Mr. Thomas J. Elzey

For more than 114 years, South Carolina State University has continued to build upon a legacy of excellence in education. As the only state-supported historically black university in the state of South Carolina, SC State has emerged as a leader among the nation’s top minority-serving institutions. This is in part due to premium academic programs and top-ranked faculty who are scholars in their fields.

At the pinnacle of our academic offerings is STEM programming and ongoing research that addresses some of the world’s most critical problems. Students pursuing their degrees in Science, Technology, Engineering, and Mathematics at SC State are trained and mentored by experts who understand that the world is quickly changing and becoming more technologically advanced. Furthermore, our student and faculty researchers are leading the charge of discover breakthroughs in the areas of diabetes research, environmental sciences, agribusiness, medical physics, and nuclear engineering, just to name a few.

As the world evolves into the 21st century and beyond, SC State University graduates will be counted prominently among the change-agents who will pave the way for future generations who will also compete, succeed, and serve as outstanding global citizens. The Department of Energy Environmental grant ensures that this university will continue to pour resources into the recruitment, training, and retention of minority students who will fortify the DOE-EM workforce. The DOE-EM grant will also broaden the university’s capacity to support the sciences through the use of state-of-the-art equipment and facilities; providing students with an educational environment conducive to learning, exploration and discovery.
Dr. W. Franklin Evans

Interim Provost for Academic Affairs

South Carolina State University celebrates a rich legacy of producing exceptional graduates that include scientists, engineers, physicians, and researchers. The talented faculty and staff at this institution work hard to recruit, train, nurture, and develop scholars in a variety of STEM disciplines. Students are afforded the opportunity to receive cutting-edge instruction along with practical, hands-on experience. The focus of SCSU is to provide a quality education that is relevant and accessible to students. As we prepare a workforce of highly skilled, competent, and socially aware graduates, we strive to reach a balance among teaching and learning, research, and service.

As the university undergoes a transformation to be the change agent that is needed in South Carolina and the region. A grant from the Department of Energy to focus on Environmental Management will provide this university with resources to assist with recruitment, retention, and graduation initiatives. The DOE-EM grant would ensure that our College of Mathematics, Science, Engineering, and Technology continues to stand out among other HBCUs and peer institutions as a beacon of light and productivity.
South Carolina State University (SCSU) has a rich history of recruiting underrepresented students in the Science, Technology, Engineering, and Mathematics (STEM) fields and further recognizes the need to actively seek prospective underrepresented students interested in pursuing careers in Environmental Sciences and other STEM related fields. The University has dynamic academic programs in the STEM areas with an integrated approach to research and technology, providing enhanced opportunities for students to pursue careers in STEM areas and fulfill the needs of the Department of Energy’s Environmental Management (DOE-EM). It is important to know that mentoring and hands-on experiences are corroborated methods of impacting students. Grant funds from the DOE-EM award have positively impacted the faculty, students, research and infrastructure at the university. This document describes in detail the research conducted under the DOE-EM project and summarizes the impact of each subproject in the following areas:

- Human Impact
- Economic Impact
- Workforce Development Impact
- Bridge to DOE-EM Mission
- Research and Development Impact
- Research Infrastructure Impact

Significant research findings will be shared through publications, professional conferences, websites, oral presentations and poster presentations. The students who participated on these research projects were exposed to state-of-the-art laboratory facilities, equipment and procedures. Furthermore, the Department of Energy has extended the award another 1½ years. This will allow SCSU students and researchers the ability to expand even further, their participation in the contribution of innovative solutions to assure that the environment is strategically sound in the next century.
THE COLLEGE of SCIENCE, MATHEMATICS, ENGINEERING & TECHNOLOGY

The mission of the College of Science, Mathematics, Engineering and Technology is to produce scientists, mathematicians, engineers and engineering technologists who are highly skilled, competent, and well prepared to enter professional careers in the public and private sector and to pursue degrees beyond the baccalaureate level in professional or graduate school. The College seeks to serve the needs of the community, state, and nation by providing quality programs in a caring, nurturing, interdisciplinary environment that fosters academic excellence in the engineering technology, science and mathematics disciplines. The College comprised the following departments:

- The Department Biological & Physical Sciences (Biology, Chemistry and Physic)
- The Department Civil and Mechanical Engineering Technology
- The Department of Industrial and Electrical Engineering Technology
- The Nuclear Engineering
- The Department of Mathematics and Computer Science
Telling Our Story
Introduction

**Project Title:** DOE-EM/HBCU Projects For Environmental Management Research and Workforce Development at South Carolina State University

**Project Period:** April 6, 2010 thru September 30, 2014

<table>
<thead>
<tr>
<th>Year #1</th>
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<th>Year #3</th>
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The Department of Energy’s Office of Environmental Management (DOE-EM) established a Memorandum of Understanding (MOU) with nine HBCUs in South Carolina and Northeast Georgia. South Carolina State University (SC State) is one of nine HBCUs that received federal funds from DOE-EM. SC State’s grant of $6 million allowed the university to address technical and workforce development needs of the DOE’s Office of Environmental Management as well as continue building upon its existing relationships with DOE-EM by creating a "pipeline" for minorities in Science, Technology, Engineering, Mathematics, Research and other related fields. Students were specifically trained and mentored to enter the DOE workforce in the following technical areas of need to improve:

- Environmental sampling and characterization methods;
- Environmental cleanup methods;
- Pretreatment options and deployment approaches for tank waste processing; and
- EM Computational Science
SC State’s project goal continues to be the development of strong STEM research and academic programs that promote the combined missions of SC State and DOE-EM by fostering collaborations through research, training, and capacity building activities. SC State used current educational and research resources of the university and its partners to implement research activities that assist DOE-EM in solving problems relative to their scientific and technical needs. SC State in conjunction with DOE-EM, focused on the following identified major research areas:

- Environmental Remediation (ER)
- Nuclear Regulatory and Transportation Safety (NRTS)
- Modeling (M)

The nine HBCUs (Allen University, Benedict College, Claflin University, Clinton Junior College, Demark Technical College, Morris College, South Carolina State University, Voorhees College and Paine College of Northeast Georgia) have formulated a consortium to address the technical and workforce development needs of the DOE’s Office of Environmental Management. SC State is pleased to join the challenge of providing society-ready graduates and generating research to strengthen our State and National economies.
Subprojects for the Environmental Management Research and Workforce Development Program at South Carolina State University:

**Administrative Core**

Mr. Elbert R. Malone (PI)

Ms. Debra Williams (Project Manager)

(F1 & F2) Detection of Sphingomonas Strains for use in Polycyclic Aromatic Hydrocarbon Degradation

Dr. Waltena Simpson (PI)

(F3) Enhancement of Environmental Remediation Monitoring and Student Training at Savannah River Site

Dr. John Williams (PI)

(F4) Analyze Fission Product from Nuclear Processes and Technology

Dr. Joe Emily (PI)

(F5) The Expansion of the Analytical National Testing and Research Center for Hazardous Material Transportation Safety

Dr. Reinhart Brown (PI)
Dr. Judith Mwakalonge (Co-PI)

(F6) Radiochemistry/Health Physics/Nuclear Engineering

Dr. Zheng Chang (PI)
Dr. Stanley Ihekweazu (Co-PI)

(F7) Improved Environmental Management and Computational Sciences Project at SC State University

Dr. Stanley Ihekweazu (PI)
Dr. Kathleen Carvalho-Knighton (Project Director)
Synopsis:

The Administrative Core designed to implement a well organized management plan to effectively achieve the objectives of the project. Considering that efforts to attain the objectives will involve South Carolina State University (SC State), its partners and DOE, this management plan needed to be extremely explicit, so that each member of the SC State project team has a thorough understanding of their specific roles and responsibilities. In doing so, the Project Manager:

1. Developed a strategic work and quality control plan for the DOE-EM/HBCU project.
2. Monitors grant budgets to insure timely expenditure of funds to carry out grant activities.
3. Track, update and maintain project requirements, and support project deliverables.
4. Assist Principal Investigators with preparation of all reports and other pertinent documents necessary to effectively carry out grant activities
5. Tracks project activities and maintain up-to-date knowledge and information of the status.
6. Planned, developed and hosted the DOE-EM/HBCU Conferences.
7. Recruit and managed summer interns

Funds awarded from the DOE-EM grant provided salaries for the Project Manager (Debra Williams) and two graduate students (Ashley Lemon and Ontrell Hicks). Ms. Lemon served as an Administrative Assistant to the Project Manager during the early phase of the six subprojects at SC State. Mr. Hicks served as a Program Assistant to assist with organizing and implementing the DOE-EM/HBCU Conference held at SC State.

