YEAR END TECHNICAL REPORT
September 17, 2013 to May 17, 2014

Waste and D&D Engineering and Technology Development

Date submitted:

June 30, 2014

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Submitted to:

U.S. Department of Energy
Office of Environmental Management
Under Cooperative Agreement No. DE-EM0000598

FIU | Applied Research Center
FLORIDA INTERNATIONAL UNIVERSITY

Addendum:

This document represents one (1) of five (5) reports that comprise the Year End Reports for the period of September 17, 2013 to May 17, 2014 prepared by the Applied Research Center at Florida International University for the U.S. Department of Energy Office of Environmental Management (DOE-EM) under Cooperative Agreement No. DE-EM0000598.

The complete set of FIU's Year End Reports for this reporting period includes the following documents and are available at the DOE Research website for the Cooperative Agreement between the U.S. Department of Energy Office of Environmental Management and the Applied Research Center at Florida International University (http://doeresearch.fiu.edu):

Project 1: Chemical Process Alternatives for Radioactive Waste
Document number: FIU-ARC-2014-800000393-04b-233

Project 2: Rapid Deployment of Engineered Solutions for Environmental Problems
Document number: FIU-ARC-2014-800000438-04b-223

Project 3: Remediation and Treatment Technology Development and Support
Document number: FIU-ARC-2014-800000439-04b-225

Project 4: Waste and D&D Engineering and Technology Development
Document number: FIU-ARC-2014-800000440-04b-220

Project 5: DOE-FIU Science & Technology Workforce Development Initiative
Document number: FIU-ARC-2014-800000394-04b-079

Each document will be submitted to OSTI separately under the respective project title and document number as shown above.

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PROJECT 4 OVERVIEW

This project focuses on delivering solutions under the decontamination and decommissioning (D&D) and waste areas in support of DOE HQ EM. This work is also relevant to D&D activities being carried out at other DOE sites such as Oak Ridge, Savannah River, Hanford, Idaho and Portsmouth and international efforts being conducted by EM-2.1 with the Nuclear Decommissioning Authority (NDA) in England and the International Atomic Energy Agency (IAEA). Detailed task descriptions and deliverables and milestones can be found in the Project Technical Plan (Appendix 7). For FIU Year 4, this project included the following 5 tasks:

Task 1: Waste Information Management System (WIMS)

This task provides direct support to DOE EM for the management, development, and maintenance of a Waste Information Management System (WIMS). WIMS was developed to receive and organize the DOE waste forecast data from across the DOE complex and to automatically generate waste forecast data tables, disposition maps, GIS maps, transportation details, and other custom reports. WIMS is successfully deployed and can be accessed from the web address http://www.emwims.org. The waste forecast information is updated annually. WIMS has been designed to be extremely flexible for future additions and is being enhanced on a regular basis.

Task 2: D&D Support for DOE EM for Technology Innovation, Development, Evaluation and Deployment

This task provides direct support to DOE EM for D&D technology innovation, development, evaluation and deployment. For FIU Year 4**,** FIU focused on assisting DOE EM-13 in meeting the D&D needs and technical challenges around the DOE complex. FIU concentrated its efforts this year on working with the Savannah River Site to identify and evaluate innovative technologies in support of the SRS 235-F project. In addition, FIU will continue to support DOE EM-13 in their interactions with EFCOG on special topics of interest to DOE EM-13 and DOE Complex. FIU further supported the EM-1 International Program and the EM-13 D&D program by participating in D&D workshops, conferences, and serving as subject matter experts.

Task 3: D&D Knowledge Management Information Tool (KM-IT)

The D&D Knowledge Management Information Tool (KM-IT) is a web-based system developed to maintain and preserve the D&D knowledge base. The system was developed by Florida International University's Applied Research Center (FIU-ARC) with the support of the D&D community, including DOE-EM (EM-13 & EM-72), the former ALARA centers at Hanford and Savannah River, and with the active collaboration and support of the DOE's Energy Facility Contractors Group (EFCOG). The D&D KM-IT is a D&D community driven system tailored to serve the technical issues faced by the D&D workforce across the DOE Complex. D&D KM-IT can be accessed from web address http://www.dndkm.org.

Task 4: Centralized Knowledge Base System and FIU-DOE Research Website

This was a new task under Project 4 for FIU Year 4. The centralized knowledge base system and FIU-DOE research website serves to capture and make easily available the work that FIU performs for DOE under the FIU-DOE Cooperative Agreement. These virtual tools function as a

point-of-access for easy retrieval by the users. The objective of this task was to centralize the virtual systems that FIU uses to capture and make available the work they perform for DOE under the FIU-DOE Cooperative Agreement.

Task 5: Cyber Security Compliance and Deployment of Environmental Contamination and Remediation Models

This was another new task under Project 4 for FIU Year 4. Under this task, FIU published and deployed one environmental contamination and remediation model, developed under Project 3, through the secured KM-IT platform to improve access to the models by project stakeholders.

TASK 1.
DOE'S WASTE INFORMATION MANAGEMENT SYSTEM

TASK 1: EXECUTIVE SUMMARY

For Task 1, FIU has developed a Waste Information Management System (WIMS) to receive and organize the DOE waste forecast data from across the DOE complex and to automatically generate waste forecast data tables, disposition maps, and other displayed reports. The data can be displayed to show the regular waste forecast, the American Recovery and Reinvestment Act (ARRA) funded waste forecast, or the combined regular and ARRA funded waste forecast.

TASK 1: INTRODUCTION

Under Task 1, the Applied Research Center (ARC) at Florida International University (FIU) in Miami, Florida, has completed the deployment of a fully operational, web-based forecast system: the Waste Information Management System (WIMS). WIMS is designed to receive and organize the DOE waste forecast data from across the DOE complex and to automatically generate waste forecast data tables, disposition maps, and other displayed reports. This system offers a single information source to allow interested parties to easily visualize, understand, and manage the vast volumes of the various categories of forecasted waste streams in the DOE complex. The successful web deployment of WIMS with waste information from 24 DOE sites occurred in May 2006. Annual waste forecast data updates are added to ensure the long-term viability and value of this system. Individuals may visit the web site at http://www.emwims.org/.

