**D3TRANSPORTATION POOLED FUND PROGRAM**

**QUARTERLY PROGRESS REPORT**

Date: \_**3-31-2014**\_\_\_\_\_\_\_\_\_\_\_\_

Lead Agency (FHWA or State DOT): \_ **FHWA** \_\_\_\_\_\_\_\_\_\_\_\_\_

**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.*

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| **Transportation Pooled Fund Program Project #***(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)***TPF(5)216** | **Transportation Pooled Fund Program - Report Period:**X Quarter 1 (January 1 – March 31) **2014**□Quarter 2 (April 1 – June 30)□Quarter 3 (July 1 – September 30) □Quarter 4 (October 1 – December 31) |
| **Project Title:****Steel Suspension Bridge Vulnerability and Countermeasures** |
| **Name of Project Manager(s):**Eric Munley | **Phone Number:**202-493-3046 | **E-Mail**Eric.Munley@fhwa.dot.gov |
| **Lead Agency Project ID:**TPF(5)216 | **Other Project ID (i.e., contract #):**IAA DTFH61-10-X-30028 | **Project Start Date:**7-12-2010 |
| **Original Project End Date:**7-11-2015 | **Current Project End Date:**7-11-2015 | **Number of Extensions:**None |

Project schedule status:

x On schedule □ On revised schedule □ Ahead of schedule □ Behind schedule

Overall Project Statistics:

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|  **Total Project Budget** |  **Total Cost to Date for Project** |  **Percentage of Work**  **Completed to Date** |
| $2,500,000Funding to date: $419,197 | $353,314 | 84% |

***Quarterly*** Project Statistics:

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|  **Total Project Expenses**  **and Percentage This Quarter** |  **Total Amount of Funds**  **Expended This Quarter** |  **Total Percentage of**  **Time Used to Date** |
| $108,342 (4.3%) | $108,342  | 84% |

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| **Project Description**:This project is a part of FHWA’s security research program for bridges and tunnels. Work is being performed through an Interagency Agreement (IAA) with the US Army Engineer Research and Development Center, Vicksburg, Mississippi. The Department of Homeland Security (DHS), and Golden Gate Bridge, Highway and Transportation District have provided additional support for this effort. In addition, the DHS has a related research program with the Corps covering a wide range of infrastructure security issues. The coordination of efforts and the exchange of information among the federal agencies and involved bridge owners have been valuable in the ongoing work to reduce the vulnerability of bridges to attack. The aims of TPF (5)216 are to increase the resistance of suspension bridges to an attack on any of their three major components: 1) Towers; 2) Main Cables; 3) Suspenders. This project has extended the work started in Pooled Fund Project 888, *Validation of Numerical Modeling and Analysis of Steel Bridge Towers Subjected to Blast Loadings.* That project not only assessed the accuracy of predictive methods for suspension bridge response to blast loads, but the effectiveness of existing methods to increase resistance to these loads. The current project has extended the range of the previous study to include older types of materials and connection details, and varying material conditions in assessing the response to blast loads. A second part of this project, as in the earlier one, is to test the performance of mitigation methods, but on these older components (These are being obtained from demolished bridges). Based on these tests, accurate assessments of the structure’s performance before-and-after retrofit can be made. The third objective of this project is to develop high performance/lower intrusion countermeasure designs through the use of advanced materials. The low intrusion is significant to bridge owners because the retrofit cannot produce material degradation (e.g., corrosion), interfere with the operation of previously-installed mitigation measures for other hazards (e.g., seismic), or obstruct normal maintenance/inspection operations. This project is particularly focused on implementation. It is designed to adapt general research results, on bridge members and bridge materials studied under the FHWA Counterterror Research Program, to implementation issues now being encountered in the field. One example is the effect of blast mitigation on seismic response: Are there practical combined retrofits, or contact vs. non-contact where separate retrofits are required. This project is a recognition that once the basic research improves countermeasures to respond to higher loads, the owner encounters a number of related issues: Altered Response to other critical loads (the example shown); Alternate load path survivability; Constructability; Maintenance/Inspection/Removability of security retrofits; and, of course, the added Dead Load.  |
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| **Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**Field Project A (Analysis for Blast Hardening of Steel Tower Members): * Results of initial tower analyses were discussed with bridge owner, including external retrofit design.
* Provided the owner with a synopsis of the methodology for addressing the specific analysis areas presented in the initial tower analysis.
* This includes: 1) A detailed analysis of as-built structural resistance and post damage stability of the bridge towers, and 2) An analysis of further retrofits internal to the bridge tower with the express purpose of limiting the propagation of damage via high velocity fragments during an event.

Field Project B (Validating Baseline Blast Impact Models and Proposed Hardening of Stay Cables/RC Towers): * Complete review of the main span design reports, and component test plans.
* Developed the scope for recommended testing and validating protection measures for cable stays.
* Developed the scope for recommended testing and validating protection measures for the RC towers.
* Developed the Cost Estimate for this work.

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| **Anticipated work next quarter**:* In the Steel Tower portion of the project, complete the detailed analysis of as-built bridge as detailed above, and provide an estimate for the internal retrofit development stage.
* In the RC Tower and Stay Cable portions, contribute final review comments on all reviewed documents, and prepare cost proposals for additional cable-related tasks.
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| **Significant Results:** The expected range of behavior, in reacting to a blast load, caused by steel type, age, and condition is currently being established. This range is a necessary factor in the design of any countermeasure. Response data is being collected to aid countermeasure designers in predicting the reaction of the main cable and towers to a dynamic loss (i.e. not just the fact that one or more are missing) of suspenders. This is directly related to potential loss of the stiffening truss and roadway.Analysis of the vulnerability of bridge towers to VBIED attack, allowing for interaction between the air-blast pressures and flexible structural elements was developed to provide a more accurate vulnerability estimate. This was coupled with the analysis of the overall stability of the structure to determine if progressive collapse will occur.  |
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| **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).**Lead abatement required on specimens obtained from early 20th Century steel bridge members has added significant time and cost. |
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| **Potential Implementation:** The research program has been developed so that its findings can be adapted for immediate use in the design of retrofits to protect suspension bridges from attack on major components.This adaptation, now underway on two owner-selected projects, is being made by the bridge owner’s retrofit project team, with COE assistance, through the secure design process developed as part of this project. Note that, while general findings of this project will be made available to bridge owning agencies for project support, individual member-specific data will not be published in a general public distribution. Reducing the vulnerability in these three suspension bridge component groups will have an effect beyond that particular type of bridge. At the member level, the blast behavior of components on stay cables or through trusses, for example, have much in common with that of suspender or tower components. The resistance improvements made on the suspension bridge components will be extended and modified for these bridges. The focus of this one project is the retrofit of existing structures. However, the knowledge base developed under this research is also intended to provide State DOTs with useable information in the design of new structures and replacement of components. |