



## Program Progress Performance Report University Transportation Centers

**Submitted to** U.S. Department of Transportation  
Research and Innovative Technology Administration

**Federal Grant Number** DTRT13-G-UTC41

**Project Title** ABC-UTC (Accelerated Bridge Construction - University Transportation Center)

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**Submission Date** December 15, 2015

**DUNS and EIN Numbers** DUNS: 07-129-8814, EIN: 237047106

**Recipient Organization** Florida International University;  
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**Account Number** 800002954

**Grant Period** September 30, 2013 to September 30, 2017

**Reporting Period Start Date** April 1, 2015

**Reporting Period End Date** September 30, 2015 (PPPR # 4)

**Report Frequency** Semi-annual

**Signature of Submitting Official:**

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Dec 30, 2015

Date

# ACCOMPLISHMENTS

## What are the major goals and objectives of the program?

The broad goals and objectives of the Tier I Accelerated Bridge Construction University Transportation Center (ABC-UTC) are to advance the frontier of Accelerated Bridge Construction (ABC); develop new ABC knowledge; effectively transfer the state-of-the-art ABC knowledge to the profession; develop a next-generation ABC work force; and collaborate with the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), Departments of transportation (DOTs), other UTCs, and the transportation profession to make ABC the best solution for design and construction of the nation's aging bridge infrastructure in line with U.S. DOT's strategic focus on State of Good Repair.

Specific goals and objectives of the ABC-UTC can be broken into three general categories:

### Research

- Extend principles of ABC to the repair, replacement and preservation of bridges, including multi-hazards and seismic issues.
- Enhance the service life of bridges constructed using principles of ABC by emphasizing design for service life (at the design stage), preservation, and timely maintenance.
- In collaboration with other UTCs that will be funded, especially those that will concentrate on highway safety, develop traffic safety systems specifically for modular bridge construction for all traffic levels.
- Building on existing knowledge, develop the next generation of decision-making tools for better communication among stakeholders, which should assess the merits of various construction processes and visualize the entire life span of bridges in a seamless manner from birth to recycling.
- Develop new and innovative ideas and applications for use of advanced materials, such as Ultra High Performance Concrete in ABC.
- Develop new knowledge to extend application of ABC in seismic areas.

### Education and Workforce Development

- Become the educational focal point for advancing principles of ABC.
- Develop and nationally distribute K-12 educational materials related to bridge engineering, and ABC in particular, for educating and attracting future generations of transportation and sustainability engineers.
- Develop educational materials that could be used in academia at both undergraduate and graduate levels for explaining fundamental and advanced topics in ABC.
- Develop and deliver continuing education opportunities on ABC for practicing engineers across the country.

## Technology Transfer

- Become a national repository and focal point for assisting federal, state, and local agencies on matters related to ABC.
- Educate the current and next generation of engineers on when and how to effectively use ABC technologies.
- Lower the cost of utilizing ABC technologies by conducting outreach activities at the local, regional, and national levels that include the dissemination of research results.
- Develop implementable tools that follow the form and function of AASHTO-type publications.

## What was accomplished under these goals?

Monthly meetings among the partner universities, were held during the reporting period to track progress in different tasks, using a matrix that included list of planned tasks. Progress in different tasks related to research, education and workforce development, and technology transfer was discussed during these meetings between ABC-UTC directors, associate directors, graduate students and key researchers.

Following is description of various tasks by three main categories that are research, workforce development, and technology transfer.

### Research

ABC-UTC aims to carry out research in close association with federal and state agencies and bridge industry. During the reporting period, technical advisory committee (TAC) was established for research projects that were selected based on input of ABC-UTC steering committee, AASHTO T-4 and AASHTO T-3 Committees. Technical advisory committee consists of professionals from FHWA, state DOT and industry. These professionals were carefully selected for each research projects based on their experience that was closely related to the ABC-UTC research projects. Meetings were held with TAC to discuss ABC-UTC research projects.

Following table provides list of research projects, technical advisory committee members for each project and progress made in the project during the reporting period.

Project #	Research Project Title	TAC Members	Progress (Apr-2015 Sep-2015)
FIU-1	Compilation of all ABC research that is ongoing and completed  Recommended by AASHTO T-4	Ahmad Abu-Hawash, Iowa DOT Ben Beerman, FHWA	The work of this project is closely related to that of the ABC solutions database project. For this reason, one database containing several data tables has been created to host all the research and project data that has been gathered by the researchers. The focus of the last few months has continued to be on the design and development of this online database. The layout and navigation of the research database will closely mirror that of the project database. The developed mock-ups have been used to create a

			<p>functioning database hosted by the ABC UTC website on a separate server. A submission process has been developed for the ABC project database so that any users of the site are able to recommend a project to the ABC UTC database subcommittee. The project is then uploaded on the site with the subcommittee's approval. A similar system is being developed for the ABC research database.</p> <p>The project data base is now online and is accessible to public through ABC-UTC web site (<a href="http://abc-utc.fiu.edu/index.php/technology/databases">http://abc-utc.fiu.edu/index.php/technology/databases</a>).</p> <p>The project data base has been very well received, by the bridge community.</p>
FIU-2	Compilation of ABC solutions	Ahmad Abu-Hawash, Iowa DOT Ben Beerman, FHWA	<p>The focus of the past few months of work has continued to be on the design and development of the online database. The developed mock-ups were made into a fully functional database site hosted by the ABC UTC website on a separate server.</p> <p>A review of existing literature and ongoing research was continued during this period and is being performed to identify potential systems to be included in the compilation.</p> <p>An additional server was obtained and formatted to host all the data for the database and all database related activity. The server was formatted and data tables created to host the data. The database is currently being populated.</p> <p>It is expected to complete solution data base very early 2016</p>
FIU-3	Extending the application of simple for dead continuous for live load (SDCL) to seismic regions- Part 1: Numerical Study	Tom Ostrom, Caltrans Reza Farimani, Thornton Tomasetti BijanKhaleghi, Washington DOT Elmer Marx, Alaska DOT Bruce Johnson and Hormoz Seraj, Oregon	<p>A Steel bridge system, referred to as Simple for Dead Load and Contiguous for Live load (SDCL) is proved to be very economical in non-seismic region is being modified to extend its application in high seismic areas. A series of detail analysis were carried out to establish the demand side of design. By demand it is meant to comprehend the type of forces that connection over the middle supports will be subjected to. It was observed that the detail used in non-seismic application is not suitable for use in high seismic areas. Consequently a modified detail was developed. The next step will be to continue this</p>

