2018 Annual Gulf Coast Ecosystem Restoration Council Report

Texas RESTORE Centers of Excellence

(October 01, 2017 - September 30, 2018)

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I. Executive Summary

In January 2015, Texas Commission on Environmental Quality (TCEQ) competitively selected two consortia, the Texas A&M University Corpus Christi - Texas OneGulf Consortium and University of Houston (UofH) - Subsea Systems Institute.

The mission of the Texas OneGulf Center of Excellence is to gather and improve knowledge about the Gulf of Mexico to inform decision making around the challenges to environmental and economic sustainability of the Gulf of Mexico and its impact on the health and well-being of Texans and the nation. Texas OneGulf is designed with the capacity and flexibility to address all five focus disciplines denoted in Section 1605 of RESTORE Act (1605). This Center has been awarded funding and has begun or completed activities on six projects. Highlights include: completed the competitive grant process Request for Proposal #2 that resulted in the development of the "Hurricane Harvey Decision-Support – Resilient Environments and Communities" project; populated delayed-mode glider data collected on website http://tabs.gerg.tamu.edu/tceq for eight associated missions and provided final Glider Monitoring Implementation Plan for the Disaster Research Response (DR2) Program; completed Strategic Plan to integrate the data from Gulf of Mexico Coastal Ocean Observing System Regional Association's (GCOOS-RA), Gulf of Mexico Research Initiative Information & Data Cooperative (GRIIDC), Gulf of Mexico Alliance Geoportal (GOMAportal); implemented priority action items from strategic plan to deliver data integration products and developed/deployed a website that will promote the Texas OneGulf Knowledge Base http://tkb.geos.tamu.edu/ ; began annual cycle of input and review to help ensure that the Strategic Research and Action Plan (SRAP) evolves with Texas OneGulf as a means of guiding future work plans and focus; and began implementation of Stakeholder Communication and Engagement Plan.

Subsea Systems Institute (SSI) is a collaborative endeavor focusing on translational engineering, validation science and appropriate policy towards maintaining the technological, economic and workforce leadership of the Gulf coast area in the realm of deepwater and ultra-deepwater hydrocarbon use. The SSI is addressing offshore energy development, including research and technology to improve the sustainable and safe development of energy resources in the Gulf of Mexico as its focus on one of the disciplines denoted in Section 1605 of RESTORE. This Center has been awarded funding and has begun or completed activities on eight projects. Highlights include:

- developed and tested a prototype supercapacitor-battery unit for under subsea environmental conditions; progress made on modifying reduced order model for predictive modeling of performance of blowout preventers; progress was made to experimentally validate the proposed adaptive mode health monitoring solution;
- completed testing of prototype autonomous underwater vehicle with NASA's Neutral Buoyancy Lab; designed and integrated hardware solution and protocol stack complete for stress-wave communication and pipeline and flow system for fiber-optic sensing system;
- mobilization of project with recruitment of personnel for the remote robotics for unmanned human environments work.

II. Programmatic Elements

A. Award Recipient

As the Texas Governor's appointee to the RESTORE Council, Toby Baker of the TCEQ has established Centers of Excellence in Texas in accordance with the requirements set forth in the RESTORE Act and U.S. Treasury regulations. On behalf of Baker and the Governor, TCEQ has received two awards from Treasury totaling $6,230,588 (June 9, 2015 $4,036,238 and October 31, 2017 $2,194,350) that addresses all five disciplines denoted in Section 1605 of RESTORE (1605).

Annual TCEQ accomplishments include:

- completed sub-awarding process for two Proposal of Grant Activities to the Centers;
- monitored and reviewed deliverables of Centers;
- responded to inquiries from Centers;
- reviewed invoices and processed eligible expenditure reimbursements;
- generated and submitted required federal reporting,
- held End-of-Year meetings with each of the two Centers to discuss detailed reviews of the progress of each of the projects;
- coordinated an Institutional Review Board (IRB) exemption request with Treasury for Proposal of Grant Activities (PGA) Stakeholder Communication and Engagement Plan project (previously titled: Gulf coast Health Alliance: achieving Resiliency Together);
- coordinated a request for prior approval of participant support cost with Treasury for lower tier sub-awardee for Stakeholder Communication and Engagement Plan project;
- coordinated prior approval of foreign travel for lower tier sub-awardee for Remote Robotics for Unmanned Human Environments project; and,
- conducted site visit at Subsea Systems Institute to discuss new Robotics project and tour labs for Remote High Power for Subsea Emergencies project and Hazard Mitigation and Facility Monitoring Program: Fiber-Optic Seismic Systems project.