Some of the activities accomplished by the Administrative Core included the following:

- Planned, developed and hosted DOE-EM/HBCU Conference.
- Assisted with the coordination of the Savannah River Nuclear Laboratory (SRNL) Research Exchange Conference.
On Wednesday, April 11, 2012 South Carolina State University (SC State) hosted the United States Department of Energy–Environmental Management/Historically Black Colleges and Universities (DOE-EM/HBCU) Conference. The conference was held in the STATE Room on the campus of South Carolina State University in Orangeburg, South Carolina. The keynote speakers were Ms. Tracy Mustin - Principal Deputy Assistant Secretary for Environmental Management, Department of Energy (Washington, DC) and Mr. Dywane Wilson - President and CEO Savannah River Nuclear Solutions (SRNS) (Aiken, SC).

The theme for the conference was “Embracing Environmental Management Research through Collaboration and Partnerships”. Participants were from eight (8) other Historically Black Colleges and Universities (HBCUs) consortium partners and the Department of Energy (DOE). The conference also included a Presidential Forum to discuss “Strengthening the Partnerships/Collaborations among the nine HBCUs and funding beyond year three” as well as a poster session which allowed students to present their research to all participates including DOE officials.
“We have tremendous resources here in the region – in our historically black colleges – and I’m making sure that we are tapping into it,” said Dr. Terry Michalske, Laboratory Director of SRNL. “It’s important for me that 10 years from now, 20 years from now that the Savannah River National Laboratory has the best scientists and engineers. And that means I need to find them today.” “What we are trying to do here is make the right matches,” Michalske said. “To get the interests of the students aligned with the needs of our programs.” The director explained that there are difficulties finding the right person to function in laboratories “when you just mail in an application. "You don’t really know how to match them together” he said. However, Michalske said at the DOE-EM Conference last spring he got to see some of the work and interact with some of the young scientists from HBCUs. “I recognized that there is a lot here that we can use,” he said. “So, this is an effort to make the matches, so we can get beyond that.” To the day’s event, Michalske said “It’s just what I hoped for; I’ve gotten to know some of the student’s work, and I’m very impressed. I’m confident we are going to find ways to work with the historically black colleges.”

Special guest also in attendance:

Teal, Dr. Rita J. Acting President, South Carolina State University
Boyd-Scotland, Dr. Joann Interim President, Denmark Technical College
Bradley, Dr. George C. President, Paine College
Copeland, Dr. Elaine J. President, Clinton Junior College
Sellers, Dr. Cleveland President, Voorhees College
Tisdale, Dr. Henry President, Claflin University
Michalske, Dr. Terry Director Savannah River National Laboratory (Aiken, SC)
Moody, Dr. David C. Manager Savannah River Site (Aiken, SC)
Anderson Ms. Cynthia V. Program Executive Officer for Asset Revitalization, DOE (Washington, DC)
Smith Ms. Tania Program Manager for Asset Revitalization, DOE (Washington, DC)
Administrative Core cont.
DOE-EM/HBCU Conference
April 11, 2012
Two SC State students (top picture below), William Dumpson and Alejandra Chirino, participated in a research on Gas Chromatography and Mass Spectrometry, one of a number of projects funded by the three-year DOE-EM grant.

SRNS Executive Vice President and SRNL Director, Dr. Terry Michalske, stated that the event featured "tremendous science, and excellent discussions that are going on between his staff and the students."

As a follow-up to the April 11, 2012, DOE-EM/HBCU Conference held at South Carolina State University (SC State), Savannah River National Laboratory, the DOE Office of Environmental Management's National Lab hosted a Research Exchange Conference for the DOE-EM/HBCU consortium partners. This conference was held at the Center for Hydrogen Research near the Savannah River Site (SRS).

**Mr. Dywane Wilson** - President and CEO Savannah River, Nuclear Solutions (SRNS) (Aiken, SC), greeted and welcomed all participants. The conference included a joint poster session which featured student researchers, (representing the DOE-EM/HBCU consortium) and SRNL researchers. The conference also allowed networking opportunities for students, faculty and SRNL staff followed by a tour of the Savannah River Site facilities.
Detection of Sphingomonas Strains for use in Polycyclic Aromatic Hydrocarbon Degradation
Principal Investigator: Dr. Waltena Simpson

Synopsis:
This innovative project led by Dr. Waltena Simpson at South Carolina State University (SC State), Orangeburg SC, in collaboration with Dr. Robin L. Brigmon of Savannah River National Laboratory (SRNL), Aiken, SC, has the objective of creating molecular tools for bioremediation of polyaromatic hydrocarbons (PAHs). The project has enabled an important scientific exchange between the two institutions by leveraged resources and technical abilities. The first two years allowed novel development of molecular products that are now in the bench-level testing stage. Recent work by SRNL on the project has focused on the development of analytical procedures to better evaluate the remedial capacity of the Sphingomonas strains BPH and BPF. In Figure 1 below are some results from utilization of phenanthrene, a PAH, as a single carbon source by BPH.

We used Sphingomonas paucimobilis EPA 505, designated 505 in the figure, a known PAH degrader, has a positive control for phenanthrene remediation. Phenanthrene concentrations were measured by gas-chromatography mass spectrometry (GC-MS). The X designation (x505 & x BPH) indicates killed or inactivated microbial controls for these strains to evaluate passive removal of phenanthrene in the procedures including volatilization and sorption. Initial concentrations of phenanthrene were 1 ppm. In the 24 hour test it can been observed that after only 2 hours some degradation of phenanthrene had occurred in BPH and S. paucimobilis EPA 505. After 6 hours 20% of phenanthrene had been removed by BPH and 100% by S. paucimobilis EPA 505. By 24 hours all phenanthrene (100%) had been degraded by BPH. This experiment has been repeated several times with other controls including BPF and Escherichia coli K12 as a negative control. Ongoing work includes testing other PAHs in a similar format.

Figure 1: Utilization of Phenanthrene as a Single Carbon Source by BPH. Sphingomonas paucimobilis and EPA 505 (505). The X designation is for killed or inactivated controls. Initial concentrations of phenanthrene were one ppm (100%) for all treatments.
Detection of Sphingomonas Strains for use in Polycyclic Aromatic Hydrocarbon Degradation

Workforce Development Cont.

The level of student success is noteworthy. Ms. Melinda Washington, a former student who received training on the project, has successfully completed her Master of Science from Georgetown University in Microbiology and Immunology. Ms. Arielle Wade, a current student, initially began her training on this project during the spring of 2011 in Dr. Simpson’s laboratory. In the summer of 2011 and 2012, Ms. Wade performed research at SRNL Environmental Biotechnology Section (EBS) in Aiken, SC, under the mentorship of Dr. Robin Brigmon. The data produced by Ms. Wade has been presented at several research conferences. Her findings were an integral part of an abstract presented at “The Oil Sands and Heavy Oil Technologies Conference” in Calgary, Alberta, July 24-26, 2012. The title of the abstract was “Biologically Enhanced Settling of Dissolved Solids in Oil Sands Tailings”. Ms. Wade was listed as a contributing author on the abstract. On January 31, 2012, Ms. Wade presented a poster entitled “Bioremediation of Polyaromatic Hydrocarbons: Technical Challenges” at the SRNL. Mr. Stanley Williams, a current student, graduated with his Bachelor of Science in Biology in May, 2013, and is currently applying to graduate schools to seek an advanced degree.
Detection of Sphingomonas Strains for use in Polycyclic Aromatic Hydrocarbon Degradation

Bridge to the Department Of Energy- Environmental Management (DOE-EM) Mission:

The ultimate goal of this research is to develop molecular tools for improved bioremediation monitoring of soil and groundwater contaminated with hazardous constituents. In this project we targeted poly aromatic hydrocarbons. At some Department of Energy (DOE) sites hazardous compounds are mixed with radioactive contaminants, making the task more difficult. This project is aimed at helping the DOE mission of environmental restoration in a safe and efficient manner through bioremediation. These tools and the fact students are trained to work in this area is allowing DOE-EM to fulfill its commitments to reduce risk and complete cleanup across all sites for generations to come. Additionally, tools, with further refinement in more user-friendly platforms, could also find applications at other sites to help in PAH remediation throughout the US.