TASK 1: EXPERIMENTAL

The initial requirement from DOE Headquarters was to consolidate waste forecast information from separate DOE sites and build forecast data tables, disposition maps and GIS maps on the web. An integrated system was needed to receive and consolidate waste forecast information from all DOE sites and facilities and to make this information available to all stakeholders and to the public. As there was no off-the-shelf computer application or solution available for creating disposition maps and forecast data, FIU built a DOE complex-wide, high performance, n-tier web-based system for generating waste forecast information, disposition maps, GIS Maps, successor stream relationships, summary information and custom reports based on DOE requirements. This system was built on Microsoft.net framework1.1 and SQL server 2000. Visual Studio 2003, SQL server reporting services, Dream Weaver and Photoshop were also used as development tools to construct the system. Since the initial requirements were met, additional features have been developed and deployed on WIMS.

TASK 1: RESULTS AND DISCUSSION

FIU regularly performed database management, application maintenance, and performance tuning to the online Waste Information Management System (WIMS) in order to ensure a consistent high level of database and website performance. New waste forecast and transportation forecast data is imported into WIMS on an annual basis.

The 2014 waste forecast and transportation data was collected, reviewed, and transmitted from DOE to FIU on April 1, 2014. FIU completed the data import into the master database by building a data interface to allow the files to be received by the WIMS application and import it into SQL Server, the database server where the actual WIMS data is maintained. FIU then modified the WIMS modules (Forecast, Disposition Map, GIS, and Transportation) to incorporate the new data set. The new data set was deployed onto the test server and FIU performed quality review and testing of the data. FIU then sent the link to DOE for further testing and review (completing project milestone 2013-P4-M1.1) on April 30, 2014. FIU incorporated the feedback from the data review and deployed the new data on the public WIMS server on May 9, 2014. The 2014 data set included low-level and mixed low-level radioactive waste data supplied by all DOE programs and included waste volumes forecasted for the ARRA funding in addition to the baseline waste forecast volumes and transportation information.

The data in WIMS can be viewed by site managers, stakeholders, and interested members of the public. Anyone with internet access may register and use WIMS (http://www.emwims.org).

Figure 1 provides a screenshot of the GIS map displaying the 2014 data update and Figure 2 provides a screenshot of the waste disposition map displaying the 2014 data update.

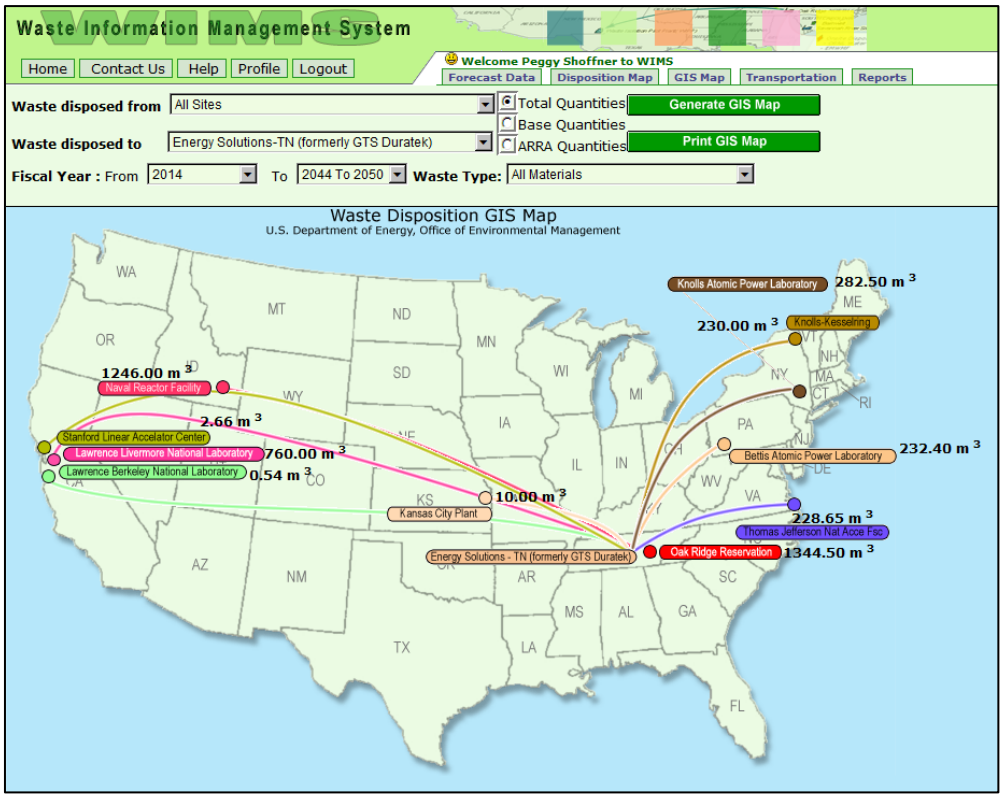


Figure 1. WIMS screenshot displaying new 2014 data set as GIS map.