		<p>Department of Transportation, Ben Beerman, FHWA</p>	<p>project in Phase II of the study and carry out a component test for verifying the merits of the new and modified SDCL detail suitable for seismic application. Parallel to this process a shake table test is being planned to be carried out at UNR to proof test the validity and merits of the FIU's seismic SDCL detail. With completion of this process, for the first time the bridge industry will have complete set of design and construction information for a very economical ABC steel bridge system suitable for high seismic application. Steel bridge systems are not used very often in west coast, where seismic consideration is a must. Development of economical ABC bridge alternative in the form of a economical ABC steel bridge system, is bound to lower the overall cost of alternate bridge systems and therefore save tax payers. The modified detail is now developed will be tested in Phase II of the project. The connection envisioned is similar to non-seismic detail, except that it uses high strength bolts to positively connect the girder ends. It was also observed that amount of reinforcement in the concrete diaphragm needs to be increased, so that concrete diaphragm remain elastic (Capacity Protected Element) during entire seismic events. Diaphragm.</p>
<p>FIU-4</p>	<p>Synthesis on calculating total public costs for short-term road closures to justify reasonable incentives/ disincentives</p> <p>Recommended by AASHTO T-4</p>	<p>Ben Beerman, FHWA Mary Lou Ralls Newman, Ralls Newman, LLC</p>	<p>A major question, by owners asked, when deciding ABC versus conventional construction choices is the cost. This project is developing a comprehensive guideline to calculate the total cost of constructing bridges using ABC versus other alternatives. Based on input from stakeholders project scope has expanded.</p> <p>The ABC total cost research project continues to examine the construction cost and the road user cost (RUC) components of ABC projects. Regarding the construction cost, first a parametric model was developed based on available data to estimate costs at a lower level of details. More detail examination of the cost associated with ABC projects is being conducted including estimating both the direct construction cost and the indirect costs. These costs are</p>

			<p>studied for different ABC methods and being compared to those associated with the conventional construction method. At the same time, additional progress is being made in identifying methods and parameters for the estimation of the road user costs and revenue loss components of the project including mobility, reliability, vehicle operating costs (VOC), safety (both worker safety and traffic safety), and impact on business and freight, and other impacts by combining modeling and data analytic methods and tools at different levels of analysis.</p>
FIU-5	<p>Development of Manual for Enhanced Service Life of ABC Bridges</p>	<p>Bruce Johnson, Oregon DOT Ali Maher, Rutgers University Hamid Ghasemi, FHWA Carlos Duart, CDR Maguire</p>	<p>Bridge owners are questioning the long term performance and service life of bridges using ABC. Their concern esteem from the fact that some ABC technologies could include many “joint”, that are proven to be the source of decrease in service life. Researchers at FIU are conducting an investigation to provide bridge owners on how to design ABC projects for service life, similar to what they do for strength design. This objective is being achieved through development of customized manual for design of bridges for service life, for bridges using ABC.</p> <p>Project is now being continued into Phase II. The second phase of the study included construction of test specimens at the Structures Lab at FIU. Three specimens have been constructed, each 15 feet long. The bridge girders are spaced 6 feet apart, and are WF 30 x 99 steel sections. Three specimens were constructed using different closure pour detail as described below:</p> <ul style="list-style-type: none"> <li>➤ An 8-inch wide, with hairpin shaped reinforcing bars forming overlapping loops in the closure pour. Longitudinal bars will then extend through the loops. The pour will consist of ultra-high performance concrete. (UHPC). This is similar to the detail in Bridge B.</li> <li>➤ A 12-inch wide pour reinforced with headed rebar extending into the closure pour. The concrete strength will match the concrete in the adjacent deck section. This is similar to</li> </ul>

			<p>the detail in Bridge A.</p> <ul style="list-style-type: none"> <li>➤ A 3-foot wide closure pours with standard overlapped reinforcing bars. The concrete strength will match the concrete in the adjacent deck section. This is similar to the closure pour detail constructed in the MASS 14 projects in Massachusetts.</li> </ul> <p>The commonly used ABC details have also been identified and their performances through field inspection, laboratory testing and reported inspection reports by State DOTs are being examined. Another aspect of this project is development of innovative solutions using advanced materials for ABC details that are demonstrating lower durability and service life.</p>
ISU-1	<p>Development of Crash-Tested Prefabricated Bridge Railings</p> <p>Recommended by AASHTO T-4</p>	<p>Ahmad Abu-Hawash, Iowa DOT Tim Fields, Connecticut DOT</p>	<p>The goal of this work is to initiate the development of a prefabricated bridge rail system. This initial phase of work is to include controlled laboratory testing coupled with fundamental hand calculations. This testing and evaluation of several different connection concepts will ultimately culminate in the selection of one or more connection details which would be subjected to full-scale crash testing. At this point, the concepts to be included in the testing have been fully developed and detailed. This includes the inclusion of appropriate material selections (including stainless steel, grout, etc.) coupled with generic construction means and methods. Further, the design of the testing apparatus has been initiated. There was a slight delay in getting some of the hardware components fabricated. These are back on schedule and should be shipped soon.</p>
ISU-2	<p>Extending the Application of ABC to Bridge Rehabilitation (synthesis first then developmental)</p>	<p>Ahmad Abu-Hawash, Iowa DOT Ben Beerman, FHWA</p>	<p>The goal of this project is to identify ABC technologies specifically for bridge rehabilitation and repair or those that are commonly used in new ABC construction that could be adapted for use in repair. Progress on the project has</p>