Research and Development:

All research, presentations, and written papers associated with this project have been equally shared by SC State and The Savannah River National Laboratory. Students have been equally involved at both institutions. An oral presentation was given at “The Oil Sands and Heavy Oil Technologies” conference in Calgary, Canada July 24-26, 2012. The presentation was given by Dr. Robin Brigmon of SRNL and includes data generated by Arielle Wade, the SC State undergraduate student who has interned at SRNL under his mentorship.
Detection of Sphingomonas Strains for use in Polycyclic Aromatic Hydrocarbon Degradation

Research Infrastructure:

Equipment purchased at SC State allow students to train on techniques that they would use at Savannah River Nuclear Lab (SRNL) for synergistic applications. For example, the new thermal cycler purchased with DOE funds is currently being used to train students in the random amplification of transposon ends (or RATE) protocol and to train them in the performance of general PCR. This thermal cycler is identical to the one at SRNL. This allows student(s) trained in PCR at SC State to easily perform the same procedure at SRNL, or vice versa and other labs. Additionally, students have utilized the new centrifuge purchased with DOE funds as well. It is important to note that all students trained using these pieces of equipment (and others) were not supported financially by the DOE grant. Dr. Simpson’s lab employed additional students who were supported by different grants. This therefore significantly extends the degree by which students have benefited from equipment purchased by the DOE grant and the university's research capacity.
Enhancement of Environmental Remediation Monitoring and Student Training at Savannah River Site
Principal Investigator: Dr. John Williams

Synopsis:

In order to maximize undergraduate intern employment pipeline training, this project interfaced laboratory instrumentation experiences with field research sampling. A major effort included training students in basic Gas Chromatograph-Mass Spectrometer (GCMS) methods and applying field methods for using tree root cores as remote samplers of VOC plume waters. A total of eighteen undergraduate interns were trained. These analyses and training will be refined and expanded in the future using our new Davis Hall Lab 105 facility. A new GCMS was obtained for Davis Hall Annex Lab 105 during year two. The Lab was originally empty with no equipment, but our environmental management (EM) activities have transformed it into a functional research-teaching lab for students and faculty in EM laboratory technology. Instrumentation includes the new GCMS, an Infrared (IR) - Fourier Transform Infrared Spectrometer (FT-IR) and a UV-Visible Spectrometer. A new Post-Doctoral Researcher, Dr. Pakritsadang Kaewsuya, was hired to supervise EM research, train students and assist faculty in GCMS usage.

During year two, a GCMS Faculty Training Institute was conducted to help STEM faculty expand EM career exposure in their various science and engineering courses. This Institute, collaborative with the University of South Carolina (USC), was very successful in stimulating brainstorming and collaborative learning between faculties from STEM disciplines. This was a good fit for the “research to classroom model” that was envisioned to expand EM pipeline outreach to multiple classrooms. The following three Institute key objectives were accomplished: 1) trained faculty to develop EM-relevant syllabus components that will expose students to GCMS uses; 2) EM technology transferred to expand students’ technical skills; and 3) increased student preparedness for the employment pipeline in technologies relevant to DOE-EM. The field linkages to EM at Savannah River Site (SRS) were focused on taking tree root tissue cores from wetlands trees adjacent to CMP Pits plumes. Cores were then analyzed by using the GCMS to determine VOC presence. A new EM grant work will complement long-term compliance monitoring sampling by Dr. Williams at SRS. It will assist Savannah River Nuclear Solutions (SRNS) in efficient placement of pilot wells to improve compliance monitoring. If the technique can be refined and verified in future years, this approach may provide a new cost-effective monitoring approach. If a protocol can be developed that is acceptable to EPA for regulatory monitoring, sizable budgetary savings to DOE nationwide may be realized.
Enhancement of Environmental Remediation Monitoring and Student Training at Savannah River Site

**Human:**

Under this grant, Postdoctoral Research Associate, Dr. Pakritsadang Kaewsuya, became employed full-time. Also, Dr. John Williams, Dr. A.J. Chakrabarti of SC State and Dr. Gary Mills of the University of Georgia were employed part-time during years one & two. An additional eleven faculty received part-time support as participants in the GCMS Faculty Training Institute. Their required curriculum-revision efforts will greatly expand the EM employment pipeline to full courses of HBCU students. The USC Mass Spectrometer Center under Dr. Bill Brewer was also contractually utilized for one day of the Institute.

**Economic:**

This project has directly impacted the economy through its purchases of equipment and supplies. Additional secondary financial impacts have resulted from the student interns utilizing their stipend pay for local purchases and supporting their educational expenses. Furthermore; the community was impacted from expenditures made by faculty, Post-Doc, and USC with salary / pay from grant work. Additional community impacts have been through our presentations about our sampling equipment and instrumentation to touring school groups and teachers.

**Workforce Development:**

The future employment pipeline has been enhanced with twenty-eight (28) undergraduate interns receiving hands-on training in a ‘real-world’ EM work environment during the past 3 years. At Savannah River Site (SRS), the field remediation study under Dr. Williams is the only undergraduate team approved by EPA to conduct regulatory compliance monitoring. According to Dr. John Williams, SC State effort may be the only one operating at this level nationally.
Bridge to the Department Of Energy- Environmental Management (DOE-EM) Mission:

This sub-project activities served well as a bridge to practical tasks within the DOE-EM Mission. The instrumentation training interns received is state-of-the-art analytical approaches to a wide array of environmental monitoring required by regulatory agencies. The tree root coring approach represents a potentially big cost and time savings methodology to help DOE locate plume fringes and better place monitoring wells. Student intern training practical and will be directly useful in the EM-related job market. Continuing this work will help to refine and better validate the use of tree root cores as a potential VOC monitoring tool acceptable to regulatory agencies. Expanded use of the GCMS lab will not only continue to train more interns, but also serve as outreach to SC State faculty and faculty from other South Carolina HCBU’s.

Research and Development:

Dr. Williams and student interns conducted tree root VOC research collaboratively with Dr. Gary Mills of University of Georgia Savannah River Ecology Lab (SREL). This research continued in year three with Dr. Kaewsuya at South Carolina State University (SC State). It is expected that work beyond year three will develop and better validate the use of tree root cores as a potential VOC monitoring tool acceptable to regulatory agencies. Additional student intern research included the assembly and installation of remote sensing weather stations at sites on the SC State campus. These stations have allowed the interns to better analyze microclimate differences and assist in peer to peer mentoring of students in course laboratories. Dr. Williams presented a lecture at the November 2011 DOE-EM/HBCU Conference at Benedict College and April 2012 DOE-EM/HBCU Conference held at SC State. Sixteen interns have presented posters at the following conferences: South Carolina Academy of Sciences 2011 Annual Meeting; Louis Stokes Alliance for Minority Participation Conference Nov. 2011; and the April DOE-EM/HBCU Conference at SC State. It is expected that publications by faculty and students will occur during year three and following years as the experimental replications necessary for analysis are completed.
Enhancement of Environmental Remediation Monitoring and Student Training at Savannah River Site

Research Infrastructure:

- The primary instruments that benefited SC State faculty and students were the new Gas Chromatography-Mass Spectrometry (GCMS) and the Remote Sensing Weather Stations. Dr. Kaewsuya has the GCMS fully operational for the VOC project analyses with student interns. Two growing employment fields within environmental management (EM) are environmental remediation and waste management, both of which rely increasingly upon advanced technologies like GCMS to assist the decision-making process. A Faculty Training Institute was held for the GCMS. The goals of the Institute were: 1) help faculty alert students to the diverse applications of GCMS for environmental remediation-related disciplines; 2) train faculty to develop EM relevant syllabus components that will expose students to GCMS use; and 3) to eventually provide students with hands-on GCMS experiences; better preparing them for career pipelines.

- Dr. Kaewsuya has also assisted faculty from the Nuclear Engineering program with their EM analyses on the GCMS. Dr. Kaewsuya has received requests from EM project faculty at Voorhees College for GCMS assistance. The wireless remote sensing weather stations have allowed students to develop technological installation skills and develop computer interfacing to support remote sensing. The remote sensing equipment activity has also impacted more students through classroom lab experiences.
Analyze Fission Product from Nuclear Processes and Technology
Principal Investigator: Dr. Joe Emily

Synopsis:
This project has trained and continues to train future scientists, how to characterize samples involved in actinide cleanup and radioactive waste stabilization projects which are important to the Office of Environmental Management at the Savannah River National Laboratory and other DOE facilities.

Human:
Funds from the Department of Energy-Environmental Management (DOE-EM) grant supported for the following faculty and staff as well as stipends for students listed below.

