**TRANSPORTATION POOLED FUND PROGRAM**

**QUARTERLY PROGRESS REPORT**

**Lead Agency: Utah Department of Transportation**

**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 #**  **TPF-5(296)** | | **Transportation Pooled Fund Program - Report Period:**  \_ Quarter 1 (January 1 – March 31, 2013)  \_ Quarter 2 (April 1 – June 30, 2013)  \_ Quarter 3 (July 1 – September 30, 2013)  **x Quarter 4 (October 1 – December 31, 2013)** | |
| **Project Title:**  Simplified SPT Performance-Based Assessment of Liquefaction and Effects | | | |
| **Name of Project Manager(s):**  David Stevens | **Phone Number:**  801-589-8340 | | **E-Mail**  [davidstevens@utah.gov](mailto:davidstevens@utah.gov) |
| **Lead Agency Project ID:**  42065, ePM PIN 12436  UDOT PIC No. UT13.407 | **Other Project ID (i.e., contract #):**  UDOT Contract No. Pending | | **Project Start Date:**  Contract in Preparation |
| **Original Project End Date:**  Contract in Preparation | **Current Project End Date:**  Contract in Preparation | | **Number of Extensions:** |

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** |
| $122,000 | $0 | 0 |

***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** |
| 0 | $0 | 0 |

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| **Project Description**:  Conventional “pseudo-probabilistic” procedures to evaluate liquefaction triggering and its effects have been shown through recent research to produce estimates of liquefaction factor of safety at inconsistent and often unacceptable levels of risk. These errors are introduced through the incorrect assumption that using probabilistic ground motions in a deterministic liquefaction analysis will yield a probabilistic estimate of liquefaction factor of safety. The inconsistent consideration of liquefaction risk could contribute to undesirable performance or even collapse of various important structures such as bridges or retaining walls in the event of an earthquake. Conversely, the inconsistent consideration of liquefaction risk could also potentially contribute to the unnecessary and expensive over-design of liquefaction mitigation alternatives. Utilization of a fully-probabilistic or performance-based liquefaction triggering procedure, which considers both uncertainty in the seismic loading and the liquefaction triggering relationship, could effectively solve these problems. Furthermore, probabilistic evaluation of liquefaction triggering could potentially be taken into account when considering liquefaction effects such as lateral spreading or free-field liquefaction settlements. However, current performance-based liquefaction procedures (e.g. Kramer & Mayfield 2007) are quite complex and beyond the level of practical application for most practicing engineers. Development of code-compatible simplified approximations of performance-based standard penetration test (SPT) analysis methods for liquefaction and its effects could be a viable solution to overcome these challenges, and will be completed for this project.  Objectives for this study include:  1. Develop simplified performance-based procedures for the SPT modeled after recently published methods (Mayfield et al. 2010) to closely approximate the performance-based analysis results for liquefaction triggering, lateral spread displacement, post-liquefaction free-field settlement, and seismic slope displacement at select return periods (475, 1033, and 2475 years).  2. Develop the tools and analysis necessary to validate and perform the new simplified liquefaction evaluation procedures in each of the participating states.  Tasks for this study include:  1. Derive new simplified performance-based procedures for assessing liquefaction triggering, lateral spread displacement, free-field liquefaction settlement, and lateral seismic slope displacement (Year 1).  2. Develop liquefaction parameter maps at the return periods of interest for liquefaction triggering and lateral spread displacement (Year 1).  3. Develop liquefaction parameter maps at the return periods of interest for volumetric strain and lateral seismic slope displacement (Year 2).  4. Develop a user-friendly analysis spreadsheet for designers to use in conjunction with the new liquefaction parameter maps. The spreadsheet will include deterministic analysis options in addition to performance-based analysis options (Year 1 and 2).  5. Select 5-10 sites in each participating state to analyze with a fictional soil profile in order to compare the new simplified performance-based analysis methods with conventional analysis methods (Year 1 and 2).  6. Develop a site-specific liquefaction design procedure that will envelope performance-based analysis results with deterministic liquefaction results in order to prevent “unrealistic” assessments of liquefaction hazard. (Year 2).  7. Prepare a technical report to document the results of the research (Year 1 and 2).  8. Hold a workshop at the end of the research project to introduce state DOT and invited consulting engineers to the new simplified performance-based liquefaction methods and to answer questions (end of project).  Dr. Kevin Franke of BYU is the Principal Investigator for this research project. |

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| **Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**  Dr. Franke prepared the draft project work plan. The technical advisory committee was established with the study partners, and the draft work plan was distributed to them for review. A kickoff meeting was scheduled for January 2014 with the technical advisory committee. |
| **Anticipated work next quarter**:  A kickoff tele-conference or web meeting will be held with the technical advisory committee for discussion of the draft work plan. The approved work plan will be utilized to establish a UDOT research contract with BYU.  BYU will begin work on the initial tasks of the project: derivation and validation of a new simplified liquefaction triggering model and new simplified lateral spread displacement models. A quarterly report will be prepared on these tasks and shared with the technical advisory committee. A tele-conference or web meeting will be scheduled near the end of the quarter to discuss progress with the committee. |

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| **Significant Results:**  Nothing to report at this stage. |
| **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).** |

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| **Potential Implementation:** |