

## **Development of a Workforce for the Nuclear Industry**

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### **ABSTRACT**

The US Department of Energy's Office of Environmental Management (DOE-EM) oversees one of the largest environmental restoration projects in the world. DOE-EM's labor statistics show that 91% of EM employees are 40 years old or older and only 1% of its workforce is under 30 years old. In addition, it is estimated that within the next three years, DOE-EM will lose as much as 30-35% of its technical workforce due to retirement. DOE-EM is responding to the aging workforce problem by proactively partnering with universities to train and develop the new generation for the environmental restoration workforce.

In 2007, DOE-EM and Florida International University's Applied Research Center (ARC) established the DOE-FIU Science and Technology Workforce Development Program. This is an innovative program designed to train and mentor FIU students in STEM (science, technology, engineering, and math) disciplines and provides them with career paths in environmental restoration and the nuclear industry. The selected students (called DOE Fellows) perform hands-on environmental remediation research and participate in internships at DOE Headquarters, DOE sites, national laboratories, and DOE contractors. Upon graduation and completion of the DOE fellowship, DOE Fellows pursue employment opportunities with DOE and its contractors. In addition, DOE-EM has also established a Minority Serving Institution STEM program targeting STEM students at Historically Black Colleges and Universities (HBCUs). Both programs have the purpose of enhancing educational and training opportunities to minority students.

DOE Fellows support DOE-EM research at FIU's ARC. The Fellows work side by side with ARC's scientists and engineers in the research of technologies and methodologies in the areas of high level waste/waste disposal and treatment, soil and groundwater remediation and modeling, deactivation and decommissioning (D&D) technology test and evaluation, and engage in the development of information technology systems in support of the DOE-EM environmental remediation mission.

### **INTRODUCTION**

According to DOE EM, the completion of environmental restoration of DOE facilities is projected to last 40 to 50 years [2]. Today, the challenges are even greater, as the environmental restoration program in the US is experiencing cuts and many sites across the DOE Complex are reducing the size of their trained and skilled workforce. Budget cuts by the government not only postpone the remediation of highly contaminated facilities across the US, which creates an even larger environmental threat to future generations and risks losing the knowledge base and knowledge transfer needed to train our future workforce.

The US Department of Energy's Office of Environmental Management (DOE-EM) is responsible for conducting one of the largest environmental restoration programs in the world, involving a workforce of over 30,000 employees including federal and private contractors. This workforce is composed in majority by experienced, seasoned professional with an average age of 50+ years. The challenges of workforce development for the environmental remediation field are evident in recent numbers reported by DOE-EM. Similar trends are reflected in by private contractor and DOE National Laboratory workforce.

The aging of a workforce for environmental management is not only a US problem, it is also an issue faced by other countries conducting large environmental restoration program, such as the United Kingdom. Further, workforce development not only affects the environmental restoration industry, but also will be a major issue with the construction of new nuclear reactors when more countries consider nuclear energy as part of their energy security strategy. New construction of nuclear power plants will require a trained and skilled workforce, compounding the aging workforce issue and increasing the demand for skilled workers. Various program in the US and UK have been created to address this workforce development issue.

Based on these facts, the US will need the development of a skilled workforce in order to complete the DOE-EM's environmental restoration mission. A pipeline of technical professionals has to be maintained and/or created in order to guarantee successful completion of this very important mission. This pipeline will include technicians and STEM professionals at the bachelor, masters and PhD levels. Training of the 21<sup>st</sup> century workforce will require development of specialized programs at universities and community and state colleges across the US. Established programs such as the DOE Fellows at Florida International University and Indian River State College's Center for Nuclear Education are examples of programs that are leading the development of future scientists, engineers and technicians for the nuclear industry workforce.

## **THE DOE FELLOWS PROGRAM**

The DOE-FIU Science and Technology Workforce Development Program was established by the US Department of Energy and Florida International University in 2007. The aim of the DOE Fellows Program is to create a "pipeline" of well trained and mentored STEM Florida International University students. The program has been designed on an "apprenticeship" model, where selected students perform "hands-on" research under the supervision of FIU's Applied Research Center staff and faculty. The DOE Fellows work side by side with ARC's scientists and engineers in the research of technologies and methodologies in support of DOE-EM's environmental restoration mission. The Fellows perform hands-on research in the areas of high level waste/waste disposal and treatment, soil and groundwater remediation and modeling, deactivation and decommissioning (D&D) technology test and evaluation, and they develop information technology systems in support of the DOE-EM environmental remediation mission.