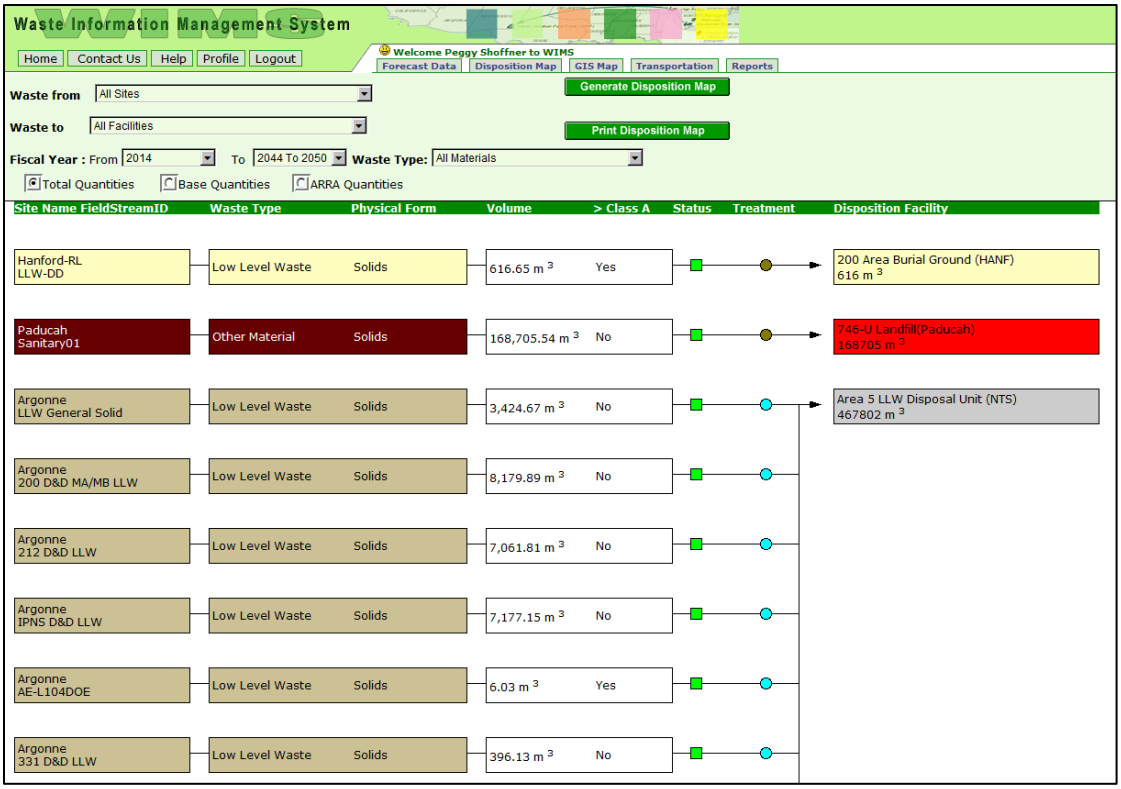


Figure 2. WIMS screenshot displaying new 2014 data as a waste disposition map.

WIMS Picklists for Querying Forecast Data

Upon entrance into WIMS, the information for display as a forecast data table, a disposition map, or a GIS map can be filtered in many ways through the provided drop-down menus. The updated filtration choices for each field of data are shown in the following lists. The fiscal year ranges are adjusted forward one year with each annual data update.

Waste type:

- All Materials
- Unknown
- Low Level Waste
- Mixed Low Level Waste
- 11e.(2) Byproduct Material
- Other Material

Fiscal Year:

- 2014
- 2015
- 2016
- 2017
- 2018
- 2019-2023
- 2024-2028
- 2029-2033
- 2034-2038
- 2039-2043
- 2044-2050

Waste from:

- All Sites
- Ames Laboratory
- Argonne National Laboratory
- Bettis Atomic Power Laboratory
- Brookhaven National Laboratory
- Energy Technology Engineering Center
- Fermi National Accelerator Laboratory
- Hanford Site – RL
- Hanford Site – RP
- Idaho National Laboratory
- Kansas City Plant
- Knolls Atomic Power Laboratory – Kesselring
- Knolls Atomic Power Laboratory – Schenectady
- Lawrence Berkeley National Laboratory
- Lawrence Livermore National Laboratory
- Los Alamos National Laboratory
- Naval Reactor Facility
- Nevada Test Site
- NG Newport News
- Norfolk Naval Shipyard
- Nuclear Fuel Services, Inc.
- Oak Ridge Reservation
- Pacific Northwest National Laboratory
- Paducah Gaseous Diffusion Plant
- Pantex Plant
- Pearl Harbor Naval Shipyard
- Portsmouth Gaseous Diffusion Plant
- Portsmouth Naval Shipyard
- Princeton Plasma Physics Laboratory
- Puget Sound Naval Shipyard
- Sandia National Laboratories – NM
- Savannah River Site
- Separations Process Research Unit
- Stanford Linear Accelerator Center
- Thomas Jefferson National Accelerator Facility
- Waste Isolation Pilot Plant
- West Valley Demonstration Project

Waste to:

- All Facilities
- 200 Area Burial Ground (HANF)
- 746-U Landfill (Paducah)
- Area 5 LLW Disposal Unit (NTS)
- Area 5 MLLW Disposal Cell (NTS)
- Clean Harbors
- Commercial TBD
- E-Area Disposal (SRS)
- EMWMF Disposal Cell (ORR)
- Energy Solutions-Clive (formerly Envirocare)
- Energy Solutions-TN (formerly GTS Duratek)
- ERDF (HANF)
- Impact Services - TN
- INL CERCLA Cell (INL)
- Integrated Disposal Facility (HANF)
- New RH LLW Vaults (INL)
- ORNL Liquid LLW System
- Paducah CERCLA
- Paducah WW Trt
- Perma-Fix Gainesville
- Perma-Fix-Diversified Scientific Services, Inc.
- Perma-Fix-Northwest (formerly PEcoS)
- Perma-Fix-Materials & Energy Corp
- River Metals
- RMW Trenches (MLLW/LLW)(HANF)
- RMW Trenches/IDF (HANF)
- RWMC (LLW disposal) (INL)
- Siemens
- Studsvik/RACE, LLC
- TA 54/Area G (LLW disposal) (LANL)

- To Be Determined
- TOXCO
- Waste Control Specialists

Waste Management Conference

FIU also participated in relevant meetings and conferences in support of this project. FIU completed a draft technical paper on WIMS and submitted it to the Waste Management Symposium 2014 (WM2014) on November 7, 2013. WM2014 accepted the technical paper and a professional poster entitled, *Waste Information Management System with 2014-14 Waste Streams*, was presented at the Waste Management Symposium 2014 during poster session 46A on March 4, 2014. This poster presented WIMS with the 2013 dataset of wastestream and transportation forecast information from the various DOE sites and facilities. FIU also demonstrated WIMS to interested conference attendees at the FIU exhibitor booth during the conference. Figure 3 shows the WIMS poster for WM14 and Figure 4 is a photograph the poster being presented at the conference.