B. Award Subrecipient(s)

<u>Projects - Texas OneGulf Consortium</u>

The nine participants in the Texas OneGulf Consortium include:

- Texas A&M University Harte Research Institute for Gulf of Mexico;
- Texas A&M University at Galveston;
- University of Houston Law Center;
- Texas A&M University Center for Translational Environmental Health Research (CTEHR);
- Gulf of Mexico Coastal Ocean Observing Regional Association (GCOOS);

- University of Texas Medical Branch at Galveston (UTMB);
- Texas A&M University Geochemical and Environmental Research Group (GERG);
- University of Texas Brownsville (Rio Grande Valley); and
- Texas State University the Meadows Center for Water and the Environment.

1-57790 General Operations of Center of Excellence project, principals Dr. Larry McKinney (Harte) and Dr. Jennifer Horney (TAMU), awarded 10/19/15, Scope of Work – This project established a fully functional Center of Excellence (COE). Project addresses all five eligible disciplines denoted in 1605. The status of performance and annual accomplishments are listed below.

- Met the reporting requirements of the COE and continues to oversee the day-to-day operations and administration of the COE.
- Completed the Request for Proposal #2 process that resulted in the development of a Grant Activity Description "Hurricane Harvey Decision-Support – Resilient Environments and Communities."
- Next Step is to receive TCEQ approval for the Hurricane Harvey Decision-Support – Resilient Environments and Communities project and begin the lower tier sub-award process.

2-61593 Strategic Research and Action Plan (SRAP) project, principal Dr. Larry McKinney (Harte), awarded 01/07/2016, Scope of Work – This project is to develop a strategic planning process to address priority Gulf problems that would guide a grant process that fosters a science-based and solutions driven framework addressing the disciplines designated in the RESTORE Act. The project addresses all five 1605 eligible disciplines. The status of performance and annual accomplishments are listed below.

- All tasks, deliverables, and milestones for the project have now been completed.
- Future SRAPs will come from an annual cycle of input and review to help ensure that the SRAP evolves with Texas OneGulf as a means of guiding future work plans and focus.

3-62428 Environmental, Human Health and Safety project, principals Dr. Larry McKinney (Harte) and Dr. Jennifer Horney (TAMU) replaced Dr. Cheryl Walker (CTEHR), awarded 02/25/2016, Scope of Work – This project will create a first time infrastructure to support disaster research response encompassing both environmental, human health and economic assessment capabilities that can be employed rapidly to assess the impact of disaster along the Texas Gulf coast in real-time. The project addresses the 1605 eligible discipline of coastal and deltaic sustainability, restoration and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast Region. Status of performance and annual accomplishments include:

- Completed all tasks, deliverables, and milestones for the project.

4-62971 Mechanisms Controlling Hypoxia – Gilder Applications to Gulf of Mexico Hypoxic Zone Monitoring project, principals are Dr. Larry McKinney (Harte) and Dr. Anthony Knap (GERG), awarded 04/22/2016, Scope of Work – This project will gather and share unique data about hypoxia off the Texas coast to assist in the development of a scalable glider monitoring implementation plan for the Gulf of Mexico hypoxic zone. The project addresses the 1605 eligible discipline of comprehensive observation, monitoring, and mapping of the Gulf of Mexico. The status of performance and annual accomplishments are listed below.