			<p>resulted in the compilation of a number of ABC concepts that could be implemented for various types of rehabilitation or repair when the total time of construction needs to be reduced. By far the most commonly identified techniques relate to repair or rehabilitation of decks. Information related to decks has been compiled into the following categories (with typical examples presented in parentheses):</p> <ul style="list-style-type: none"> <li>• Rapid removal (hydro-demolition, milling, etc.)</li> <li>• Rapid protection (polymer overlays, penetrating sealers, etc.)</li> <li>• Rapid repair (asphalt concrete patching, high early strength concrete patching, etc.)</li> <li>• Rapid replacement (CIP high early strength systems, precast panels, exodermic deck panels, etc.)</li> </ul> <p>Information related to girders has been categorized as:</p> <ul style="list-style-type: none"> <li>• Rapid repair</li> <li>• Rapid replacement (inverse panels, adjacent box and tee beams, etc.)</li> <li>• Information related to substructures has been separated into: <ul style="list-style-type: none"> <li>• Piers and columns</li> <li>• Abutments</li> </ul> </li> </ul> <p>By far, the most applicable and available information relates to deck systems. Clearly there is an opportunity here to expand on the available information and techniques for the other bridge components. It may be possible to include research in this area in future funding.</p> <p>This work has been completed</p>
ISU-3	Durability and strength of grouted sleeve couplers	Ahmad Abu-Hawash, Iowa DOT Elmer Marx,	The original goal of this project was to evaluate the feasibility of using grouted couplers to create integral abutment connections in ABC

		Alaska DOT	<p>projects. Since project initiation the scope has been modified slightly to include the development of ANY connection detail that creates an integral abutment connection in ABC projects. Two principal concepts have been developed and are being evaluated in the laboratory under static strength conditions. The first system utilizes the originally intended grouted couplers. One principal benefit of this system is that the design of the connection can be completed using emulative design approaches. The biggest drawback to this system is ensuring proper alignment of the numerous grouted couplers needed to make the connection. The second system utilizes a so-called stabbed shaft idea. In this concept a short section of H-pile is temporarily installed within a portion of the abutment and then lowered into final place once all precast units are in place. The entire connection is then grouted to ensure continuity. The benefit of this connection detail is that there is more room for error in the placement of the connection. The principal drawback is that emulative design approaches are not possible.</p> <p>To date the full-scale specimens of each of the two concepts plus a baseline integral abutment connection have been tested and the results are being summarized in a final report format.</p>
UNR-1	Behavior and design of precast bridge cap beams with pocket connections	Bijan Khaleghi, Washington DOT Elmer Marx, Alaska DOT Tom Ostrom, Caltrans	This project was completed. A project report entitled: "DESIGN AND CONSTRUCTION OF PRECAST BENT CAPS WITH POCKET CONNECTIONS FOR HIGH SEISMIC REGIONS" was prepared, posted on the project website, and underwent review by the ABC-UTC steering committee members. The report is currently being finalized based on the comments.
UNR-2	Evaluation of Seismic Performance of Bridge Columns w/ Couplers and	Ahmad Abu-Hawash, Iowa DOT Bijan Khaleghi,	This project was completed. A project report entitled: "DESIGN AND CONSTRUCTION OF BRIDGE COLUMNS INCORPORATING MECHANICAL BAR SPLICES IN

	Development of Design Guidelines	Washington DOT Elmer Marx, Alaska DOT Tom Ostrom, Caltrans	PLASTIC HINGE ZONES” was prepared, posted on the project website, and underwent review by the ABC-UTC steering committee members. The report is currently being finalized based on the comments.
UNR-3	Development and Seismic Evaluation of Pier Systems w/ Pocket Connections and Hollow PT/UHPC Columns	Bijan Khaleghi, Washington DOT Elmer Marx, Alaska DOT Tom Ostrom, Caltrans	A large-scale square single column test model with CFRP tendons and UHPC plastic hinge was constructed, instrumented, and tested on a shake table. The measured data are being processed. In addition, a two-column bent with square columns and pocket connections in the cap beam is being designed. This model will be tested on a shake table to evaluate and generate information on the seismic performance of cap beam pocket connections for square columns.

### Education and Workforce Development

The following table lists different tasks related to workforce development, provides a brief description of each task, identifies the lead institution for each task, and states the progress made in each task during the reporting period.

Task #	Brief Description of Task	Lead Institution	Progress (Apr-2015 Sep-2015)
WD-1	<b>Student Education:</b> Each ABC-UTC consortium member will be expected to mentor a minimum of one graduate student for each \$50,000 to \$75,000 in project work.	ALL (FIU, ISU, UNR)	In total, sixteen graduate students are working on ABC-UTC research projects. Eleven graduates students at FIU, three at ISU and two at UNR. In addition, a post-doc is working on ABC-UTC funded research projects at UNR.
WD-2	Increasing the number of research assistantship opportunities for graduate students.	ALL (FIU, ISU, UNR)	No report for this cycle
WD-3	Upgrading course content in the areas of structural engineering and construction engineering/management to include modules on the use of ABC topics.	UNR	UNR developed an ABC module. The module is five hour long. It was used in a graduate course at UNR. The module has been posted on the UNR ABC-UTC website. The module will be updated by Jan. 2016 based on new research. Also audio will be added to the Power Point files.
WD-4	Developing online courses and making	FIU	FIU and ISU are looking at the

	progress towards the development of fully online degree programs.		creation of online programs with ABC specific materials included.
WD-5	Development of a mentoring program where students are put in direct contact with industry representatives who are active in the field of accelerated bridge construction.	FIU, ISU, UNR	<p>Following professionals from industry have been mentoring ABC-UTC students on their researches.</p> <ul style="list-style-type: none"> <li>• Michael LaViolette, HDR</li> <li>• Mike Culmo, CME</li> <li>• Finn Hubbard, Fish &amp; Associates</li> <li>• Dr. Reza Farimani, Thornton Tomasetti</li> <li>• Dr. Francesco Russo, Michael Baker Jr., Inc.</li> <li>• Dr. Jawad Gull, HDR</li> <li>• Dr. Arash Tarighi, HDR,</li> <li>• Dr. Ardalan Sherafati, BlueScope Construction.</li> </ul> <p>FIU and ISU are actively encouraging several productive mentorship relationships between graduate students and former graduate students and professionals.</p> <p>Advertisement and efforts are being made to encourage the participation of more mentors and more students.</p>
WD-6	Each graduate student will be required to give a technical presentation at the conclusion of their research study. These presentations will be delivered electronically as part of the ABC-UTC technology transfer activities.	ISU	This task will be completed at the end of research projects.
WD-7	Encourage one-on-one interaction with industry.	ISU Lead; ALL (FIU, ISU, UNR)	Opportunities are being developed to develop a closer interaction with industry. One of the strongest ABC-UTC strength is its association and working relation with industry.
WD-8	<b>Internship Program-</b> All three consortium members will develop an undergraduate research internship program.	UNR Lead; ALL (FIU, ISU, UNR)	Undergraduate intern are hired at FIU and UNR to assist the ongoing research projects. from FIU and an undergraduate intern from UNR were hired to work on different tasks related to workforce development, technology transfer and research. In addition numbers of hourly students are hired