Waste Information Management System with 2013-14 Waste Streams

Authors: Himanshu Upadhyay, Walter Quintero, Peggy Shoffner, Justin Phillips, Leonel Lagos (FIU)

Presenters: Walter Quintero, Himanshu Upadhyay

Figure 3. WIMS poster for Waste Management 2014.

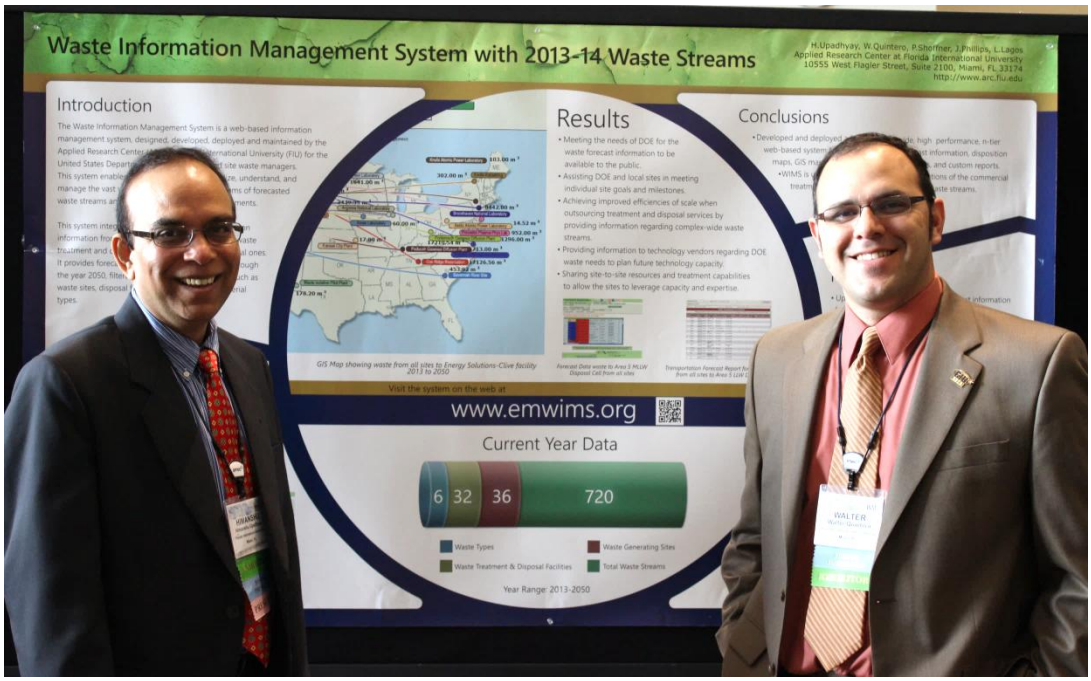


Figure 4. ARC staff Himanshu Upadhyay & Walter Quintero presenting WIMS at WM14.

TASK 1: CONCLUSIONS

WIMS continues to successfully accomplish the goals and objectives set forth by DOE for this project. WIMS has replaced the historic process of each DOE site gathering, organizing, and reporting their waste forecast information utilizing different database and display technologies. In addition, WIMS meets DOE's objective to have the complex-wide waste forecast information available to all stakeholders and the public in one easy-to-navigate system. The data includes low-level and mixed low-level radioactive waste data supplied by all DOE programs and includes waste volumes forecasted for the American Recovery and Reinvestment Act (ARRA) funding in addition to the updated baseline waste forecast volumes and transportation information

TASK 1: REFERENCES

Office of Environmental Management (DOE-EM), http://www.em.doe.gov, U.S. Department of Energy.

Waste Information Management System (WIMS), http://www.emwims.org, Applied Research Center, Florida International University.

Upadhyay, H., W. Quintero, P. Shoffner, J. Phillips, L. Lagos, *Waste Information Management System 2013-14*, Waste Management 2014 Conference, Phoenix, AZ, March 2014.

TASK 2. D&D SUPPORT FOR DOE EM FOR TECHNOLOGY INNOVATION, DEVELOPMENT, EVALUATION AND DEPLOYMENT

TASK 2: EXECUTIVE SUMMARY

This task provides direct support to DOE EM for D&D technology innovation, development, evaluation and deployment. For FIU Year 4**,** FIU focused on assisting DOE EM-13 in meeting the D&D needs and technical challenges around the DOE complex. FIU concentrated its efforts this year on working with the Savannah River Site to identify and evaluate innovative technologies in support of the SRS 235-F project. In addition, FIU will continue to support DOE EM-13 in their interactions with EFCOG on special topics of interest to DOE EM-13 and DOE Complex. FIU further supported the EM-1 International Program and the EM-13 D&D program by participating in D&D workshops, conferences, and serving as subject matter experts.

TASK 2: INTRODUCTION

FIU directly supports DOE-EM's Office of D&D and Facility Engineering and affiliated DOE sites, national laboratories, and institutions contributing to the development of innovation in D&D. This task also collaborates with DOE-EM's international partnerships and agreements, when appropriate, by providing D&D expertise, knowledge and support. The technical approach for this task is to identify and demonstrate new technologies, methodologies, and approaches to support the D&D of facilities across the globe. In this report, FIU will present the accomplishments achieved during FIU Year 4 in support of technology innovation, development, evaluation and deployment.

TASK 2: EXPERIMENTAL

For FIU Year 4, FIU performed a focused literature review and developed a technical report on contamination control products (including strippable coatings, fixatives, and decontamination gels) for radiological surface decontamination in support of the SRS 235-F Risk Reduction Project, and collaborated with the EFCOG DD/FE Working Group on a study of aging infrastructure across the DOE complex as well as in the development of D&D lessons learned and best practices. FIU also participated in workshops and conferences and served as subject matter experts.

TASK 2: RESULTS AND DISCUSSION

Contamination Control Products for Radiological Surface Contamination (D&D Technical Support to SRS's 235-F Facility Decommissioning)

FIU performed a focused literature review and developed a technical report on contamination control products (including strippable coatings, fixatives, and decontamination gels) for radiological surface decontamination in support of the SRS 235-F Risk Reduction Project. FIU received review comments from SRS on the summary report, incorporated the comments into the

report and submitted the revised report back to SRS. The summary report will help the project team develop their decontamination concepts for the PuFF process cells and define the FY 14 and out year's technical activities.