- All collected observations from the eight glider missions were examined and the finalized quality assured data sets were placed on the dedicated project web site at http://tabs.gerg.tamu.edu/tceq/.
- The infrastructure to quickly assess the impact of both man-made and natural disasters has been completed. It is recommended that a combination vehicle types (surface gliders and sub-surface buoyancy gliders) be deployed to maximize spatial coverage and temporal duration of the event.
- PI Dr. Knap hosted and participated in the "Prioritizing Public Health Risks From Oil Spills: 2018 Stakeholder Meeting" on 6 April 2018.
- The final glider monitoring implementation plan for the DR2 program has been completed.
- Completed all tasks, deliverables, and milestones in Mechanisms Controlling Hypoxia.

6-70739 Texas Knowledge Base project, principals Dr. Larry McKinney (Harte), Dr. James Gibeaut (Harte), and Dr. Matthew Howard (TAMU), awarded 01/18/2017, Scope of Work – This project will establish the Gulf of Mexico Coastal Ocean Observing System Regional Association's (GCOOS-RA) and Gulf of Mexico Research Initiative Information & Data Cooperative (GRIIDC) programs as part of the Texas OneGulf Knowledge Base (TOKB) information system. This system will provide decision-makers with the best available science and real-time data and information on which to make decisions and act to the benefit of Texas. TOKB will bring together extensive, complementary and well-maintained online information systems for marine science, oceanographic and related data currently available from the Gulf of Mexico.
The project addresses all five 1605 eligible disciplines. The status of performance and annual accomplishments are listed below.

- The development and launching of the first version of the website was a significant milestone that will serve to establish the TOKB for managing the coast and providing data and tools for addressing future environmental issues.
- The coastal Texas Sensitive Areas geodatabase, which includes more than 30 state-wide Texas geographic layers showing the distribution of environments and other ancillary information such as dredged channels, and protected areas was compiled.
- The first version of the Texas coast literature atlas was launched.

- The deliverable requirements for the Knowledge Base data integration products have been completed.
- Completed all tasks, deliverables, and milestones for the Texas Knowledge Base project.

7-84395 Stakeholder Communication and Engagement Plan, principals Dr. Sharon Croisant (UTMB) and Dr. Katya Wowk (Harte), awarded 9/21/18, Scope of Work – This project is to develop a communications and engagement plan that will summarize stakeholder perceptions of threats to Gulf's environmental, economic and human health; identify the ways the consortium can address gaps; and suggest a plan of action for how the consortium will engage and communicate to its stakeholders. The project addresses the 1605 eligible discipline of Coastal and deltaic sustainability, restoration and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast Region. The status of performance and annual accomplishment is listed below.

- Begining implementation of project by the identification process of stakeholders and developing surveys to glean knowledge from these individuals with expertise.

Projects - Subsea Systems Institute

The Subsea Systems Institute is a collaboration between the University of Houston, Rice University, and National Aeronautics and Space Administration (NASA)/Johnson Space Center. The Subsea Systems Institute (SSI) is located on the University of Houston campus in Houston, TX. Currently the center is staffed by a Director and a Program Manager.

Dr. Ramanan Krishnamoorti, serves as Director of SSI and Center of Excellence principle. He provides day-to-day leadership for the institute including external relations with industry and government institutions. Airica Rollins is the Program Manager with responsibility for the administration of the research projects. Charles McConnell (Rice) and Dr. Kamlesh Lulla (NASA-JSC) are the Co-PIs and provide institutional support to the Director.

All projects address the 1605 eligible discipline offshore energy development, including research and technology to improve the sustainable and safe development of energy resources in the Gulf of Mexico.

1-57794 General Operations of the Center of Excellence, principal Dr. Ramanan Krishnamoorti (UofH), awarded 10/05/15, Scope of Work – This project tasks are the ongoing administrative monitoring of existing projects, the integration of industry expert insight, and meeting of the reporting requirements. The status of performance and annual accomplishments are listed below.

- Have begun the Request for Proposal (RFP) process for the third round of projects.

- Completed amendment to project to increase funding through August 31, 2019.
- Continued ongoing monitoring of existing projects and reporting requirements.