- Principal Investigator: Dr. Joe Emily
- Consultant: (SRNL Retiree, Analytical Services Lab) Mr. William Boyce

Students:
- Brandi Jefferson
- Kara McCollough
- Chris Payton
- JoEttie Clinton
- Charlencia Owens
- Anjellica Miller
- Manasha Gilbert
- Garrick Sanders
- Valerie Williams
Analyze Fission Product from Nuclear Processes and Technology

**Economic:**

In addition to stipends and salaries this grant provided funds for travel and indirect cost revenues. DOE support definitely had an economic impact in training students in trace metal analytical techniques, we’ve stumbled upon a serious trace element pollution issue in the Edisto River watershed, which SC State is a part of. The Edisto River is the longest free flowing blackwater river in North America. It is totally contained within South Carolina and provides a perfect laboratory to study the interaction between natural organic matter (NOM) found in the river and toxic elements such as arsenic, chromium, selenium, and lead emitted by energy producing facilities.

Students are presently involved in assessing the level of contamination and the impact on this community. In addition no noticeable contamination from activities at the Savannah River National Laboratory has been found within the Edisto River watershed.

**Workforce Development:**

Undergraduate students were trained in cutting edge trace elemental analysis techniques. Approximately ten (10) undergraduate research associates have been thoroughly indoctrinated in proper trace element laboratory Procedures.

Students in C201-Analytical Chemistry and C408-Instrumental Analysis courses were exposed to testing equipment which is not normally available to the undergraduates. Again this accents their undergraduate learning experience and increased the Likelihood of pursuing successful careers in science. Seventy high school students were introduced to the field of Environmental Toxicology during a visit to the BASL laboratory during the 2012 South Carolina Area Health Education Consortium (AHEC) Health Careers Summer Institute, Oral Presentation (June 14, 2012).

The fall 2012 visit from this group potentially increased the number of young people exposed to STEM disciplines and potential DOE-EM employment. Forty-Five undergraduate students were introduced to Nuclear Environmental Remediation during the summer 2011 SC State and Savannah River Environmental Science Field Station.
Analyze Fission Product from Nuclear Processes and Technology

Workforce Development cont:
- # of K-12 student exposed to Analytical testing equipment and techniques 75
- # Undergraduate Students exposed to Analytical testing equipment and techniques 105
- # Undergraduate Research Assistant 10

Bridge to the Department Of Energy-Environmental Management (DOE-EM) Mission:
Dialog has been established with at least three local DOE offices to forge potential future collaboration. These include:

1) Savannah River Ecology Lab
2) Savannah River Environmental Science Field Station and
3) Savannah River Nuclear Solutions.

The establishment of the Basic Analytical Support Laboratory (BASL) for Environmental Remediation at South Carolina State University is an ambitious undertaking. It will implement and merge technologies, such as field flow fractionation and ICPMS speciation which have only been commercially available less than 15 years. One advantage of the novelty of this technology is that it will expose SC State and local public school students and faculty to cutting edge emerging analytical techniques. Therefore establishment of the lab and methods of analysis are only the beginning. More time is needed to perfect training programs and to develop research strategies of importance to DOE-EM.

Research and Development:

Dr. Joe Emily, PI – Supervised and participated in all projects involving elemental analysis, speciation, LASER ablation and nanoparticle analysis in the following four areas:
- Modern Environmental Toxicology, 2012 South Carolina Area Health Education Consortium (AHEC) Health Careers Summer Institute, Oral Presentation (June 14, 2012)
- Development of a Materials Research and Spectrometric Oil Analysis Research Program at South Carolina State University, $572,000 grant proposal, Department of Defense, submitted August 2012.

Brandi Jefferson – SC State chemistry graduate. Presently pursing a master’s degree in computer forensics at the University of Alabama Birmingham. Participated in initial ICPMS setup.

Analyze Fission Product from Nuclear Processes and Technology

Research and Development cont.: 

Kara McCullough – senior undergraduate with plans to attend graduate school in radiochemistry. Participated in initial ICPMS setup.

Joettie Clinton – junior undergraduate whom completed a pharmacy research internship at NC State and currently involved in research. Participated in ICPMS setup and method development.


Garrick Sanders – A senior undergraduate with plans to seek employment, participated in ICPMS setup and method development.

Valerie Williams – A returning 1989 SC State biology graduate currently pursuing a degree in chemistry, participated in ICPMS setup and method development.

Chris Payton – A SC State junior, chemistry major, participated in ICPMS setup and method development.

Manasha Gilbert – A freshman SC State, chemistry major, participated in ICPMS setup and method development.

Research Infrastructure:

The Office of Environmental Management at the Savannah River National Laboratory is heavily involved in Actinide cleanup and radioactive waste stabilization projects. All of these activities require accurate quantification of samples to determine their efficiencies. Inductively Coupled Plasma Mass Spectroscopy (ICPMS) is the chosen method for the quantification of metals in complex matrices. Funds from the Department of Energy, Environmental-Management grant (DE-EM0000594) SC State was able to purchased the following equipment:

- Agilent 7700X Inductively Coupled Plasma Mass Spectrometer (ICPMS)
- A Dionex 5000 Ion Chromatograph (IC)
- A Cetac LSX 213 LASER Ablation (LA)
Analyze Fission Product from Nuclear Processes and Technology

Agilent 7700X Inductively Coupled Plasma Mass Spectrometer (ICPMS):

This powerful analytical tool, is capable of identifying and measuring the amounts of most of the elements in the periodic table in a variety of sample matrices. ICPMS is routinely used to analyze drinking water for harmful toxic contaminants such as lead, arsenic, selenium, mercury and more at the part- per-quadrillion level. The ICPMS can also determine isotope ratios which allow forensic scientists to determine the origin of various unknown materials. SC State students used the ICPMS to solve problems of interest to the nuclear waste processing and environmental management industry. Student participation and development in the research objectives of the DOE-EM mission has been achieved at many Levels such as undergraduate research assistants receiving hands on training in testing equipment operations maintenance and problem solving. Once these skills are acquired by SC State students, they will be prepared to enter an expanding environmental management workforce with confidence. These are valuable skill to potential employers.
Analyze Fission Product from Nuclear Processes and Technology

A Dionex 5000 Ion Chromatograph (IC): Allowed students to study the separation and detection of highly polar species such as arsenic (III) and arsenic (V) as well as less toxic organic forms of arsenic. The system is equipped with an onboard conductivity detector but can be easily coupled to the more sensitive ICPMS detection system.

A Cetac LSX 213 LASER Ablation (LA): Allow students to sample the surface of solid materials directly into the ICPMS analyzer for elemental analysis. The LSX 213 is capable of etching craters ranging from 10 to 200 microns in diameter with an optical resolution of better than two microns in a variety of patterns including depth profiling. This technique is ideal for analyzing radioactive waste materials stored in glass as well as rocks and other geological materials.
The Expansion of the Analytical National Testing and Research Center for Hazardous Material Transportation Safety
Principal Investigator: Dr. Reinhart Brown & Co-Principal Investigator: Dr. Judith Mwakalonge

Synopsis:

• Hazardous Materials (HAZMAT) transportation is a critical component of Environmental Management (EM) and most environmental cleanup activities involve the transportation of HAZMAT. Over the past decade, HAZMAT transportation modeling has attracted considerable attention. Most of these studies focused on topics such as designing emergency response networks, identifying routes with minimal risk and cost, and developing routing algorithms that can take into account of complex factors such as terrorists’ strategies. However, less consideration has been given to the modeling of intermodal transportation of HAZMAT.

• Given the fact that (Finewood, 2009) railways carry a significant percentage of HAZMAT (especially for radioactive waste), it is very interesting and important to investigate how different transportation modes can be properly coordinated, how to optimally locate HAZMAT storage facilities (for transfer between different transportation modes), and the joint modeling of storage facility locations and intermodal routing. In addition, it would also be very interesting to incorporate the development of emergency response plan into the aforementioned intermodal HAZMAT transportation modeling. In this way, the consequence of an accident can also be minimized in addition to transportation cost and the risk of having an accident.
The Expansion of the Analytical National Testing and Research Center for Hazardous Material Transportation Safety

Human:

The following faculty, staff, and students received either wages, scholarships, or stipends from this project.

• Seven Faculty & Staff
• Twenty-two Students

Economic:

This research project enabled SC State to hire faculty, staff, and students, the majority of which live in the local community and support local commerce. Funds were utilized from this project for salaries, scholarships, and stipends positively contributed to the change in economic growth associated with income wages and employment in our local economy.