			<p>by all three universities to assist in experimental research in the structural laboratories.</p> <p>ISU has also started an undergraduate research program (with a stipend provided to the student).</p>
WD-9	<p><b>Educational Modules-</b> Develop three educational modules, in the form of print and videos, for K-12 with focus on developing age-appropriate programs.</p>	UNR	<p>New information was gathered for a Power Point presentation appropriate for middle school students. The information is being compiled and audio will be added.</p> <p>An introductory module to bridge engineering and ABC with a K-12 focus is being developed. ISU is working with primary and secondary education experts to investigate methods for developing and implementing materials into the classroom or summer camps.</p>
WD-10	<p><b>Summer Teacher Program-</b> Each consortium member will develop a two-day-long summer camp for elementary, middle and high school teachers to familiarize them with basics of transportation engineering in general and principles of bridge engineering and ABC in particular.</p>	UNR	<p>ISU ran a successful teacher summer camp in 2015. A similar camp will be run at ISU in 2016 and will involve teachers from Miami and Reno areas as well.</p>
WD-11	<p><b>Online e-Zine Go-</b> ISU will publish quarterly articles in the online “e-zine Go!” related to the ABC-UTC’s mission.</p>	ISU	<p>Three articles are already published by ISU, UNR and FIU. These articles can be found at the following links</p> <ul style="list-style-type: none"> <li>• <a href="http://www.go-explore-trans.org/new-series-the-abcs-of-putting-drivers-first-in-bridge-projects/">http://www.go-explore-trans.org/new-series-the-abcs-of-putting-drivers-first-in-bridge-projects/</a></li> <li>• <a href="http://www.go-explore-trans.org/the-many-faces-of-bridge-engineering/">http://www.go-explore-trans.org/the-many-faces-of-bridge-engineering/</a></li> </ul> <p>Fourth article will be published by FIU. A two year schedule for publishing articles is developed. Articles were written by UNR, ISU, and FIU on ABC related topics and published through the Go! Publication. These articles are viewed by thousands of students and</p>

			educators.
WD-12	Offer travel scholarship with emphasis on traditionally underrepresented students	All (FIU, ISU, UNR)	No report for this cycle.
WD-13	Make presentations on transportation careers at major minority institutions and conferences.	All (FIU, ISU, UNR)	This task has been accomplished through presentations at FIU, which is designated minority institution.

## Technology Transfer

The following table lists different tasks related to technology transfer, provides a brief description of each task, identifies the lead institution for each task, and states the progress made in each task.

Task #	Brief Description of Task	Lead Institution	Progress (Apr-2015 Sep-2015)
T2-1	<b>AASHTO Subcommittee on Bridges and Structures (SCOBS) Meeting:</b> ABC-UTC Director and key research team members will be attending the annual AASHTO meetings and, where needed and possible, will brief the related committees on research findings by giving technical presentations.	All (FIU, ISU, UNR)	<p>ABC-UTC presentations at April, 2015 SCOBS Annual Meeting in Saratoga Springs, NY:</p> <p>Dr. Azizinamini provided two presentation, to AASHTO SCOB T-3 and T-9 committees. These presentation were based on ongoing research projects at FIU and supported by ABC-UTC. The presentations were related to service life design of ABC projects and development of seismic details for ABC steel bridge systems. In additions, Dr. Azizinamini gave number of presentations at International Bridge Conference, ASCE Structures Congress and NSBC world steel bridge symposium</p> <ul style="list-style-type: none"> <li>• T-3 (Seismic) by Saiidi</li> </ul> <p>In addition, presentations were given at the Int. Bridge Conference, Caltrans, and WashDOT with some of the SCOBS member in attendance.</p>
T2-2	<b>National Committee Meetings:</b> Each ABC-UTC consortium member will be expected to attend at least 3 meetings of national committees each year (other than annual AASHTO	All	<p>FIU gave presentations on ABC-UTC progress to AISI Steel bridge task force.</p> <p>UNR presented at following meetings during the reporting period.</p>

	meetings) and give technical presentations.		Keynote Speech, International Conferences on concrete bridge design and rail transportation in Iran, earthquake engineering of bridges in Columbia, Smart bridge conference Turkey, and several domestic meetings and three venues in Japan.
T2-3	<b>Journal Publications:</b> Each ABC-UTC consortium member will be expected to prepare and submit a minimum of two journal publications, in high impact journals, for each research project as lead.	All	No report for this cycle.
T2-4	<b>Outreach:</b> Each ABC-UTC consortium member will be expected to participate in a minimum of two outreach activities each year. Ideally one outreach activity would be geared toward a national audience and one would be geared toward regional audiences.	UNR	FIU, continues to provide assistance to local and national agencies in ABC area, through active participation and presentations and providing assistance where asked. In addition to the presentations listed before, UNR is scheduled to give multiple presentations on ABC at various conferences and meeting: ASCE Structures Congress, IBC Pittsburgh conference, and three international conferences.
T2-5	<b>ABC strategic plan:</b> In collaboration with AASHTO T-4 Technical Committee on Construction, a strategic implementation plan will be developed to promote and support the use of ABC across the U.S.	All	ABC-UTC is in close communication with AASHTO T-4 and TRB ABC committee and FHWA. Through these activities, activities of ABC-UTC are complementary to other national programs.
T2-6	<b>Collaboration with bridge groups:</b> The research team will work with other bridge groups such as the FHWA Long-Term Bridge Performance Program.	All	Efforts have continued to develop a working relation with FHWA LTBP Program.
T2-7	<b>Provide bridge owners with tools to implement ABC as a standard practice:</b> Research team will convene meetings of select practicing engineers and bridge owners to assist them in implementation of ABC as a standard practice.	FIU	No report for this cycle
T2-8	<b>Supplier input:</b> Suppliers that	All	No report for this cycle