2-62404 Remote High Power for Subsea Emergencies project, principals are Dr. Ramanan Krishnamoorti (UofH), Dr. James Tour (Rice), and Dr. Haleh Ardebili (UofH), awarded 05/03/2016, Scope of Work – This project will directly address one of the critical failures that occurred during the Deepwater Horizon disaster by designing nanoporous NiF2 (NP-NF)-based supercapacitors to reliably provide power to a blind shear ram. The project is to develop a combination of two new technologies using batteries and high-power supercapacitors for subsea applications including the control pod for a subsea blowout preventer. The status of performance and annual accomplishments are listed below.

- Completed the construction of the high-pressure apparatus for capacitator-battery testing at 5,000 psi for testing under subsea environment.
- Completed feasibility testing of supercapacitor – battery unit under subsea environmental conditions by developing a preliminary package for the Remote High Power for Subsea Emergencies project.
- Submitted the final report in May 2018.
- Completed all tasks, deliverables, and milestones for the project.

3-62406 A Model-Based Real-Time Annular Blowout Preventer (BOP) Monitoring System project, principals are Dr. Ramanan Krishnamoorti (UofH), Dr. Matthew Francheck (UofH), and Matthew Brake (Rice), awarded 05/03/2016, Scope of Work – This project will develop a rigorous analytical approach to systematic BOP monitoring using an adaptive model-based real-time strategy, and then validate/demonstrate the approach on a small-scale BOP annular health monitoring testbed. The program will focus on real time health and risk assessment (monitoring) of annular BOPs. A blowout preventer is a large specialized mechanical device used to seal, control, and monitor oil and gas wells to prevent the uncontrolled release (blowout) of crude oil and/or natural gas from a well. This project will produce a BOP Monitoring System capable of self-integration whereby it learns the specific BOP thereby enabling accurate estimations of BOP health. The status of performance and annual accomplishments are listed below.

- Made progress on modifying reduced order model of the axisymmetric volume averaged finite element model of annular and worked toward capturing the elastomer degradation.
- Completed experimentally validating the adaptive mode health monitoring solution for A Model-Based Real-Time Annular Blowout Preventer (BOP) Monitoring System project.
- Submitted the final report in August 2018.
- Completed all tasks, deliverables, and milestones for the project.

4-62408 Marine Drilling Hazard Mitigation and Production Facility Monitoring using Seismic and Sonar Imaging project, principals are Dr. Ramanan Krishnamoorti (UofH) and Dr. Robert Stewart (UofH), awarded 05/03/2016, Scope of Work – This project will develop a proof-of-concept monitoring system for the early detection and assessment of drilling or production problems. It will inform about the design and capability of a full field system which will contribute substantially toward the safety and efficacy of deep-water operations. The status of performance and annual accomplishments are listed below.

- Completed all tasks, deliverables, and milestones for the project.
- The project's next step to this project is being completed under 7-74785 Hazard Mitigation and Facility Monitoring Program: Fiber-Optic Seismic Systems.

5-62412 Autonomous Underwater Vehicles (AUV) for Subsea Energy Applications project, principals are Dr. Ramanan Krishnamoorti (UofH) and Dr. Fathi Ghorbel (Rice), awarded 06/08/2016, Scope of Work – Develop an AUV prototype that will be highly maneuverable in tight spaces, can hold station vertically, can perform docking, and will be capable of autonomous manipulation. The final goal of the project is to establish a sound and comprehensive program in autonomous AUVs for subsea energy applications with engagement and endorsement of major operators. This project is broken into two programs. Program 1 is to organize a workshop to engage industry in overviewing the state of the art of AUV technology and build a collaborative relationship with operators in subsea energy applications to define the new challenges of subsea AUVs. Program 2 is to build an updated, more functional and more robust version of the Rice University RiSYS Lab swimming robot prototype and for it to be tested at NASA's Neutral Buoyancy Lab. The status of performance and annual accomplishments are listed below.

- All appropriate paperwork has been filed and specifications for testing apparatus and space proximal to autonomous underwater vehicle (AUV) has been identified.
- Completed testing of updated prototype at NASA's Neutral Buoyance Lab (NBL) for the autonomous underwater vehicle (AUV) project.
- Submitted the final report in August 2018.
- Completed al tasks, deliverables, and milestones for the.