Workforce Development:

SC State were able to purchase fourteen (14) high-performance computers and basic furniture (tables, chairs, etc.) for the new transportation research lab. These computers enabled research students as well as graduate students in the master of transportation program the ability to learn microscopic traffic simulation programs and conduct simulation and optimization.
The Expansion of the Analytical National Testing and Research Center for Hazardous Material Transportation Safety

Bridge to the Department Of Energy Environmental Management (DOE-EM) Mission:

While the mission of the DOE-EM mission is to complete the safe cleanup of the environment legacy brought about due to years of nuclear weapons development and government sponsored nuclear energy research, this research project provided critical information on a key component to HAZMAT clean-up: transportation.

Transportation is a necessity to environmental management and therefore topics such as designing emergency response networks; identifying routes with minimal risk and cost; and development routing algorithms that can take into account complex factors such as “terrorists strategies” provides the research to incorporate how different modes of transportation modeling. Thus, intermodal HAZMAT transportation modeling can help the DOE-EM potentially reduce/minimize cost and the risk of having an accident.

Research and Development:

Conference presentations and publications:

- 2012 TRB Annual Meeting—“A Multimodal Location and Routing Model for Hazardous Materials Transportation”
- DOE support has been acknowledged, in all articles,
- Three Master’s thesis were produced from this project.
The Expansion of the Analytical National Testing and Research Center for Hazardous Material Transportation Safety

Research Infrastructure:

Students and SC State benefited from the following transportation software and technology purchased from the DE-EM0000594 grant:

- **Four** pocket radars were purchased; these radars are useful in collecting speed data. See picture (A) below.
- **Bluetooth technology** was purchased; this is the state-of-the-art technology that is used for traffic data collection as shown in the picture (B) below.
- **VISSIM simulation software:** this widely used traffic simulation software will be used in this project and later be used for teaching and research purposes.

**Future work:** The research team has successfully completed coding a multimodal HAZMAT transportation network and is currently working on validating the model. The results will be submitted to the 2014 Transportation Research Board (TRB) meeting for presentation and publication consideration and other transportation conferences.
Radiochemistry/Health
Physics/Nuclear Engineering

Principal Investigator: Dr. Zheng Chang
&
Co-Principal Investigator: Dr. Stanley Ihekweazu

Synopsis:

The primary objective of the project was to promote the research and education capacity of the nuclear science & engineering programs including: Radiochemistry, Health Physics, Nuclear Engineering, and Medical Physics at SC State University. Meanwhile, the project activities were designed in agreement with the missions of the DOE-Environmental Management Program. Accordingly, the project research activities have been carried out in the fields of nuclear detection technology and environmental radioactivity. As to the nuclear detection technology, the focus was on the detection of neutrons, which had become a hot topic in the homeland security applications because there were a growing requirement for the new generation detection technologies for fissile materials along the U.S. borders. As to the environmental radioactivity, concentration was placed on the radioactivity level of natural and artificial Radionuclides in the SC Edisto River Basin, which encompassed 30 watersheds and about 2 million acres of land.

Nearly all of Orangeburg County, a large portion of Lexington and Aiken, and some portions of Berkeley, Calhoun, and Dorchester, counties were included in the Edisto Basin. The Basin was also surrounded by nuclear facilities including the Savannah River National Laboratory at Aiken, Nuclear Waste Depository Site at Barnwell, Westinghouse Nuclear Fuel Assembly at Columbia, and the US Navy shipyard at Charleston. It is thus of great interest to study and monitor the level of background and artificial Radionuclides in the basin from the viewpoint of environmental protection and the well-being of the local citizens. Therefore, five (5) research topics were conducted: i) synthesis of boron-loaded organic scintillators for neutron detection; ii) the radon emanation from a natural black mineral material in Lexington; iii) the RaDeCC system for the detection of 223Ra and 224Ra; iv) observation of the air-borne Radionuclides from Fukushima nuclear accident; and v) monitoring long-term atmospheric radioactive pollution with Spanish moss.
This project enhanced the research/education capability of South Carolina State University by providing the professors with research grant projects. A number of the university administrators and faculty members were included in the project. The information of the senior investigators including name, position, service period, academic position during the service and responsibility are summarized in table 1 below:

### Table 1. A list of the name, position, service period, and responsibility of the senior investigators in the project

<table>
<thead>
<tr>
<th>Name (Position)</th>
<th>Service Period</th>
<th>Academic Position during the service</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Kenneth Lewis (PI)</td>
<td>Spring 2010 – Summer 2011</td>
<td>Dean of Science College</td>
<td>Supervised the subproject.</td>
</tr>
<tr>
<td>Dr. Stanley Ihekweazu (PI)</td>
<td>Fall 2011- Current</td>
<td>Interim Dean of Science College</td>
<td>Supervised the subproject.</td>
</tr>
<tr>
<td>Dr. Zheng Chang (Co-PI)</td>
<td>Spring 2010 – Current</td>
<td>Associate Professor of Nuclear Engineering</td>
<td>Directed the research/education activities. Carried out tasks. Managed the project and student assistants. Writing report and publish papers of the results</td>
</tr>
<tr>
<td>Dr. Nasrollah Hamidi (Consultant)</td>
<td>June 2010</td>
<td>Assistant Professor of Chemistry</td>
<td>Provided professional consulting on the synthesis and characterization of solid polymers</td>
</tr>
</tbody>
</table>
Radiochemistry/Health Physics/Nuclear Engineering

Economic:
Funds awarded provided stipend support for students, faculty, new faculty, and staff salaries as well as travel and indirect costs revenues for this subproject. DOE support also had an economic impact on both the institution and the state as shown below. The results of the research have showed impact to the local community in improving the knowledge and understanding about the local environment, effect of human activities on the environment, and the influence of the environmental radioactivity to human health. Such impact is summarized in Table 2 below:

Table 2. A List of the Community Impact

<table>
<thead>
<tr>
<th>Research Activity</th>
<th>Impact</th>
<th>Community</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conducted the investigation of radioactivity in the atmosphere. Studied the nuclear fallout in Orangeburg, SC from the Fukushima Nuclear Accident</td>
<td>The results were reported by the local newspaper “The Times and Democrat” on April 2, 2011, “Radiation detected here not a health hazard”</td>
<td>Orangeburg and South Carolina (See attachment #1)</td>
</tr>
<tr>
<td>Conducted the investigation of radioactivity in the private wells. Help the local citizens to test the water quality of their wells</td>
<td>Informed the well owners the analytical results on the water quality. Help well owners with the information about how to protect the families from the hazardous materials in the well water. The research was reported by the local newspaper “The Times and Democrat” on Sep. 09, 2011</td>
<td>Orangeburg and surrounding counties (See attachment #2)</td>
</tr>
<tr>
<td>Held two workshops on the Research of Environmental Radioactivity and Development of Generation III and IV nuclear reactors</td>
<td>Help students gain the knowledge and understanding in the fields. Help the researchers update the trend of research in the fields</td>
<td>South Carolina State University and collaborating universities (USC, Univ. of Tennessee) (See attachment #3)</td>
</tr>
</tbody>
</table>
Workforce Development:

Twenty two (22) students were employed and worked on the project. The students were hired from a variety of majors, including Chemistry/Radiochemistry, Nuclear Engineering, Physics/Health Physics, Physics/Medical Physics, Biology, Nursing, etc. A detail list of the student assistants and their work is summarized in the Table 3 below.

Table 3. The Student Assistants Hired during the First Two Years of the Project

<table>
<thead>
<tr>
<th>Name</th>
<th>Major</th>
<th>Academic Position</th>
<th>Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kyle Childs</td>
<td>Chemistry/Radiochemistry</td>
<td>Junior</td>
<td>Conducted experiments on the synthesis of organic scintillation materials for the detection of thermal neutrons</td>
</tr>
<tr>
<td>Ashley Thomas</td>
<td>Nuclear Engineering</td>
<td>Senior</td>
<td>Carried out investigations in searching for a new method to detect natural and artificial radionuclides in environments</td>
</tr>
<tr>
<td>Christine Jones</td>
<td>Physics/Health Physics</td>
<td>Graduated</td>
<td>Carried out experiments on atmospheric radionuclide (7Be, 40K, etc.) using Spanish moss</td>
</tr>
<tr>
<td>Jasmine Oliver</td>
<td>Physics/Medical Physics</td>
<td>Graduated</td>
<td>Carried out experiments on searching for a procedure to dissolve lichens and mosses using microwave digestion vessel. This procedure was adopted for the chemical and radiometric analysis of lichen and moss samples</td>
</tr>
<tr>
<td>Emmanuela Ojukwu</td>
<td>Nursing</td>
<td>Sophomore</td>
<td>Conducted an experiment in searching for a proper method to separate a type of radioactive mineral particles from common sands in nature</td>
</tr>
</tbody>
</table>
## Workforce Development cont.