	specialize in products suitable for making ABC more efficient will be consulted on their products and systems; as appropriate, ABC-UTC will assist suppliers in assembling and/or acting as an independent body that evaluates the products (similar to HITEC).		
T2-9	<b>Data dissemination through partnership:</b> Several existing resources will be utilized for data dissemination, such as a) DOT/RITA research clusters and b) NEEShub, which is established by the NSF George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES).	All	No Progress; NEES program is completed.
T2-10	<b>Offices of technology transfer:</b> As appropriate, cooperative agreements will be developed with industries for eventual marketing of products developed through research studies conducted by the ABC-UTC. At the request from an individual researcher, industry partner or the ABC-UTC Director, it will be determined if there is a merit to develop a patent based on research outcomes.	All	Currently a new bridge system is envisioned under one of the FIU research projects. FIU office of research will be contacted to develop a provisional patent application.
T2-11	<b>Three forms of publication:</b> ABC-UTC publications will be of three forms, each serving a different purpose: (1) journal articles, (2) conference papers; and (3) research reports.	All	Conference papers on ABC were prepared for upcoming conferences.
T2-12	<b>Technical briefs:</b> Every ABC research project will have a one-page (front and back) technical brief of the pertinent details that will be sent out via e-news to a larger transportation community.	All	Description of each ABC-UTC research project has been posted on ABC-UTC web site. <a href="http://www.abc-utc.fiu.edu">www.abc-utc.fiu.edu</a>
T2-13	<b>Dedicated website:</b> Currently the FIU ABC Center has a website ( <a href="http://www.abc.fiu.edu">www.abc.fiu.edu</a> ). With enhancements, this web site will become the official site of the ABC-UTC.	All	A dedicated web site for the ABC-UTC is developed and is fully activated.  In addition a dedicated website is developed for the ABC-UTC-Seismic by UNR and is linked to the FIU site: <a href="http://wolfweb.unr.edu/homepage/saiidi/">http://wolfweb.unr.edu/homepage/saiidi/</a>

			USDOT/index.html
T2-14	<b>Periodic e-newsletter (ABC Talk):</b> An online newsletter (ABC Talk) will be published to present the highlights of ABC-UTC activities. The availability of the newsletter will be communicated through resources available to AASHTO, FHWA, and TRB.	All	FIU, UNR and ISU contributed to the annual highlights.
T2-15	<b>Printed newsletter:</b> Annually, a hard copy version of the select articles from e-newsletter (ABC Talk), summarizing the highlights of ABC-UTC activities, will be published	All	FIU, UNR and ISU contributed to the annual highlight report.
T2-15a	<b>Webcasting and video Clips:</b> Selected tests will be webcast, and video clips of critical parts of selected tests will be developed.	All	Select shake table test were webcast by UNR.
T2-16	<b>Social media:</b> Researchers will actively participate in professional social media such as Facebook, Twitter and LinkedIn.	All	FIU has created and actively maintaining ABC-UTC accounts following social media website. <ul style="list-style-type: none"> <li>• LinkedIn</li> <li>• Twitter</li> <li>• YouTube</li> </ul>
T2-17	<b>Statewide or region-wide continuing education courses:</b> Three short courses, each four hours long, will be developed: a short course on basic principles of ABC and overview (FIU), a short course on issues related to seismic (UNR), and a short course on use of principles of ABC in small communities (ISU). The materials for each course will be developed for presentation on the web to DOTs and consulting engineers across the country. The course materials will be archived for future use.	FIU	FIU, ISU and UNR gave number of presentations at various gathering
T2-18	<b>In-depth web conference training:</b> Specific featured presentation topics from the planned monthly webinars will be expanded to 3- to 4-hour in-	FIU	An In-Depth web training was conducted at November 10. Similar to the 2014 inaugural training,

	depth web conference trainings to assist practitioners in developing a better understanding of the specific topics.		the 2015 in-depth web training was four hours long and consists of six modules, each a 30-minute presentation by an expert in the focus area of the module followed by a 10-minute Q&A session. This year's in-depth web training featured the Milton-Madison Bridge lateral slide replacement project.
T2-19	<b>Monthly ABC webinars:</b> The current FIU ABC center monthly webinars, attracting 3000 to 5000 participants, will be continued. Webinars will be archived for subsequent viewing.	FIU	FIU has continued to organize and successfully conduct monthly free webinars, without any interruption. These webinars are being attended by about 3000 to 4000 bridge professionals from across the country. Almost all State DOTs listen to these monthly webinars. These monthly webinars have become the most listened bridge webinar in the country.
T2-20	<b>Annual national conference:</b> In coordination with FHWA, state DOTs, and industry, a national ABC conference will be organized each year.	FIU	The 2015 National Accelerated Bridge Construction Conference was held during December of 2015. More than 600 bridge professionals attended the conference. Ten workshops, each four or eight hours long were conducted on Sunday December 6, 2015 at the conference locations. On Monday and Tuesday, December 7 and 8, 2015, 115, thirty minutes long technical presentations were made during the conference. The first annual ABC conference was held in December of 2014. These two annual conferences have become among most important bridge engineering events of the year. Following two videos capture the highlights of 2014 and 2015 National ABC Conferences.  <a href="http://www.2015abc.fiu.edu/2014Conference_video.html">http://www.2015abc.fiu.edu/2014Conference_video.html</a>

			<a href="http://www.merge-studios.com/abc-bridge-conference">http://www.merge-studios.com/abc-bridge-conference</a> The next conference is scheduled for December 6, 7 and 8, 2017 (www.2017abc.fiu.edu)
T2-21	<b>Annual workshop:</b> An annual 1.5-day technical workshop on ABC topics of current concern will be held at FIU. FIU held its first such ABC workshop in December 2012 with more than 40 attendees. There will be a registration fee and the event will be self-supporting.	FIU	Ten workshops, covering different ABC topic, were held during 2015 National ABC conference. For details of these nine workshops, please visit www.2015abc.fiu.edu
T2-23	<b>Assessment and Evaluation Tool:</b> Initially develop the tool, determine the goal of the activity, and identify the criteria. For each activity, populate the tool. See EDC “National and State Implementation Goals” and SHRP2 “Evaluation of Benefits.”	FIU	Progress of different activities is being monitored using a evaluation matrices.

## What opportunities for training and professional development has the program provided?

Please see the tables above for details. Following are highlights of information provided in the tables listed above

- 2014 and 2015 National ABC conference
- Educational modules were developed and used in graduate courses to train students.
- Nine, four hours long, workshops that were held in conjunction with 2014 National ABC Conference. Ten workshops that were held during 2015 National ABC conference
- Monthly webinars were continued
- In-depth webinar series were initiated, starting on November 2014.
- ABC sessions are organized at several major conferences
- PhD students, post-doctoral fellows, and undergraduate students involved in ABC-UTC projects have been trained on ABC topics.