Since the inception of the program, 120 FIU STEM students (graduates and undergraduates) have been inducted as DOE Fellows and completed 95 internships at DOE Headquarters, DOE sites, national laboratories, and private industry. Some of their successes are:

- DOE Fellows have given over 142 posters & oral presentations at national & international conferences (e.g., WM, ANS, and ICEM) and won awards for the Best Student Poster at WM09, WM10, WM11, WM14, and WM15, and a DOE Fellow won Best Professional Poster at WM09.
- Eight (8) DOE Fellows have been hired by DOE-EM: 3 at DOE-EM headquarters, 2 at DOE national laboratories, and 3 with DOE contractors. In addition, 13 Fellows have been hired by other federal, state or local government agencies including the Department of Defense, NASA, Department of Commerce, Florida Department of Environmental Protection, Miami Dade County Department of Environmental Resources Management (DERM), and the Department of the Navy (NAVSEA).
- Over 53 DOE Fellows graduated FIU with BS or MS degrees and obtained employment in the STEM industry, including: Florida Power & Light, GE, Lockheed Martin, Raytheon, and Texas Instruments, etc. The hiring rate for DOE Fellows is over 99%.
- Over 45 Fellows have obtained Master's or Ph.D. degrees; most of these STEM students joined the program as undergraduate students and continued onto completion of their Master's and Ph.D. degrees.

### **Recruitment Efforts**

Formal recruitment efforts of FIU minority STEM students are conducted during April/May in the Spring Semester and September/October in the Fall Semester each year. Recruitment efforts include dedicated program web site (<https://fellows.fiu.edu>), classroom presentations, recruitment tables at the College of Engineering and the College of Arts and Sciences, booths at FIU Job Fairs, and information sessions. Additionally, there presentations at student societies such as the Society of Hispanic Professional Engineers, the Society of Women Engineers, and the Society of Black Engineers.

Students are required to turn in application packages that include a complete application, two letters of recommendation from FIU faculty, an updated resume, and unofficial FIU transcripts. A DOE Fellows selection committee of DOE's EM personnel (including DOE-EM HR), FIU faculty members, and ARC scientists review the applications and selected students are called for formal interviews. The program typically accepts 10-15 new students per year.

### **DOE Fellows Induction Ceremony**

FIU students that are recruited and selected for this program are formally inducted as DOE Fellows. The selected students are vested with this honor at a special DOE Fellows Induction Ceremony conducted at FIU each November. This event is attended by DOE Officials (HQ), DOE National Laboratory officials, FIU administration, faculty, staff, students and, of course, our DOE Fellows. A total of nine (9) formal induction ceremonies have been conducted since 2007.

These ceremonies have included the participation of several DOE officials including: Assistant Secretary for Environmental Management (Mr. Jim Rispoli in 2008, Dr. Ines Triay in 2010, Dr. Monica Regalbuto in 2015), Mrs. Tracy Mustin (former Principal Assistant Secretary for Environmental Management) in 2011, Mrs. Alice Williams (former Associate Principal Deputy Assistant Secretary for Environmental Management) in 2012, Mrs. Beth Connell (Senior Science Advisor for DOE EM) in 2014. Mr. John De Gregory (DOE Technical Monitor for FIU Cooperative Agreement) and Mrs. Rosa Elmetti-Ramirez (DOE EM International Programs and former DOE Fellow) in 2015 (see Figure 1 below).



**Fig. 1 DOE-EM's Representatives, DOE Fellows and ARC Leadership at 2015 Induction Ceremony**

### **DOE Fellows Conducting "Hands-On" Research for DOE-EM**

Since the program started in 2007, all DOE Fellows inducted into the program have been engaged in DOE-EM applied research activities conducted at FIU-ARC. The DOE Fellows are integral part of the applied research activities and work side-by-side with ARC scientists and engineers in the development of research portfolio under the DOE-FIU Cooperative Agreement.

DOE Fellows are actively engaged in decontamination & decommissioning (D&D) projects, soil and groundwater and high level waste research. For example, the DOE Fellows are involved in soil and groundwater EM projects being conducted by ARC scientists in collaboration with Savannah River National Laboratory and Pacific Northwest National Laboratory, investigating uranium sequestration issues due to polyphosphate injection.

DOE Fellows have also participated in D&D activities including the evaluation of D&D technologies such as the evaluation of a robotic platform capable of spraying fixatives inside hot cell facilities. The Fellows also support the design and development of D&D Knowledge Management Information Tool (KM-IT) for DOE-EM.

DOE Fellows have collaborated with our researchers in the development of innovative technologies for the detection and measurement of high level waste at Hanford's Tank Farm (i.e. ARC's Solid-Liquid Interface Monitor technology) and for designing and developing robotic systems for the inspection of Hanford's Double Shell Tanks (see Figure 2 below).



