined concepts ready for fabrication and testing by the end of the quarter.

Significant Results:

On March 26, 2014, MwRSF conducted a 1500A crash test (test no. MWP-1) into the Midwest high-tension cable median barrier with the Midwest Weak Post placed at the slope break point of a 6:1 slope using a 1500-kg Ford Taurus according to the TL-3 safety performance guidelines of MASH, specifically test designation no. 3-17. The vehicle was successfully contained and redirected.

On April 18, 2014, MwRSF conducted one pickup crash test (test no. MWP-2) into the Midwest high-tension cable median barrier with the Midwest Weak Post using a 2270-kg Dodge QuadCab according to the TL-3 safety performance guidelines of MASH, specifically test designation no. 3-11. The pickup was successfully contained and redirected. However, the member states had concerns about the dynamic deflections of the system. Thus, the system was further modified by reducing the post spacing to 8' to attempt to reduce the system deflections and reducing the number of keyways and holes to make the post stronger.

On July 11, 2014, MwRSF conducted one pickup crash test (test no. MWP-3) into the Midwest high-tension cable median barrier with the Midwest Weak Post with 8' post spacing and a reduction in the number of keyways and holes using a 2270-kg Dodge QuadCab according to the TL-3 safety performance guidelines of MASH, specifically test designation no. 3-11. The pickup overrode the cables and eventually rolled over. Hence, the system was further modified by reducing the top cable height to 38", increasing the bottom cable height to 15.5", adjusting the inner cable spacing to 7.5", and increasing the post spacing to 10'.

On October 20, 2014, MwRSF conducted one pickup crash test (test no. MWP-4) into the modified Midwest high-tension cable median barrier with the Midwest Weak Post using a 2270-kg Dodge QuadCab according to the TL-3 safety

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

This project is an extension to previous projects (RPFP-08-02: Four-Cable Median Barrier in 4:1 V-Ditch; RPFP-09-01: New Funding for High-Tension Cable Barrier on Level Terrain with New Cable Attachment; RPFP-10-CABLE-2: Replacement Funding for High-Tension Cable Barrier on Level Terrain; RPFP-12-CABLE1&2: Completion of the Development and Evaluation of the Midwest Four-Cable, High-Tension, Median Barrier Phase I, V-Ditch; and RPFP-12-CABLE1&2: Completion of the Development and Evaluation of the Midwest Four-Cable, High-Tension, Median Barrier Phase II, Level Terrain).

A portion of this project ($264,372 is not included in the project budget shown on page 1) will be funded with the following projects:
$64,746 from Project No.: RPFP-10-CABLE-3 – TPF-5(193) Supplement #21, Project Title: Additional Funds to Complete Development of Crashworthy HT, 4-Cable Barrier Terminal
$199,626 from Project No.: RPFP-12-CABLE1&2 – TPF-5(193) Supplement #46, Project Title: Completion of the Development and Evaluation of the Midwest Four-Cable, High-Tension, Median Barrier Phase III, End Terminal

To date, total funds spent are from the following project funds:
$64,736 from Project No.: RPFP-10-CABLE-3 – TPF-5(193) Supplement #21
$199,626 from Project No.: RPFP-12-CABLE1&2 – TPF-5(193) Supplement #46
$335,824 from this project, Project No.: RPFP-14-CABLE-1 - TPF-5(193) Supplement #64

In addition, Contingency Funds from several prior years have been designated for Cable R&D and Cable Reporting. To date, $294,745 has been posted to the contingency funds for Cable R&D and Cable Reporting.

Potential Implementation:

The successful completion of the development, testing, and evaluation of the Midwest four-cable, high-tension, median barrier on level terrain will allow the member states to implement a non-proprietary, high-tension, cable system along our nation's highways and roadways. In addition, the crash testing of the four-cable, high-tension, median barrier on level terrain would also provide a more complete understanding of barrier performance (i.e., dynamic deflections, working width, etc.) when used in relatively flat, narrow medians. The crash results from the level terrain testing will be used in combination with computer simulation to evaluate the effects of reduced post spacing. The successful completion of this project along with the non-proprietary four-cable, high-tension, median barrier in V-ditch and cable guardrail end terminal would help to assure acceptance by FHWA and improve its chances for widespread implementation.