## How have the results been disseminated?

The results will be disseminated by followings:

- 2014 and 2015 National ABC conference

- Educational modules
- Nine four hours long workshops that were held in conjunction with 2014 National ABC Conference. Ten 4 or 8 hour long workshops were held during 2015 National ABC Conference
- Monthly webinars
- In-depth webinars
- Various presentations to AASHTO, TRB, other national and international conferences, website, and conference publications.

## **What do you plan to do during the next reporting period to accomplish the goals and objectives?**

During next reporting period following tasks will be emphasized

- Continuing with conduct of research projects
- Finalizing the research topics for second incremental funding that was received in March 2014.
- Conducting 2<sup>nd</sup> in-depth webinar
- Development of more ABC educational modules
- Identifying more workforce development tasks and activities
- Continuing with monthly free webinars
- Continue with the research tasks as envisioned in the proposals. Continue with training of researchers, outreach to the ABC stakeholders, other engineers, and researchers. Continue to disseminate research results through various outlets.

## **PRODUCTS**

### **Publications, conference papers, and presentations**

#### **❖ FIU**

- Mohammadi, A., Taghinezhad, R., Garber, D., and Azizinamini. A., “A Review of three ongoing researches in ABC-UTC Center at Florida International University”, Poster Session, 2015 UTC Conference for the Southeastern Region, Birmingham, Alabama, March. 2015.
- Dickinson, M., Pham, H., “Development of Service Life Design Guide for ABC Projects”, 2014 National Accelerated Bridge Construction (ABC) Conference, Miami, Florida, Dec. 2014.
- Gull, J., Shafieifar, M., “Compilation of Accelerated Bridge Construction Solutions”, 2014 National Accelerated Bridge Construction (ABC) Conference, Miami, Florida, Dec. 2014.
- Rezaei, N., Garber, D., “Compilation of all ABC research that is ongoing and completed”, Poster Session, 2014 National Accelerated Bridge Construction (ABC) Conference, Miami, Florida, Dec. 2014.

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- Taghinezhad, R., Mohammadi, A., and Azizinamini, A., "Extending Application of Simple for Dead and Continuous for Live Load Steel Bridge System to ABC Applications in Seismic Regions", 2014 National Accelerated Bridge Construction (ABC) Conference, Miami, Florida, Dec. 2014.

❖ **UNR**

- Saiidi M., "Accelerated Bridge Construction of Column to Pile-Shaft Connections in Moderate and High Seismic Zones", Structures Congress 2015, Portland, Oregon, April 2015.
- Varela, S., and M. Saiidi, "Shake Table Tests on a Precast Modular 2-Span Bridge Model with Innovative Materials," Poster Session, University of Nevada, Reno College of Engineering Distinguished Lecture Series, Reno, Nevada, October 2014.
- Varela, S. and M. Saiidi, "Damage-Free Earthquake-Resistant Deconstructible Columns for ABC," National Accelerated Bridge Construction Conference, Miami, Florida, December 2014.
- Mehrsoroush A. and Saiidi, M., "An Earthquake-Resistant Column Base Pipe Pin Connection for ABC," *National Accelerated Bridge Construction Conference*, Miami, Florida, December 2014.
- Tazarv, M., Saiidi, M., Itani, A., Mehraein, M., Mehrsoroush, A., "Behavior and Design of Precast Bridge Cap Beams with Pocket Connections," *National Accelerated Bridge Construction Conference*, Miami, Florida, December 2014.
- Tazarv, M., Saiidi, M.S., Itani, A., and Shrestha, K., "Evaluation of Seismic Performance of Bridge Columns with Couplers and Development of Design Guidelines", Poster Session, 2014 National Accelerated Bridge Construction (ABC) Conference, Miami, Florida, Dec. 2014.

Mohebbi, A., Saiidi, M.S., Itani, A., and Tazarv, M., "Development and Seismic Evaluation of Pier Systems with Pocket Connections and Hollow PT/UHPC Columns", Poster Session, 2014 National Accelerated Bridge Construction (ABC) Conference, Miami, Florida, Dec. 2014.

- Saiidi, M., "Seismic Design of Column Base Pipe Pin Connections," TRB Committee AFF50 Technical Presentation, Transportation Research Board 94th Annual Meeting, Washington, DC, January 2015.
- Saiidi, M., "Update on USDOT University Transportation Center on Accelerated Bridge Construction," TRB Committee AFF50 Technical Presentation, Transportation Research Board 94th Annual Meeting, Washington, DC, January 2015.
- Saiidi, M., "Accelerated Bridge Construction in High Seismic Zones," Hot Topics Related to Seismic Design and Performance of Bridges, Transportation Research Board 94th Annual Meeting, Washington, DC, January 2015.
- Saiidi, M., "UHPC Performance for ABC Columns in High Seismic Zones," Caltrans Workshop on Ultra High Performance Concrete, Sacramento, California, March 2015.

## Website(s) or other Internet site(s)

ABC-UTC website is further developed to describe ABC-UTC center activities. Following features of the website (<http://abc-utc.fiu.edu>) were developed during the reporting period.

- "Content Management System" was installed that allows different ABC-UTC personnel to update content of the website
- Main menu of the website include followings:
  - Home
  - Research Projects
  - Education (Workforce Development)
  - Technology Transfer
  - Resources
  - Events
  - News
  - Monthly Webinars
  - Archive Webinars

ABC-UTC will be conducting the 2015 National Accelerated Bridge Construction conference in Miami, Florida on December 7-8, 2014. Thirty States have Co-Sponsored the conference. Conference has its own dedicated web site. Visit ABC Conference Website (<http://2015abc.fiu.edu/>) for more details.

## Technologies or techniques

Nothing to Report

## Inventions, patent applications, licenses

FIU is working on following two innovative ideas for which patent application will be filed:

- Sandwich Folded Girder System
- Innovative connection for ABC Bridges.

## Other products

Nothing to Report

# PARTICIPANTS & COLLABORATING ORGANIZATIONS

## ABC-UTC Participants at FIU

Name	Atorod Azizinamini, Ph.D.
Program/Project Role	ABC-UTC Director

Number of hours worked during the reporting period	Approximately 400 hrs.
Contribution to Program/Project	Responsible for oversight and governance of ABC-UTC
Funding Support	FIU, FDOT, UTC
Collaborated with individual in foreign country	N.A.
Country(ies) of foreign collaborator	N.A.
Travelled to foreign country	N.A.
If traveled to foreign country(ies), duration of stay	N.A.