The SRS 235-F facility was constructed in the 1950's as part of the weapons complex materials production and fabrication. The facility has since had several production missions, the most recent of which was receipt, storage, and disbursement of plutonium-bearing materials in support of SRS and the DOE complex. In 2006, the storage vaults for nuclear materials were emptied and the facility was thereafter maintained in a surveillance and maintenance mode awaiting deactivation. The most significant quantities of residual contamination remaining in 235-F building are found in the Plutonium Fuel Form (PuFF), Plutonium Experimental Facility (PEF), Old Metallography Lab (OML), and Actinide Billet Line (ABL) facilities.

The search parameters for the literature review were established by telephone conversations with SRNL. Based on the established parameters, FIU conducted a detailed literature search and developed an Excel spreadsheet containing the results of the study. The literature search included a detailed evaluation of previous reports and demonstrations conducted at FIU-ARC and throughout the DOE Complex as part of technology evaluations/demonstrations sponsored by DOE-EM. Also, FIU made used of the D&D Knowledge Management Information Tool (D&D KM-IT) and DOE's Information Bridge (OSTI). The World Wide Web was also utilized to search for these products. In addition, vendors and manufacturers were contacted via telephone and via e-mail for additional information not available online. Material safety data sheets (MSDS), project profiles from applications already performed using some of the products listed and fact sheets were collected when available.

The following information was collected for each one of the products identified by the study:

- Product Name
- Manufacturer
- Strippable Coating (Yes/No)
- Application Instructions
- Price/Coverage
- Use
- Advantages
- Previous used
- Documentation
- Product Website
- Photos
- Contact Information

The preliminary evaluation of the strippable coatings, fixatives, and decontamination gels was conducted based on application parameters established by SRNL. A comprehensive Excel sheet was developed and presented in the report. Figure 5 shows images of contamination control products from the report.

Figure 5. Images of contamination control products from report to SRS.

FIU expanded on the research for the list of identified strippable and fixative coatings. In addition, 5 more coatings were identified and added, for a current total of 40 products. Telephone conferences were conducted between FIU and Michael Serrato at SRNL during the execution of this work. The following additional information was collected for the products:

- Category (fixative/strippable/washable)
- pH
- Ingredients (only those published by manufacturers)
- Specific gravity
- Viscosity
- Solubility in Water
- % Volatile by volume
- Incompatibility
- Conditions to avoid
- Hazardous decomposition products
- Hazardous Material Identification System (HMIS) rating
- Minimum recommended thickness
- Density
- Shelf life
- Combustion
- Flash point

A significant amount of the information researched is not available online or on the documents collected to date. To fill in the data gaps, FIU contacted the product manufacturers and distributers in order to collect any information that was not been available from product documentation, industry reports, or online resources.

FIU also worked on creating a decision tree to better guide the product end users in the selection of the appropriate products depending on their specific needs. For this, FIU created a list of key parameters that would be essential for the decision making process and assigned a level of relevance to each parameter. FIU worked directly with Michael Serrato at SRNL to incorporate his knowledge and experience into this process. The parameters identified include:

- Facility type
- Operational status
- Isotopes involved *
- Surface type *
- Contaminant characteristics *
- Activity level
- Contaminant configuration *
- Application area
- Secondary waste
- Cost

The parameters marked with an asterisk (*) will be used initially to create a simple decision process that would be developed into a more complex model using a fuller set of parameters in the future.

With the help of a report by Jeff Hunter from the former ALARA Center at Hanford, FIU began development of a preliminary model to illustrate how future models will work. This preliminary model took 4 of the 12 parameters into account while all 12 would be taken into account in the future development of the decision model.

In this preliminary model, the user can choose the following parameters from dropdown lists:

Surface Properties: Metal/Concrete/Equipment/Plexiglas/Carbon Steel/Other
Surface Type: Smooth/Porous
Isotopes Involved: Plutonium 238
Product: Decon Gel 1101

Percent of decontamination for this specific isotope on the surface varies with the reported test results as shown in the following table.

Table 1. Decontamination Results Using Decon Gel 1101

Surface Properties	Surface Type	Isotopes Involved	Product	% Decon
Carbon Steel	Smooth	Plutonium 239	Decon Gel 1101	98%
Surface Properties	**Surface Type**	**Isotopes Involved**	**Product**	**% Decon**
Plexiglass	Smooth	Plutonium 239	Decon Gel 1101	53%
Surface Properties	**Surface Type**	**Isotopes Involved**	**Product**	**% Decon**
Concrete	Porous	Plutonium 239	Decon Gel 1101	71%

For an easier visualization of the input parameters that will be taken into account in the decision model, the following tree model has been developed (Figure 6):