<table>
<thead>
<tr>
<th>Name</th>
<th>Major</th>
<th>Academic Position</th>
<th>Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>JuLeia Allen</td>
<td>Physics</td>
<td>Senior</td>
<td>Carried out experiments to measure 222Rn and 220Rn in air with RAD7</td>
</tr>
<tr>
<td>Kara McCullough</td>
<td>Chemistry/Radiochemistry</td>
<td>Junior</td>
<td>Carried out a study on the detection of the fission products from Fukushima nuclear accident triggered by the earthquake on March 11, 2011</td>
</tr>
<tr>
<td>Oluwammuyiwa Abdayo</td>
<td>Nursing</td>
<td>Sophomore</td>
<td>Conducted a study on the radioactive black minerals found in Lexington, SC. The investigation involved the separation of the black minerals from natural sand, and the characterization of the radioactive properties of the sample</td>
</tr>
<tr>
<td>Daniel Odeghe</td>
<td>Nursing</td>
<td>Junior</td>
<td>Measured the radon concentration in groundwater. Collected the spanish samples in the Orangeburg area</td>
</tr>
<tr>
<td>Nkemakonam Okoye</td>
<td>Chemistry/Radiochemistry</td>
<td>Sophomore</td>
<td>Conducted experiments on the synthesis of organic scintillation materials for the detection of thermal neutrons. Both liquid and solid organic samples have been synthesized</td>
</tr>
<tr>
<td>Kayland F. Huckaby</td>
<td>Biology</td>
<td>Junior</td>
<td>Conducted a research post-harvest pest management under the direction of Dr. R. Mahroof</td>
</tr>
<tr>
<td>Sharee Harris</td>
<td>Chemistry/Radiochemistry</td>
<td>Graduated</td>
<td>Carried out a study on the detection of the fission products from Fukushima nuclear accident triggered by the earthquake on March 11, 2011</td>
</tr>
<tr>
<td>Harishankar Kushwaha</td>
<td>Nuclear Engineering</td>
<td>Sophomore</td>
<td>Carried out an experiment in searching for a proper method to separate a type of radioactive mineral particles from common sands in nature</td>
</tr>
</tbody>
</table>
## Workforce Development cont.

<table>
<thead>
<tr>
<th>Name</th>
<th>Major</th>
<th>Academic Position</th>
<th>Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dharey Samuel</td>
<td>Nuclear Engineering</td>
<td>Freshman</td>
<td>Carried out investigations in searching a new method to detect natural and artificial radionuclides in environments</td>
</tr>
<tr>
<td>Mary Iroha</td>
<td>Chemistry</td>
<td>Sophomore</td>
<td>Carried out experiments on searching a procedure to dissolve lichens and mosses using microwave digestion vessel. This procedure was adopted for the chemical and radiometric analysis of lichen and moss samples</td>
</tr>
<tr>
<td>Jernai Ellis</td>
<td>Nuclear Engineering</td>
<td>Graduated</td>
<td>Carried out investigations in searching a new method to detect natural and artificial radionuclides in environments</td>
</tr>
<tr>
<td>Esther Odeghe</td>
<td>Nursing</td>
<td>Junior</td>
<td>Carried out the investigation on the monitoring of air quality with Spanish moss</td>
</tr>
<tr>
<td>Shuai Tan</td>
<td>Chemistry/Radiochemistry</td>
<td></td>
<td>Carried out experiments to measure 222Rn and 220Rn in air with RAD7</td>
</tr>
<tr>
<td>Eric Davis</td>
<td>Nuclear Engineering</td>
<td>Senior</td>
<td>Measured the radon concentration in city water. Collected Spanish samples in the Orangeburg area.</td>
</tr>
<tr>
<td>Candice Hampton</td>
<td>Nuclear Engineering</td>
<td>Graduated</td>
<td>Measured the radon concentration in city water. Collected Spanish samples in the Orangeburg area.</td>
</tr>
<tr>
<td>Danny Steele</td>
<td>Nuclear Engineering</td>
<td>Graduated</td>
<td>Carried out experiments on atmospheric radionuclide (7Be, 40K, etc.) using Spanish moss.</td>
</tr>
<tr>
<td>Ahmed Majekodunmi</td>
<td>Biology</td>
<td>Sophomore</td>
<td>Carried out the investigation on 223Ra and 224Ra in groundwater with the RaDeCC system.</td>
</tr>
</tbody>
</table>
Bridge to the DOE-EM Mission:

The DOE-EM Missions are listed as:

1) DOE-EM is constructing and operating facilities to treat radioactive liquid tank waste into a safe, stable form to enable ultimate disposition.

2) DOE-EM is securing and storing nuclear material in a stable, safe configuration in secure locations to protect national security.

3) DOE-EM is transporting and disposing of transuranic and low-level wastes in a safe and cost effective manner to reduce risk.

4) DOE-EM is decontaminating and decommissioning facilities that provide no further value to reduce long-term liabilities and maximize resources for cleanup.

5) DOE-EM is remediating soil and ground water contaminated with the radioactive and hazardous constituents.

6) DOE-EM is fulfilling its commitments to reduce risk and complete cleanup across all sites for the generations to come.

The research topics in this subproject are closely related to the following DOE-EM Mission 1), 2), 4), 5) and 6). A brief of the research topics, achievements, representative photos/graphs, and the correlation with the DOE-EM missions are shown on the next page in Table 4.
Table 4. A summary of the research activities and achievements

<table>
<thead>
<tr>
<th>Research Topics and Achievements</th>
<th>Images of Results</th>
<th>Correlation to DOE-EM Missions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Synthesis of boron-loaded organic scintillators for neutron detection</strong></td>
<td></td>
<td>DOE-EM Mission 1): Securing and storing nuclear materials in safe and secured locations to protect national security</td>
</tr>
<tr>
<td>a. Systematically studied the liquid boron-loaded scintillators with different primary scintillates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Systematically studied the liquid born-loaded scintillators with different secondary scintillates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Successfully synthesized solid polymeric scintillators. Studied the scintillation properties of the solid scintillators</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>The radioactivity of a natural black mineral material</strong></td>
<td></td>
<td>DOE-EM Mission 4) and 5): Background radiation. Remediation of soil and groundwater contaminated with radioactive wastes</td>
</tr>
<tr>
<td>a. Discovered a radioactive natural black mineral material in Lexington, SC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Successfully separated this radioactive mineral from the original sand samples by size and density separation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. The black material was found 10-12 times as radioactive as the original sand due to the content of U &amp; Th</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Topics and Achievements</td>
<td>Images of Results</td>
<td>Correlation to DOE-EM Missions</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------------</td>
<td>--------------------------------</td>
</tr>
</tbody>
</table>
| *The RaDeCC system for the detection of 223Ra and 224Ra*  
  a. Studied the calibration of RaDeCC system for the detection of 223Ra and 224Ra  
  b. Carefully studied the factors affecting the analytical errors  
  c. Established a complete procedure for the analysis of 223Ra, 224Ra, 226Ra, and 228Ra with the RaDeCC counting and γ-spectrometry | ![Images of Results](image1.png) | DOE-EM Mission 4) and 5): Background radiation. Remediation of soil and groundwater contaminated with radioactive wastes |
| *Observation of the air-borne radionuclides from Fukushima nuclear accident*  
  a. Successfully observed airborne 131I, 134Cs, and 137Cs from Fukushima nuclear accident on March 11, 2011  
  b. The filter samples were collected with an air sampler and analyzed by HPGe-spectrometry  
  c. It was found that the radioactive pollution level at Orangeburg, SC was related to a series of nuclear events occurred in Japan | ![Images of Results](image2.png) | DOE-EM Mission 2) and 6): Monitored the leak of radionuclides from nuclear accidents. Cleanup radioactive materials from environments |
A number of collaborations were set up in order to raise the research level and increase the chances for the students to learn from experts from a variety of the academic areas. Researchers were also invited to give seminars and lectures to the students on the research team. Table 5 (see next page) list the collaborating activities that were or partially supported by the DOE-EM grant.
Table 5. The Collaborating Activities Supported by the Present Project

<table>
<thead>
<tr>
<th>Collaborator/Field/Institution</th>
<th>Activity</th>
<th>Collaborating Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Willard Moore/Professor of Geology and Oceanography/University of South Carolina</td>
<td>Seminar Talk “The Application of Radioisotopes in Oceanographic Researches”, Nov. 19, 2011, SC State.</td>
<td>Radium isotopes in the groundwater</td>
</tr>
<tr>
<td>Dr. Larry Miller/Professor of Nuclear Engineering/University of Tennessee at Knoxville</td>
<td>Seminar Talk “The Development of Nuclear Reactors”, April 15, 2010, SC State.</td>
<td>Studied of the organic scintillators for the detection of neutrons and fissile materials</td>
</tr>
<tr>
<td>Dr. Nasrollah Hamidi/Assistant of Chemistry/SC State</td>
<td>Consulted on the characterization of organic polymers</td>
<td>N. Okoye, Z. Chang, studied the organic scintillators for the detection of neutrons and fissile materials</td>
</tr>
</tbody>
</table>
Many presentations on the experimental results from the DOE-EM grant were presented during oral and poster presentations at various conferences and meetings. Table 6 list the poster and oral presentations.