Name	Mary Lou Ralls, P.E.
Program/Project Role	ABC-UTC Technology Transfer Director
Number of hours worked during the reporting period	Approximately 240 hrs.
Contribution to Program/Project	Responsible for oversight of ABC-UTC technology transfer and assistance to ABC-UTC Director as needed
Funding Support	UTC, AASHTO, TTI
Collaborated with individual in foreign country	N.A.
Country(ies) of foreign collaborator	N.A.
Travelled to foreign country	N.A.
If traveled to foreign country(ies), duration of stay	N.A.

Name	Jawad Gull, Ph.D.
Program/Project Role	Assistant Director ABC-UTC
Number of hours worked during the reporting period	260 hours.
Contribution to Program/Project	Responsible for assisting on different ABC-UTC tasks.
Funding Support	ABC-UTC
Collaborated with individual in foreign country	N.A.
Country(ies) of foreign collaborator	N.A.
Travelled to foreign country	N.A.
If traveled to foreign country(ies), duration of stay	N.A.

Name	Ali Mostafavi
Program/Project Role	ABC-UTC – Co-PI on a research project
Number of hours worked during the reporting period	Approximately 120 hours
Contribution to Program/Project	Co-PI on the Public Cost Estimation Project
Funding Support	ABC-UTC
Collaborated with individual in foreign country	N.A
Country(ies) of foreign collaborator	N.A
Travelled to foreign country	N.A
If traveled to foreign country(ies), duration of stay	N.A

Name	Mohammad Hadi
Program/Project Role	ABC-UTC – Co-PI on a research project
Number of hours worked during the reporting period	Approximately 80 hours
Contribution to Program/Project	PI on the Public Cost Estimation Project (FIU-4)
Funding Support	ABC-UTC
Collaborated with individual in foreign country	N.A
Country(ies) of foreign collaborator	N.A
Travelled to foreign country	N.A
If traveled to foreign country(ies), duration of stay	N.A

Name	Wallied Orabi
Program/Project Role	ABC-UTC – Co-PI on a research project
Number of hours worked during the reporting period	Approximately 110 hours
Contribution to Program/Project	Co-PI on the Public Cost Estimation Project
Funding Support	ABC-UTC
Collaborated with individual in foreign country	N.A
Country(ies) of foreign collaborator	N.A
Travelled to foreign country	N.A
If traveled to foreign country(ies), duration of stay	N.A

Name	Albert Gan
Program/Project Role	ABC-UTC – Co-PI on a research project
Number of hours worked during the reporting period	50 hours
Contribution to Program/Project	Design, Supervision, and Coordination of ABC-UTC Homepage, 2014 ABC-UTC Conference Website, and ABC Seminar Certification Process Automation.
Funding Support	Volunteer
Collaborated with individual in foreign country	N.A
Country(ies) of foreign collaborator	N.A
Travelled to foreign country	N.A
If traveled to foreign country(ies), duration of stay	N.A

Name	David Garber
Program/Project Role	ABC-UTC – Co-PI on a research project
Number of hours worked during the reporting period	Approximately 220 hours
Contribution to Program/Project	Responsible for Project #FIU-1 and assisting with other center activities.
Funding Support	ABC-UTC and FIU
Collaborated with individual in foreign country	N.A
Country(ies) of foreign collaborator	N.A
Travelled to foreign country	N.A
If traveled to foreign country(ies), duration of stay	N.A

Name	Atiosis Blanco
Program/Project Role	Web Developer on ABC-UTC website
Number of hours worked during the reporting period	105 hours
Contribution to Program/Project	Development of ABC-UTC Homepage and 2014 ABC-UTC Conference Website
Funding Support	ABC-UTC
Collaborated with individual in foreign country	N.A
Country(ies) of foreign collaborator	N.A
Travelled to foreign country	N.A
If traveled to foreign country(ies), duration of stay	N.A

Name	Haifang Wang
Program/Project Role	Web Developer on ABC-UTC website
Number of hours worked during the reporting period	89 hours
Contribution to Program/Project	<ul style="list-style-type: none"> <li>• Development of Abstract Submission and Review System for 2014 ABC Conference.</li> <li>• Development of Paper and Conference Material Submission system for 2014 ABC Conference.</li> <li>• Automation of ABC Seminar Registration Certification Process.</li> </ul>
Funding Support	ABC-UTC
Collaborated with individual in foreign country	N.A
Country(ies) of foreign collaborator	N.A
Travelled to foreign country	N.A
If traveled to foreign country(ies), duration of stay	N.A

### **ABC-UTC Participants at ISU**

Name	Brent Phares
Program/Project Role	ABC-UTC Co-Director
Number of hours worked during the reporting period	350 hours
Contribution to Program/Project	Overall leadership
Funding Support	-
Collaborated with individual in foreign country	No
Country(ies) of foreign collaborator	NA
Travelled to foreign country	No
If traveled to foreign country(ies), duration of stay	NA

### **ABC-UTC Participants at UNR**

Name	M. Saiid Saiidi
Program/Project Role	ABC-UTC Co-Director
Number of hours worked during the reporting period	120 hours
Contribution to Program/Project	Management of ABC-UTC-Seismic projects and workforce development/outreach at UNR.
Funding Support	ABC-UTC, Caltrans, WashDOT
Collaborated with individual in foreign country	No
Country(ies) of foreign collaborator	NA
Travelled to foreign country	Yes, but not w/ ABC-UTC funding
If traveled to foreign country(ies), duration of stay	NA

Name	Ahmad Itani
Program/Project Role	ABC-UTC-Seismic Co-PI at UNR
Number of hours worked during the reporting period	80 hours
Contribution to Program/Project	Help manage ABC-UTC-Seismic projects and workforce development/outreach at UNR.
Funding Support	ABC-UTC, Caltrans
Collaborated with individual in foreign country	No
Country(ies) of foreign collaborator	NA
Travelled to foreign country	No
If traveled to foreign country(ies), duration of stay	NA