6-74270 Stress Wave Assisted Communications in Subsea Environments project, principals are Dr. Ramanan Krishnamoorti (UofH), Dr. Miao Pan (UofH), Dr. Robert Stewart (UofH), Dr. Jiefu Chen (UofH), and Dr. Aijun Song (University of Alabama), awarded 06/30/2017, Scope of Work – Develop a novel stress wave-based communication method for subsea applications. This method of communication will bypass most drawbacks of conventional communication techniques (i.e. radio, optical, and acoustic) and allow artificial structures such as pipelines to be used as robust, low loss communication conduits. The status of performance and annual accomplishments are listed below.

- Finalized the design for piezo-based transducer.

- Developed more advance algorithm to encode messages across the model pipeline.
- Developed the protocol stack and integration of hardware solution and protocol stack.
- The next steps are to complete the test scaled model and generate the final report.

7-74785 Hazard Mitigation and Facility Monitoring Program: Fiber-Optic Seismic Systems project, principals are Dr. Ramanan Krishnamoorti (UofH), Dr. Robert Stewart (UofH), and Dr. Michael Ho (UofH), awarded 08/24/2017, Scope of Work – Develop a proof-of-concept marine, fiber-optic vibration sensing system, an instrumented flow loop for the lab and field. Along with associated analysis and interpretation methods, this system will provide learnings for improved subsea reservoir monitoring and production: The Instrumented and Intelligent Marine Oilfield. Industry support will come in the form of collaborations with Apache Corporation. Lawrence Berkeley National Laboratory, OptaSense, and Halliburton. The status of performance and annual accomplishments are listed below.

- Successful buildout of pipeline, flow system with interrogator and fiber-optic system
- Successful measurement of fiber-optic sensors
- The next steps are to complete the seismic tests and generate the final report.

8-84091 Remote Robotics for Unmanned Human Environments project, principals are Dr. Ramanan Krishnamoorti (UofH), Dr. Kimberly Hambuchen (NASA), Dr. Joshua Mehling (NASA), and Dr. Marcia O'Malley (Rice), awarded 07/17/2018, Scope of Work – Increase the ability of robotic assets to manage the physical operations and tasks necessary for both oil platform and spacecraft habitat maintenance by advancing the autonomous skills of dexterous robots capable of performing these remote tasks.

- The next steps are to establish and engage the Robotics Advisory Council to develop roadmap for the Remote Robotics for Unmanned Human Environments project. Advance the research progress for this project after roadmap exercise is completed.

III. Financial Elements

A. Award Recipient

During this reporting period, TCEQ has drawn down funds and obligated project funding to the Centers:

- $6,230,588 awarded from Treasury, TCEQ has drawn down $2,810,681.18 (45%) for Center's expenditure reimbursement request
- $2,031,454.77 of $3,018,119 (67%) has been obligated to Texas A&M University Corpus Christi - Texas OneGulf

- $2,922,588.75 of $3,018,119 (97%) has been obligated to University of Houston - Subsea Systems Institute (SSI)
- TCEQ has no leverage funds

B. Award Subrecipient(s)

Center	Project	Awarded	Expended	Lower Tier Subawardee	Amount
Texas OneGulf	1-57790	$768,318.00	$335,516.84	Texas A&M (TAMUHSC)	$167,036
Texas OneGulf	2-61593	$139,041.78	$139,041.78	N/A	$0
Texas OneGulf	3-62428	$182,531.99	$182,531.99	Texas A&M (TAMUHSC) University of Texas (UTMB)	$171,639 $133,365
Texas OneGulf	4-62971	$457,361.00	$356,908.55	Texas A&M (TAMU)	$457,361
Texas OneGulf	6-70739	$389,443.00	$257,759.74	Texas A&M (TAMU)	$194,998
Texas OneGulf	7-84395	$94,759.00	$0.00	University of Texas (UTMB)	$79,949
Subsea Systems Institute (SSI)	1-57794	$802,184.00	$633,561.13	N/A	$0
SSI	2-62404	$300,000.00	$213,255.92	Rice University	$150,000
SSI	3-62406	$189,535.00	$175,130.86	Rice University	$99,330
SSI	4-62408	$109,868.75	$109,868.74	N/A	$0
SSI	5-62412	$100,000.00	$80,851.33	Rice University	$92,000
SSI	6-74270	$300,000.00	$143,523.71	University of Alabama	$40,075
SSI	7-74785	$298,001.00	$149,998.78	N/A	$0
SSI	8-84091	$823,000.00	$0.00	Rice University	$448,881