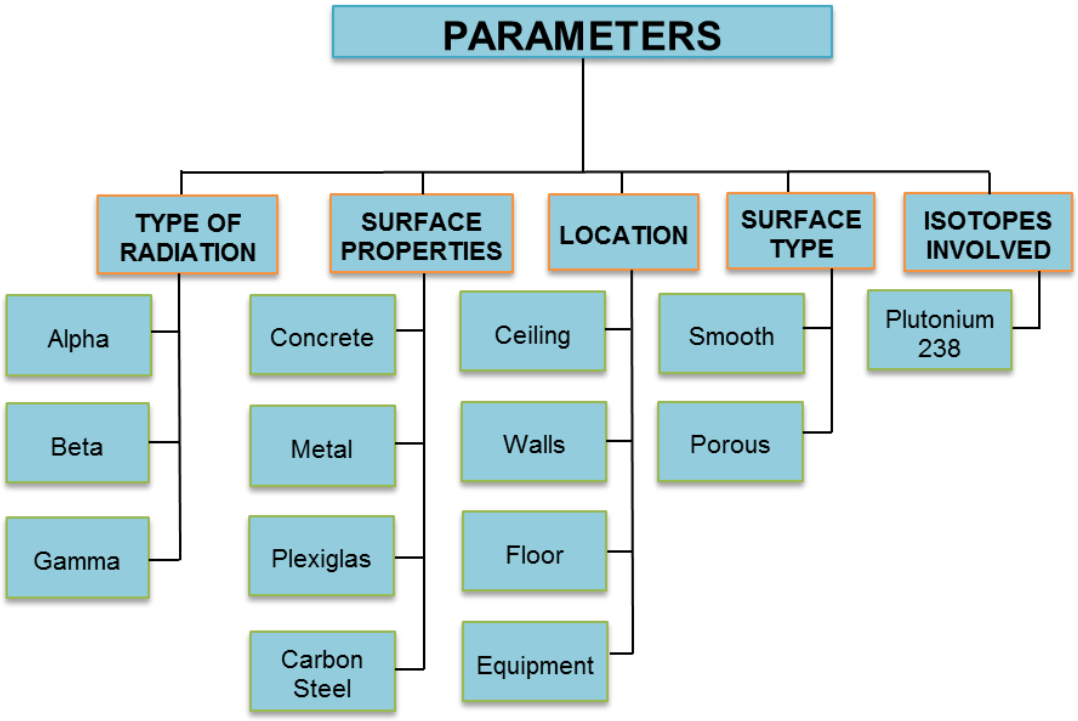


Figure 6. Tree model for fixative/coating input parameters.

Output parameters will be limited to the products listed in the Contamination Control Fixatives Matrix.

In order to narrow down and better match each of the strippable and fixative coatings during the decision making process, FIU focused on determining the following parameters for each of the products according to their manufacturers:

- Surface/Location (for easier application)
- Advantages/Recommended Use (for best results)

These parameters were added to the Contamination Control Fixatives Matrix. While contacting manufacturers and other companies that have used these products in the past to acquire new details about their performance, FIU received feedback from companies such as CBI Polymers which resulted in the substitution of two of their products: DeconGel 1101/1121 was replaced with DeconGel 1108/1128 and a new product called DeconGel Pro was added.

In addition, FIU has been collecting performance data from previous studies conducted with some of these products. Some of these studies have been retrieved from the D&D KM-IT and from other online resources such as the Environmental Protection Agency website. By collecting this existing data, additional future testing needs should be reduced.

For future elaboration of the decision model, FIU evaluated the use of a software package or add-in, such as SolutionTree Add-In for Excel, that would aid in the calculation of the optimal path within the decision tree. The standard Microsoft Excel features do not allow for automated

solutions when plugging in parameters and it does not allow users to program values into the different nodes. For the development of the preliminary decision tool, FIU focused on the pair-wise comparison method. Pair-wise comparisons match each parameter one-on-one and prioritize those parameters of greater significance to find the optimal solutions for the specific facility. During the pair-wise comparison, each parameter received a value from 1 to 9 depending on its importance in relation to each of the other parameters. Then, within each parameter, each sub-parameter would be evaluated. The subsequent values are be plotted using Excel where each parameter is weighted according to the input.

For example, if the type of radiation is slightly more important than the surface properties, a 3.0 value will be provided to the cell that compares Type of Radiation (row) and Surface Properties (column). This will assign a higher weighted value to the Type of Radiation than to the Surface Properties. Within the Type of Radiation parameter, a similar process will take place for the sub-parameters.

From the weighted values determined by the comparison of each parameter and each sub-parameter, a decision is made based on the efficiency of each individual product (output parameter). The following table shows how the primary parameters provide weighted result after manually inputting the values:

Table 2. Weighted Values for Primary Parameters

Parameters	Type of Radiation	Surface Properties	Location	Surface Type	Itoropes Involved	Normalized Weight
Type of Radiation	1.0	9.0	9.0	9.0	9.0	**0.669**
Surface Properties	0.1	1.0	2.0	1.0	2.0	**0.100**
Location	0.1	0.5	1.0	1.0	3.0	**0.088**
Surface Type	0.1	1.0	1.0	1.0	3.0	**0.097**
Itoropes Involved	0.1	0.5	0.3	0.3	1.0	**0.045**
sum	*1.4*	*12.0*	*13.3*	*12.3*	*18.0*	*1.0*

Going forward, the list of decontamination products will need to be periodically updated with new products as well as with additional information on each product. In addition, to further develop the model, more data/information is needed on the efficiency of each product under the conditions and circumstances that are compared throughout the pairwise comparison chart. One challenge that the research for this task has revealed is that there is not enough information available on decontamination factors.

Support for Aging Infrastructure (Support to DOE EM-12 and Interface with EFCOG)

During FIU Year 4, FIU worked in collaboration with the EFCOG DD/FE working group on the issue of aging infrastructure. FIU completed a literature search on this issue to gather any existing articles, papers, reports, and other documents from within the DOE complex. FIU also reached out to DOE site points of contact through the EFCOG DD/FE Working Group members to solicit information on the efforts being taken at the DOE sites to identify all the excess facilities, prioritize the maintenance/surveillance activities, and prioritize D&D when funding becomes available. The resulting information was compiled into a technical report to provide an

overall picture on the status of aging infrastructure across the DOE complex. The draft report was sent to DOE on May 2, 2014, completing project milestone 2013-P4-M2.2.

During the literature search, FIU performed searches on sources including:

- D&D Knowledge Management Information Tool
- OSTI online catalog
- Archived Waste Management Symposia papers
- WM13 and WM14 Programs for papers not yet archived to the WM website
- GOA.gov
- Google – general internet searches
- EFCOG DD/FE Working Group meeting notes
- EFCOG documents, including lessons learned and best practices
- DOE Reading Rooms and Information Centers
- DOE site websites and document libraries

The challenges presented by aging infrastructure across the DOE complex are multifaceted. Limited funding requires difficult decisions be balanced across multiple priorities, including reducing footprint and risks by completing D&D of deteriorated excess facilities, repairs and surveillance and maintenance for empty facilities as needed to reduce risk to future D&D workers, as well as refurbishment and modernization to aging operating facilities and infrastructure needed for the current and future site missions. The approaches and processes used to make these determinations vary from one DOE site to the next. Efforts to gain an understanding of the challenges and needs complex-wide include FIMS, the D&D Map, and a current undertaking between DOE and NNSA to develop a comprehensive identification and prioritization process for the aging infrastructure across the complex. Figure 7 shows the facilities planned for D&D as of 2009, Figure 8 shows examples of the aging infrastructure at DOE facilities, and Figure 9 shows the typical end of life phases of a nuclear facility.