**Fig. 2, DOE Fellows and ARC staff showing robotic inspection tool to DOE-EM's Dr. Regalbuto & Savannah River National lab representative (Dr. Jeff Griffin)**

### **DOE Fellows Summer Internships at Across the DOE Complex**

DOE Fellows also conduct environmental restoration research as part of their summer internship assignments, where they get the opportunity to work with DOE scientists and engineers at DOE sites, DOE national labs, DOE-HQ, and/or DOE contractors. Since 2007, our DOE Fellows have participated in a total of 95 internship assignments at:

- DOE sites (Hanford, Moab, Savannah River, Idaho),
- DOE-HQ (Forrestal and Germantown offices),
- DOE National Laboratories (PNNL, ORNL, NETL, and SRNL), and
- DOE contractors (Washington River Protection Solutions, NuVision Engineering, Columbia-Energy Environmental Services, Sullivan International Consulting).

The DOE Fellows program director works closely with DOE-HQ, national labs and DOE contractors to secure 10 week-long internship assignments for the Fellows. Approximately 10 – 15 Fellows participate in summer internship each year (see Figure 3 below).

The Fellows are exposed to real-life DOE-EM environmental restoration challenges during their summer assignments. This experience allows them to become familiar with the DOE-EM mission and to understand the magnitude of environmental issues



faced by the DOE Complex. At the end of the internship, Fellows typically present their research to the hosting organization, and they are tasked with developing a technical report as part of their summer internship assignment. These technical reports are submitted to DOE-HQ as a deliverable for this program, and are posted on the DOE Fellows website (<https://fellows.fiu.edu/internships-reports>). The Fellows also present their summer internship research at the Waste Management Symposia and the annual DOE Fellows Poster Exhibition and Competition held in Miami every October.



**Fig. 3 DOE Fellows Summer 2015 Interns with Dr. Lagos (Program Director), and Dr. Gudavalli (Program Coordinator)**

### **OTHER FELLOWSHIP, INTERNSHIP, AND TRAINEESHIP PROGRAMS**

In addition to the DOE Fellows Program at FIU, DOE-EM supports other STEM programs as part of the Minority Serving Institutions Partnership Program. This program also supports STEM students by providing research and summer internship opportunities. In addition, other federal agencies support various types of scholarship and fellowship programs every year, including programs sponsored by National Nuclear Security Agency (NNSA), DOE Nuclear Energy, Nuclear Regulatory Commission (NRC), and other federal agencies targeting STEM workforce development.

NNSA offers a HBCU STEM Fellowship Program, and NNSA Graduate Programs providing internships and job experience for graduate students. DOE's Nuclear Energy also provides fellowship programs under the Nuclear Energy University Program (NEUP), offering research experience to college students from participating institutions. DOE Office of Science supports summer internships at DOE national laboratories under programs such as Higher Education Research Experiences (HERE) and Science Undergraduate Laboratory Internships (SULI). These programs directly support students at various universities by providing fellowships and/or scholarships directly to the students. All these programs have the same aim of training STEM students that will compose the 21<sup>st</sup> century nuclear workforce.

In addition to four-year university-led STEM workforce programs, many community colleges provide 2 year technical programs for students. As an example, Indian

River State College's Regional Center for Nuclear Education and Training provides educational and hands-on training to students to get them ready for technical jobs in the nuclear industry. The Center aims to fulfill the demand for skilled nuclear technicians across the US and provide standardized curriculum and training to students. In addition, the Center provides career assistance and placement of the students within the nuclear industry. RCNET counts with participation of 44 partner community colleges across the nation. A large percentage of their graduates are hired by the nuclear industry including commercial utility companies and DOE sites.

## CONCLUSIONS

STEM workforce development programs such as the DOE-FIU Science and Technology Workforce Development Program, and other programs at DOE's Office of Science, Nuclear Energy, NNSA, NRC, and community colleges (i.e. RCNET) aim to develop talented STEM students in an effort to secure a future nuclear workforce. Specifically, the DOE-FIU Science and Technology Workforce Development Program created by US DOE-EM and Florida International University's Applied Research Center in Miami, Florida, has created a pipeline of STEM minority students ready to enter the DOE-EM's workforce.

Since its inception, the program has inducted 120 DOE Fellows. Under this program, 95 internships have been conducted across the DOE Complex and 142 presentations have been given at the Waste Management Symposia and other related conferences. The DOE-FIU program has been able to provide hands-on DOE-EM research to 120 students and exposed them to real-life environmental restoration challenges faced by DOE-EM. A large number of DOE Fellows have started their STEM career by obtaining employment at DOE-EM, other federal agencies and STEM private industry.

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