IV. Gulf Coast Ecosystem Restoration Council Element

A. Leveraging Multipliers

Texas OneGulf Consortium

1-57790 Total other funds for this project is $414,687 from the Harte Charitable Foundation and Harte Research Support Foundation to assist in with the important task of establishing the center and having it operational as soon as possible. The goal of Harte Research Institute (HRI) is to allow more money to be put toward research by providing additional funds that reduce the center's burden of administrative costs.

6-70739 Total other funds for this project is $143,976. The Harte Research Support Foundation and a grant from Gulf of Mexico Alliance have provided two years of funding to support the Texas OneGulf Knowledge Base system.

This project is utilizing underserved datasets which are datasets of significant value that are difficult to use for one or more reasons. For example, a dataset may not be available online or if it is available online it may be in an obscure location. Data can be difficult to use if it is in an inconvenient format such as those used by some environmental sampling systems. Data use can be improved when data are transformed into preferred formats with complete metadata and served through systems that support both human and machine access.

Coordination between RESTORE Centers of Excellence (COE)

Texas OneGulf has played a leading role in establishing coordination between both designated and presumptive COEs. There is a monthly call between the Centers hosted by Florida RESTORE Act Centers of Excellence Program (FLRACEP), where the focus has been on joint research activities.

The Gulf Restoration Science Programs Ad Hoc Coordination Forum, hosted by the NOAA RESTORE Science Program, provides a venue for all Gulf science programs to come together to develop common data management, share funding opportunities and look for synergies and activities that can be shared. The Texas OneGulf Executive Director participates in the monthly call and attends events like Gulf of Mexico Oil Spill and Ecosystem Science Conference (GOMOSES). These face to face meetings serve to enhance coordination and joint actions, reduce duplication and afford opportunities to leverage individual actions.

The Texas OneGulf Executive Director serves on the Friends Board of the Florida Institute of Oceanography, providing additional opportunities for coordination of COE funding. This Board also acts as part of the Florida COE Management Team and provides review and approval for funding FLRACEP projects. The management team looks for opportunities to minimize duplication and promote

coordinated research.

Subsea Systems Institute

The Subsea Systems Institute has secured the grant with the Office of the Governor (OOG).
The following activities have taken place under the award from the OOG.

- Research Programs: This includes research programs that have not been funded by TCEQ. These programs are in the following categories:
  - programs identified through the TCEQ grant award process, but not funded by TCEQ, which are identified as valuable research topics that meet the SSI objectives; and
  - research topics that are identified through SSI engagement with industry or the government that meet SSI objectives including safety, risk mitigation and improved reliability.
- The following Research Programs have been launched using OOG funds:
  - Pilot project to develop new computational methods for hydrocarbon behavior in a marine riser.
    - The Principal Investigator on this project is Dr. Andrea Prosperetti (UH). This project has undertaken a theoretical and computational study of the character of hydrocarbons that are inadvertently introduced into a marine riser. This issue has been discussed with industry and the need for new methods and understanding has been identified in order to establish improved operating procedures. Current project status includes a newly developed algorithm and has been successfully applied to a set of equations. This work may be extended through programs to be awarded by the Bureau of Safety and Environmental Enforcement (BSEE) and the Gulf Research Program (GRP). The value of the pilot program is $50,000.
  - Demonstration project with industry partner The Jukes Group, to develop improved manufacturing and testing methods to predict the performance of API pipe flanges under a combination of loading conditions.
    - The Principal Investigator on this project is Dr. Gangbing Song (UH). This work will improve the leak performance of pipe flanges, as is a major topic for operators. In September 2017 a meeting was held with industry operators to engage in discussions to focus the testing of the flange in a way that would most benefit the industry and make improvements to industry standards. A follow up meeting was held with joint industry project interested industry operators in May 2018 to discussion the preparation of a proposal to fund phase II. Current project status includes the writing of the proposal and planning of the demonstration testing. The cost of this demonstration project is $41,731.
  - Development project of High Power Density Fault Tolerant Subsea

Drives with Advanced Circuit Breaker to support the ongoing development of the power requirements for subsea equipment.