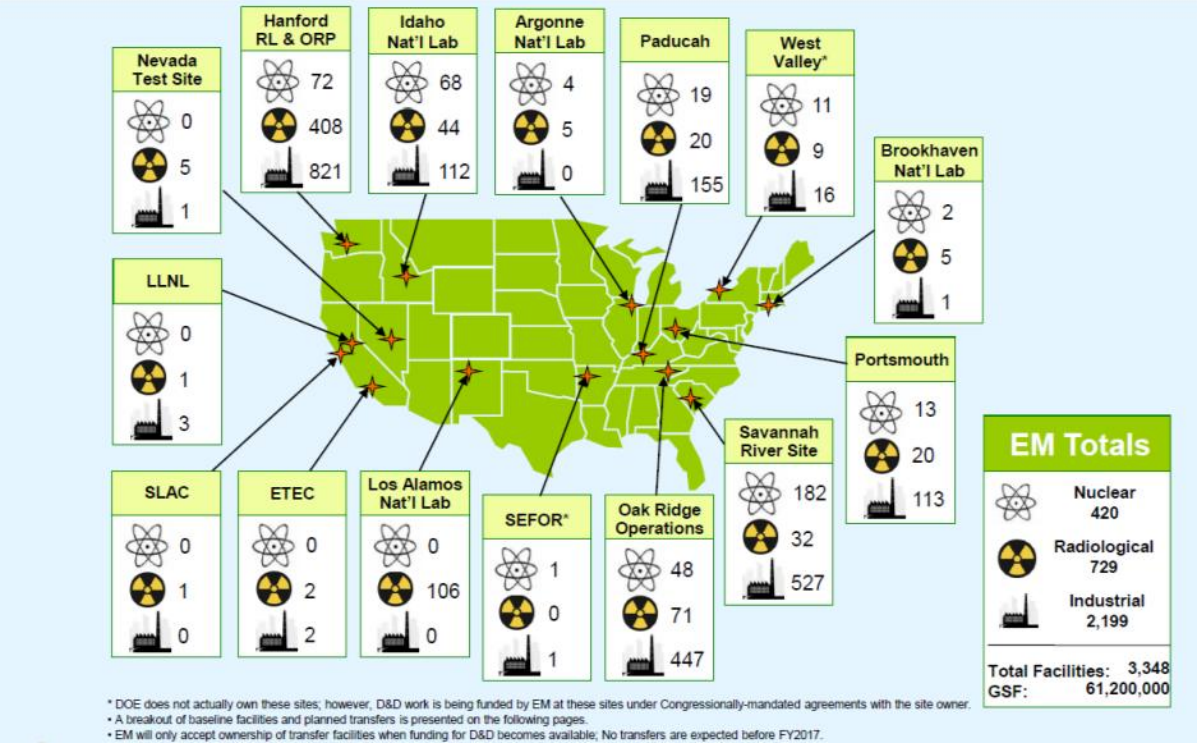


Figure 7. Facilities planned for D&D as of 2009, including current EM baseline and facilities planned for transfer to EM for D&D. *(Source: D&D Program Map, DOE, June 13, 2011).*

Figure 8. Aging infrastructure at DOE facilities.

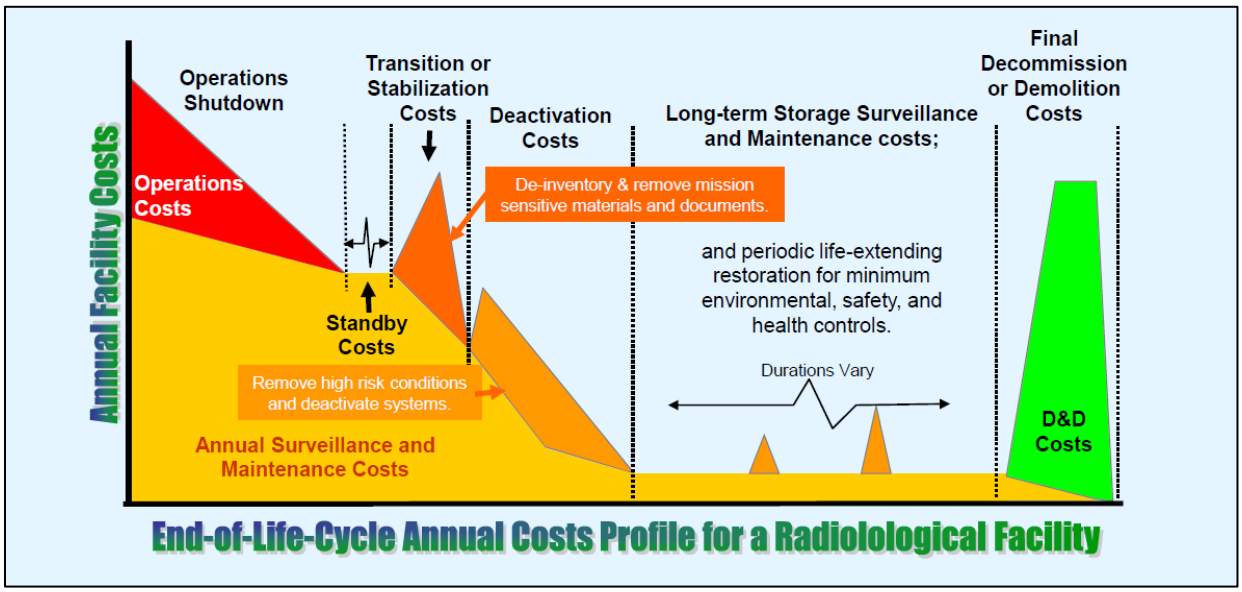


Figure 9. Typical End of Life Phases of a Nuclear Facility (*(Source: D&D Program Map, DOE, June 13, 2011)*.