**Table 6. The academic research presentations on the DOE-EM project**


3) B. K. Bett, S. Tan, and Z. Chang “A Study on the Calibration of RaDeCC System for 224Ra Analysis”, 68th University Professional Agricultural Workers Conference, Dec. 5-7 2010.


14) Bett, Boaz “The Calibration of RaDeCC System for 223Ra and 224Ra Analysis Contents”. Advisor: Z. Chang, 69th Professional Agricultural Workers Conference (PAWC), Tuskegee University, Tuskegee, AL, Dec. 4-6, 2011.


16) McCullough Kara, “The Rise and Fall of The Radioactivity Monitoring”, Advisor Z. Chang, Tuskegee University, Tuskegee, AL, Dec. 4-6, 2011


The following research papers will be published:

Data collected by the glass fiber and carbon cartridge obtained in the experiment, regarding the observation of the air-borne radionuclides from Fukushima nuclear accident. The radionuclides fallout observed during the Fukushima nuclear accident included 131I, 134Cs, and 137Cs in aerosol and gases samples.

Three journal articles on the experimental data obtained in the investigation regarding the synthesis of boron-loaded organic scintillators for neutron detection. The articles discussed the liquid organic scintillators with different primary scintillates, liquid organic scintillators with various secondary scintillates, and solid polymeric scintillators respectively.

**Research Infrastructure:**

DOE-EM funds made it possible to purchase the following two types of capital (instruments) equipment:

- **Eight-Stage Ambient Air Sampler:** Studied the radionuclides in atmosphere. More than five students have been trained in using the air sampler to study the aerosols in the atmosphere and collecting the radioactive dusts from the air.

- **LaBr3 Gamma Spectroscopy Detectors:** All radioactive study that needed gamma spectroscopy analysis. Over ten radiochemistry and nuclear engineering students were using these instruments in their nuclear instrumentation classes. The instruments were also used to count the samples of the present project.

Both have been well used in research for students in the nuclear sciences and engineering programs.
Two gamma spectrometers with LaBr₃(Cs) solid scintillation detectors were purchased from ORTEC. The total cost of the instruments was over $30,000.00 including the led shield. These detectors has become crucial in the investigation of nuclear detection and college education activities in the Nuclear Engineering and Radiochemistry programs at SC State University.

The eight stage air sampling impactor was purchased (bottom left) was purchased from Environmental Tisch Co. (~$6,000.00) This project was proved to be very successful because we have detected the nuclear fallout from the Fukushima Nuclear Accident in March 2011. The investigation will be published in US Health Physics Journal Soon.

Dr. Z. Chang (right) explaining the principle of the air sampler to the radiochemistry students Samuel Morenikeji (left) and Boaz Bett (middle).
Improved Environmental Management and Computational Sciences Project at SC State University
Principal Investigator: Dr. Stanley Ihekweazu

Synopsis:

The Environmental Management Internship (EMI) works to prepare and diversify the technological workforce entering the environmental management profession. Funding has allowed the Savannah River Environmental Sciences Field Station (SRESFS) to build on its environmental education initiative as it continues to offer courses during its 15th year of operation. SRESFS recruits and educates an increased number of underrepresented groups in environmental science and engineering to prepare them to solve complex environmental management issues. We developed and delivered specific coursework that will enable students to meet the employment requirements for Department of Energy in environmental related career fields. Past interns have been provided research experiences in the environmental field.

Human:

SRESFS was able to recruit and fund critical office staff by hiring a full time academic coordinator. Also, a fiscal analyst was hired during the first year of funding. A consultant was hired to develop courses, create syllabi and other supporting documents. Teaching and/or program assistants have been hired each year to provide critical support to faculty during the summer months.
Improved Environmental Management and Computational Sciences Project at SC State University

Workforce Development:

In the original proposal, a total of 108 course enrollments to 27 students (nine students taking four courses each summer over the course of three summers) were planned to be offered. However; as of year three there were a total 116 course enrollments to a total of 44 students. While taking classes at the Savannah River Site, students had the opportunity to tour labs within Savannah River National Lab (SRNL) and Savannah River Ecology Lab (SREL). Students were able to network with DOE scientists and engineers to gain a better perspective of the career potential with DOE. They were made aware of future internship opportunities and received valuable information on DOE career choices. This program also help prepared students for the expectations of graduate school, including public speaking, preparing reports and poster presentations. Below are a few impact statements from SRESFS interns.

Javashia Scott, Voorhees College

Javashia is a rising junior, mathematics major at Voorhees College and is from Beaufort, S.C. When asked about her experience with the program, she stated, “I wanted to try something new. After I read what a normal day consists of, I decided to take on the challenge for the entire summer. I think the benefits are the hands on experience. I gained experience on how to manage different situations better because things go wrong at times. The program taught me how to deal with people, and adjusting to change.” Javashia plans to pursue a graduate degree in Mathematics Education. Her advice to future interns is, “The professors expect a lot from us, and they were not our normal teachers from our home institution. I will say “make sure you have money saved up for food, and expect long days no matter the weather. Overall, it was a challenge, but I learned a lot and the trips were awesome.” Javashia is a member of the Just Science Club, Rotaract Club, S.I.F.E, Presidential Scholar, and Dean’s List.

Christopher McCray,
South Carolina State University

Christopher is a senior, industrial technology major at SC State and is from Silsbee, SC. Christopher enjoyed the opportunity to explore and learn about the land in the surrounding area. He stated he “gained a better understanding of his industrial technology field and its opportunities from an environmental perspective and the knowledge and critical thinking skills needed for better decision making. Through the research we performed and the writing tasks, it has enhanced my communication skills.” His advice to future interns is, “If you do this, take it seriously and treat everyone around you like family because you will need every one there with you as they will need you.” Christopher is a Presidential Scholar at SC State University.

Samiydah, a New York native, is a junior, biology major at Livingstone College. Samiydah heard about the program through her professor at Livingstone. She feels that the information learned and lab experiences on site at SRS has given her a better understanding of the environment. Two characteristics that have been beneficial while she attended the internship were patience and confidence. She plans to pursue her graduate degree in Dentistry at Howard University. She received assistance in creating presentations, extending her vocabulary, and professional preparation. Her advice to future interns is to “make the best out of everything you do”. Samiydah is on the Dean’s list, a peer educator, Spanish Department Assistant, and a member of the marching band.

Samiydah Kearney,
Livingstone College
Megan, a native of Portsmouth, VA, is a rising junior, biology major at SC State. Megan thinks that the Field Station is a unique opportunity to learn about the environment because you are exposed to the science work force. While in the program, she learned how to identify different flora and fauna of the South Eastern region of the United States. She plans to obtain a Doctorate in physical therapy at Hampton University or Old Dominion University. She encourages future interns to have a positive attitude. Megan is a former player, current manager of the Women's soccer team at SC State; a member of the SC State Honor’s College; a recipient of a full academic scholarship; a two-time recipient of the Presidential Bronze Award for Academic Achievement; Miss Honors 2012-2013; and a member of Alpha Kappa Alpha Sorority Inc.

Mikayla was born in Washington, D.C and is a rising junior, biology major at SC State. Mikayla states, “I was interested in seeing what [the program] had to offer. The hands on and physical experience along with the lectures are very beneficial. I have gained more knowledge in the field of environmental science. The program has helped me to better handle situations dealing with professors or anyone of a higher authority. I plan to go to graduate school to complete a physician's assistant program. The papers and presentations are a good eye opener to what is to come in grad school.” Mikayla is a member of the LS-SCAMP program, Alpha Kappa Psi Professional Business Fraternity, Alpha Kappa Alpha Sorority, and she is a Student Orientation Leader.