## Industry Partners and Collaborators

### ABC Center Executive Board

- Atorod Azizinamini, Florida International University
- Mary Lou Ralls, Ralls Newman, LLC, Former State Bridge Engineer, State of Texas
- Kevin Thompson, URS, Former State Bridge Engineer California
- Jugesh Kapur, Burns & McDonnell, Former State Bridge Engineer, Washington State
- Ben Beerman, Federal Highway Administration
- Paul Liles, Former State Bridge Engineer, Georgia

### ABC-UTC Steering Committee Members

- Atorod Azizinamini, Florida International University
- Mary Lou Ralls, Ralls Newman, LLC, Former State Bridge Engineer, State of Texas
- Kevin Thompson, URS, Former State Bridge Engineer California
- Jugesh Kapur, Burns & McDonnell, Former State Bridge Engineer, Washington State
- Ben Beerman, Federal Highway Administration
- Carmen Swanwick, AASHTO SCOBS T-4, Chair, Utah DOT
- Paul Liles, AASHTO SCOBS T-4 Vice Chair, Georgia DOT
- Ahmad Abu-Hawash, Iowa DOT
- Nancy Daubenberger, Minnesota DOT
- Shoukry Elnahal, Delaware River & Bay Authority
- Bruce Johnson, Oregon DOT
- Bijan Khaleghi, Washington State DOT
- Elmer Marx, Alaska DOT&PF
- Tom Ostrom, California DOT

- Robert Robertson, Florida DOT (**New**)
- Monica Starnes, Transportation Research Board
- Wayne Symonds, Vermont Agency of Transportation
- Maury Tayarani, MassDOT

### **Federal Highway Administration**

- Ben Beerman, Resource Center
- Phil Yen, Office of Infrastructure

### **Industrial and Government partners**

- John Busel, American Composites Manufacturers Association (ACMA)
- Reid Castrodale, Lightweight concrete rep.
- Randy Cox, American Segmental Bridge Institute (ASBI)
- Jerry DiMaggio, Applied Research Associates, Inc.
- Bill Duguay, Associated General Contractors of America (AGC), rep.; J.D. Abrams, LP
- Mike Engestrom, Small Span Steel Bridge Alliance (SSSBA)
- Mal Kerley, NXL Construction Services, Inc.
- Danielle Kleinhans, National Concrete Bridge Council (NCBC), rep.
- Bill McEleney, National Steel Bridge Alliance (NSBA)
- William Nickas, Precast/Prestressed Concrete Institute (PCI)
- Eliza Partington, FIGG

### **Collaborators from Partner Universities**

- SaiidSaiid, University of Nevada, Reno
- Brent Phares, Iowa State
- Ahmad Itani, University of Nevada, Reno
- Terry Wipf, Iowa State University

### **Faculty and Staff at Florida International University**

- Mohammad Hadi, Associate Professor
- Albert Gan, Professor
- Seung Jae Lee, Assistant Professor
- David Garber, Assistant Professor
- Xia Jin, Assistant professor
- Hesham Ali, Professor of Practice
- Ali Mostafavi , Assistant Professor
- Wallied Orabi , Assistant Professor
- Jawad Gull, Research Associate
- Alireza Mohammadi, Graduate Student
- Huy Pham , Graduate Student
- Ramin Taghinezhad, Graduate Student
- Alireza Valikhani, Graduate Student

- Azade Jaber, Graduate Student
- Mahsa Farzad, Graduate Student
- Mohamadreza Shafieifar, Graduate Student
- Haifeng Wang, Senior Software Engineer
- Atiosis Blanco, Specialist Computer Research International Members of the ABC Center
- Taek-RyongSeong, RIST - South Korea
- Chan-Hee Park, RIST - South Korea

# **IMPACT**

## **What is the impact on the development of the principal discipline(s) of the program?**

The ABC-UTC is taking a national lead in ABC area and has established a very good working relation with FHWA and AASHTO T-4 that is responsible for developing the national roadmap for State DOTs for implementing ABC. The Director of ABC-UTC was also elected to be liaison between the newly formed TRB ABC committee and ABC-UTC. These connections and activities are allowing ABC-UTC to better fill the knowledge gap, especially in the research and workforce development areas. ABC-UTC has also made major accomplishments in developing a close working relationship with State DOTs. Twenty Six States have Co-sponsored the 2014 National ABC Conference. Thirty State DOTs are sponsoring 2015 National ABC Conference and plans are for having the next conference in 2017. The State DOT engineers of sponsoring State DOTs work very closely with ABC-UTC. The connection created with State DOT bridge engineers will greatly facilitate the implementation of ABC-UTC work.

## **What is the impact on other disciplines?**

ABC-UTC has identified research areas that will help the ABC cause and that falls outside the mission of ABC-UTC. In coming months we will be contacting other UTC for developing collaborative work in these areas.

## **What is the impact on physical, institutional, and information resources at the university or other partner institutions?**

The establishment of ABC-UTC has allowed obtaining many additional resources for the faculties, active in ABC areas at FIU and partner universities. The three institutions work closely on many activities and this is proving to be a great opportunities for the students to collaborate.

## **What is the impact on technology transfer?**

The ABC-UTC monthly webinars are proving to be the most effective means of transferring the knowledge to the profession. Having more than 4000 bridge professional participate in these monthly webinars are unparalleled. The 2014 National ABC conference was co-sponsored by 26 state who actively participated in this event. The 2015 National ABC Conference was Co-Sponsored by 30 State. These activities are providing opportunities for effective communications with State DOTs and bridge professionals, making the task of Technology transfer much easier.

## **What is the impact on society beyond science and technology?**

The major goal of ABC-UTC is to make the ABC the method of choice for bridge replacement and retrofit. This in turn will improve the mobility and save the society in many different ways. One of the most important contributions of ABC to society is reducing the number of accidents and therefore

significantly enhancing the safety. A single accident could cost tax payers millions in litigation and legal expenses.

## **CHANGES/PROBLEMS**

### **Changes that have a significant impact on expenditures**

No changes

### **Actual or anticipated problems or delays and actions or plans to resolve them**

No changes

### **Changes that have a significant impact on expenditures**

No changes

### **Significant changes in use or care of human subjects, vertebrate animals, and/or biohazards**

No changes

### **Change of primary performance site location from that originally proposed**

No changes

## **SPECIAL REPORTING REQUIREMENTS**

Financial report and documents will be sent by Depart of Research at Florida International University

**Completed by:**

**Florida International University:** Atorod Azizinamini

**Iowa State University:**

**University of Nevada, Reno:**