- The Principal Investigator on this project is Dr. Kaushik Rajashekara (UH). The first year of this project will be supported by the grant funds. There are a number of technology components to this program.
  - The development of advanced power converter topologies using high frequency magnetics to reduce the footprint of subsea and down-hole drive systems.
  - Real-time simulation of the entire subsea system to evaluate the harmonics, to study the effects of long distance cable capacities and voltage stability.
  - The project also targets development of a novel solid-state DC circuit breaker and connector suitable for subsea systems.
- The project launched in September 2017 and laboratory personnel have been established and a database was developed. Current project status includes testing and extracting data and experimental results have been verified and shown the capability of the proposed circuit performance. In the coming months, the thermal cycling test board which have already been designed, will be implemented and a high-temperature SiC-MOSFET and high-temperature gate driver will be installed, and tests will commence in high-temperature. The cost for the first year of research project is $148,000.

Center of Excellence federally funded Grant Activity Descriptions (GADs) that include leveraging multipliers are listed here:

- GAD No. 2:
  - Dr. James Tour (PI) provides supervision for work being done on the project at Rice as delineated in the SOW and proposal. His annualized salary is $129,272.00. His contribution to the project over the 22-months will be 1-month each year (12-months).
    - Year 1: PI salary will be provided from the Rice University (non-federal local) (1-month).
    - Year 2: PI salary will be provided from the Rice University (non-federal local) (1-month).
    - This amount includes a 3% merit increase.
    - Fringe Benefits are actual and is estimated at about 30% for faculty
- GAD No. 3:
  - Dr. Matt Franchek (PI), with an annualized salary of $279,600, will dedicate 1-month effort to manage the UH portion of the work.
    - Year 1: $13,255.00 will be paid by the University funds (state appropriations) for .5-month in the academic year.
    - Year 2: $13,255.00 will be paid by the University funds (state appropriations) for .5-month in the academic year.

        - Fringe Benefits are actual and is estimated at 16% in the summer for this faculty.
    - Dr. Brake (Co-I) will supervise the work to be done on the 22-month project at Rice as delineated in the SOW.
        - Year 1: $10,946.94 will be paid by the University funds (non-federal local) for .4-month in the academic year.
        - Year 2: $11,095.01 will be paid by the University funds (non-federal local) for .4-month in the academic year.
        - Fringe Benefits rates for this faculty is 23.40%.
    - Use of a testbed, which is a Transocean test facility, is made available to this project at no cost. The approximate market value for access to this test equipment is $10,000 per year.
- GAD No. 4:
    - Dr. Rob Stewart (PI), with an annualized salary of $281,856.00, has dedicated .6-month in the summer (20%) and .5-month academic time (6%) to manage the work.
        - Year 1: $14,129.00 of the PI salary was provided by the grant and $11,744.00 by the university.
        - Fringe Benefits are actual and is estimated at 30% in the academic year for this faculty and 22% in the summer.
    - Jiming Bao (Co-I) with an annualized salary of $137,592.00, dedicated .4-month summer (13%) and .5-month academic time (6%) to work on the project.
        - Year 1: $4,610.00 of the Co-I salary was provided by the grant and the other$5,733.00 by the university.
        - Fringe Benefits are actual and is estimated at 30% in the academic year for this faculty and 22% in the summer.
- GAD No. 5:
    - Dr. Fathi Ghorbel (PI) oversees the statistical analyses, data management, and be responsible for reporting the project's results.
        - Year 1: The PI will devote 2-months effort to the project. One-month salary will be provided from the grant funds and one-month funding will be provided by Rice University (non-federal funds). The PI will spend the remaining time not spent on the project on other university activities.
        - Fringe Benefits 23.4% for faculty.
    - The use of an existing prototype AUV represents an in-kind contribution (Estimated amount $10,000.00).