Allen, a Marion, SC native, is a rising junior, social science major at Allen University in Columbia, SC. Allen states, “Many of the courses are actually taught in the field, in our natural wildlife environment. I like the outdoors and enjoy becoming one with nature. I live within city limits, and the outdoors was a perfect home away from home. This program was for my personal preference, because I wanted to be outdoors for the summer. I plan to attend Law School after graduation. I was here to take advantage of a few natural experiences.” Allen is on the President's List and the Dean's List.
Michael Tolbert, South Carolina State University

James Sherman, South Carolina State University

Michael, an Augusta, GA native, is a rising senior, agribusiness major at SC State. He joined the program to further his knowledge on how we can protect our environment. During his studies, he learned how the smallest form of pollution can form into a big environmental issue. Michael states, “It helped me gain further knowledge on how we can protect our environment.” He plans to attend graduate school at either Clemson or SC State and major in Agribusiness. He feels that the various writing assignments and the scientific poster projects have helped prepare him for graduate school. His advice to future interns is to “come into the program with an open mind and be ready to learn. “There will be long, hot days, but it is enjoyable.” Michael is a Drum major in the band at SC State.

James, a Bronx, NY native, is a rising senior, industrial technology major at SC State. James states, “I was attracted by this program because of the activities that were displayed through pictures and I have received by word of mouth that it was great internship experience and would look good on my resume. The benefits I see are hands-on, physical, environmental learning with the Savannah River Site Field Station. I have gained knowledge of how to take care of our environment more and what is causing problems on our lands. I now understand how important it is for certain people to do research and to keep advancing to make our world a better and clean place. This program has shown me many problems with our world and what the scientists and regular people need to do to make sure our future does not become any worse than what we are making it.” James feels the program did give him skills that would help him in graduate school through the research and papers he had to write. His advice to future interns is, “I would tell that student about the different experiences I had and I would get them prepared for being responsible for [money management], proper character, and to stay focused with many notes in class. I would love for them to know the landscapes I have seen and how amazing the views were.” James has received two honors scholar pins and is a member of Omega Psi Phi Fraternity Inc.

Barbara Edwards, Claflin University

Barbara, a native of Walterboro, SC, is a senior, environmental science major at Claflin University. The courses attracted her to the program. She recently changed her major to environmental science and needed the classes. The benefits of the program are getting the hands on experience and networking/meeting new people. She also feels that the program offers insight on finding out if this is something that she would want to do for a career. Barbara stated, “I gained a lot more knowledge than I previously knew since I was new to the major. I also gained hands on experience. The program has helped and prepared me for the present and future. I now know how it is to be outside in the field doing research and other things. I spoke with my advisor, who suggested that I pursue graduate school, so I think I will. I’m not sure what school yet, but my major would probably be in Environmental Health or Policy. I believe [the program] has prepared me for graduate work. The trips to the labs and the long hours gave me a small insight on how it might be in graduate school”. Barbara is a member of Friends of the Earth, Gospel Choir, National Leadership & Success, and Public Health Alliance.
Improved Environmental Management and Computational Sciences Project at SC State University

Louise, a native of Charlotte, NC, is a senior, agriculture major at North Carolina A&T State University. She was attracted to the program because it is directly related to her field of study and could help with employment. She found the hands on training and networking helpful. Louise feels that graduate work will be much like the work done in the field. She advice future interns to “definitely read up on what the internship is about and the work they’ll be doing over the summer”. The internship is great for hands on training and will be helpful in the long run as far as graduate school and future employment.

Louise Houston, North Carolina A&T State University

Courtney, an Austin, TX native, is a rising senior, chemistry major at Albany State University. Courtney was attracted to the program because of the Environmental Science courses. Prior to the program she hadn’t taken any environmental science courses. She feels the courses have been helpful for graduate school, and to get a better look into hands on field experience. She plans to attend graduate school at Florida State University majoring in environmental science. She encourage those interested in Environmental Science to apply at the SRESHFS. Courtney is a member of the American Chemical Society, recipient of the outstanding student award, and secretary of the Albany State University chemistry club.

Courtney Seay, Albany State University

Shelton, a native of Trenton, SC, is a rising junior, mechanical engineering technology major at SC State. Shelton attended the program to further his understanding of the environment. While taking courses, he gained an understanding of different species and experience writing reports and making presentations. He plan to go to graduate school, but is undecided on where at this time. His advice to future interns is to bring bug spray! Shelton is a member of NSBE and track & field at SC State.

Shelton Garrett, South Carolina State University

Caldwell, a native of St. Matthews, SC, is a rising senior, mechanical engineer technology major at SC State. The opportunity to learn more about the environment and how to protect it attracted Caldwell to the program. One benefit of the program is that it will help him obtain a minor in land surveying and it shows him how to make this world safe and healthy. “The way the program prepared me for the present and future is allowing me to know that if we don’t change the way we treating our environment, then we will have a big problem in the future.” Caldwell plans to attend graduate school and major in Mechanical Engineering. He feels the program assisted in preparing him for graduate school by way of the papers that he had to write and the hard studying. His advice to future interns is, “Make sure you take it serious and stay focused. Your experience here is what you make it out to be.” Caldwell is a member of National Society of Black Engineers, Skills USA, Junior Chamber Commerce(JCC), Epsilon Pi Tau, Alpha Pi Tau, Silver Pin, and he is a MOX scholarship recipient.

Caldwell McFadden, South Carolina State University
Improved Environmental Management and Computational Sciences Project at SC State University

Workforce Development cont.

All opportunities afforded to students participating in the DOE Environmental Management Internship (EMI) are truly unique, yet necessary to maintain a pipeline of diverse and qualified applicants. As a result of completing these courses, the EMI students improved their analytical and critical thinking skills. The following course competencies achieved enable students to solve complex environmental management issues and meet the workforce development needs of DOE-EM. Students were able to:

- Address environmental stressors and pollution, their sources in the natural and workplace environments, their modes of transport and transformation, their ecological and public health effects, and existing methods for environmental disease prevention and remediation.
- Successfully conduct field studies, write experimental reports, conduct literature reviews and comprise an annotated bibliography
- Become familiar with the history of SRS and explore current contamination issues and remediation techniques taking place on site
- Become knowledgeable about the Savannah River Site and current contamination issues and remediation techniques in this area and abroad
- Conversant on remediation techniques currently being researched
- Analyze the biological, chemical, social, political, cultural, and economic factors that affect the environment.
- Have an attitude and ability to critically and independently investigate environmental issues.
- Understand the concept of natural ecosystems and the impact of human activity that causes major types of pollution
- Explain the scientific and social implications of climate changes and the effects of anthropogenic pollutants and human population growth on the environment.

Students expanded their knowledge base by learning sustainable practices in environmental science and the importance of preservation and restoration of natural habitats. By invoking critical thinking and use of the scientific method, they also learned, their interdisciplinary study as an intern gives them a competitive edge when applying to positions within the Department of Energy.
Improved Environmental Management and Computational Sciences Project at SC State University

Bridge to the DOE-EM Mission:

We have been able to integrate course instruction with DOE field work, laboratories and applied research work by partnering with DOE to secure these opportunities and interactions and by working with the existing collaborators of the field station. The DOE contacts also exposed the interns to research and DOE careers. The students not only heard about ongoing research, but also had a chance to go into the field and see real-life application of the technology that resulted from the laboratory’s research efforts.

Research and Development:

During the summer 2011, SRESFS had the honor of making a special presentation to the DOE-Savannah River Managers and Staff. Managers were able to hear perspectives of our SRS DOE Contact (also a previous SRESFS Intern), a 2010/2011 Faculty and Advisory Board member, and student perspectives. Students discussed why they were attracted to the program, how the program has impacted their career decisions thus far, and their future career plans. After the presentations, students presented their class project posters to the group in a poster forum.

Improved Environmental Management and Computational Sciences Project at SC State University

On July 25th, students had an opportunity to showcase their posters and field station experiences to the SRS Citizen’s Advisory Board (CAB) bimonthly combined committee meeting at the Savannah Rapids Pavilion in Martinez, GA. This board is comprised of local stakeholders who are members of the surrounding communities, many represent local businesses or agencies. Students presented their posters and were available to answer questions from the committee. Students also participated in an oral and poster presentation during the DOE-EM/HBCU conference held at SC State University which included presidents from nine HBCU’s, DOE officials and students.
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