Best Practices and Lessons Learned (Support to DOE EM-12 and Interface with EFCOG)

Under this subtask, FIU-ARC interfaced with the DOE's Energy Facility Contractor's Group (EFCOG) D&D/FE Working Group by collaborating in the development of Lessons Learned and Best Practices. In addition, FIU participated in working group conference calls and Annual EFCOG meetings and presentations.

EFCOG Participation

FIU participated in the EFCOG D&D and Facility Engineering Working Group meetings and teleconferences during FIU Year 4, and reported on the progress of the Lessons Learned and Best Practices documents being developed by FIU.

EFCOG Lessons Learned and Best Practices

This subtask focused on capturing the manager experience through the EFCOG points-of-contact. In an effort to capture the lessons learned and best practices acquired at DOE sites, FIU worked with EFCOG to identify various sites who were able to share their experiences and lessons learned with the EM D&D community. The development of each lessons learned and best practice was conducted with a standardized process, as shown in Figure 10.

Figure 10. Process for developing Best Practice and Lessons Learned documents.

An article on the lessons learned and best practices was published in EM Update (Vol. 5, Issue 9, September 2013) and titled "Website Collects EM's D&D Lessons Learned." The article highlighted recent lessons learned and best practice documents that have been developed and the effort that the Office of Environmental Management is making to collect the information gained through the experience of its workforce and make it available to the current and future workforce.

In total, FIU has completed the development, review, and approval for 9 lessons learned and best practice documents and developed an additional 4 documents that are in the review and approval stages. The objective of these efforts was to capture previous work performed by the D&D community and facilitate the transfer of knowledge and lessons learned. The lessons learned and best practices developed by FIU to date include:

1. The Washington Closure Hanford Site Explosive Demolition of Buildings 337 and 337B
2. Lawrence Livermore National Laboratory Open Air Demolition of Asbestos Gunite by Using Track Mounted Wet Cutting Saw Best Practice
3. Savannah River Site 185-3K Cooling Tower Demolition Best Practice
4. Lawrence Livermore National Laboratory Historical Hazard Identification Process for D&D Best Practice
5. Closure of the Reactor Maintenance, Assembly, and Disassembly Facility and the Pluto Disassembly Facility at the Nevada National Security Site
6. Unanticipated High Dose During the Removal of Wire Flux Monitor Cabling from the Heavy Water Component Test Reactor (HWCTR) Vessel

7. Radiological Contamination Event During Demolition of the Separations Process Research Unit (SPRU) Building H2
8. Structural Code Guidance for D&D Activities at DOE Facilities
9. Electrical Code Guidance for D&D Activities at DOE Facilities
10. Savannah River Site R and P Reactor Disassembly Basin In Situ Decommissioning
11. Use of Earthen Benches and other Technologies to Support River Structures' Demolition Activities at the Hanford Site
12. Hanford Site 327 Facility Source Term Stabilization and/or Removal Prior to Demolition
13. Use of a Remote Tapping Tool at INL to Minimize Worker Exposure and Avoid Future Contamination Accidents

Documents 1 to 4 were final and attached to the Year End Report for FIU Year 2. Documents 6, 8, and 9 were finalized during FIU Year 3 were linked in last year's Year End Report. Documents 5 and 7 were finalized during FIU Year 4. The remaining documents (10, 11, 12 and 13) are in progress and being reviewed and/or revised. A summary of the lessons learned and best practices that were finalized or in progress during FIU Year 4 are included below.

Closure of the Reactor Maintenance, Assembly, and Disassembly Facility and the Pluto Disassembly Facility at the Nevada National Security Site: American Recovery and Reinvestment Act-Funded Acceleration of Demolition and Lessons Learned

The U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office received funding from the American Recovery and Reinvestment Act to demolish two Nevada National Security Site facilities. These facilities are the Reactor Maintenance, Assembly, and Disassembly (R-MAD) Facility and the Pluto Disassembly Facility (Figure 11). They were both constructed in the late 1950s and early 1960s to support design and testing of nuclear reactor-powered components. Both facilities were previously closed under the Federal Facility Agreement and Consent Order (FFACO).

Using ARRA funds to accelerate work scope and maintaining the same subcontractor and site workers across several projects resulted in identification of more efficient methods for performing work that were applied to R-MAD, Pluto, and Test Cell C. Lessons learned on these projects included identifying efficiencies in waste packaging and shipment, and the importance of a rigorous approach for identification of asbestos-containing materials. These lessons learned are being used to plan for future demolition activities. Utilizing this experience allows for more effective and efficient planning for other demolition activities.

Figure 11. R-MAD Facility (left) and Pluto Facility (right).

Radiological Contamination Event During Demolition of the Separations Process Research Unit (SPRU) Building H2

The Separations Process Research Unit (SPRU), located at the Knolls Atomic Power Laboratory (KAPL), near Schenectady, New York, was operated from 1950 to 1953 as a pilot plant to research the REDOX and PUREX chemical processes to extract uranium and plutonium from irradiated uranium. The research operations contaminated the SPRU facilities and land areas, resulting in the need to remediate the site.

Between September 29, 2010 and October 1, 2010, three separate events occurred at the (SPRU demolition project. Process vessels and associated piping were removed and size reduced without adequate controls, resulting in worker contamination and a small release of radioactive material to the environment Subsequent rain events and a failure of a hillside drain system sump pump resulted in radioactive material from the release, as well as some material from the exposed building basement, to be released to the facility outfall and into the Mohawk River.

A formal causal analysis was performed on the events which identified deficiencies; 18 specific findings were identified where site operations and workers failed to implement best practices in demolition of a radioactively contaminated facility and site. Three of these findings formed the basis for the 3 lessons learned captured in the lesson learned document:

1. Proper use of fixatives: Use of fixatives must be implemented carefully after setting conservative RadCon limits and decontamination criteria based upon technically valid sampling and characterization data. This will allow for an accurate estimation and minimization of the risk of worker exposure and radioactive releases to the public;
2. Proper preparation and staffing for extreme weather conditions is necessary to avoid operational problems and possible radiological releases. This should include clear expectations for communication with management, establishing on-call personnel, and staging response equipment;
3. Regular operations team assessment of the use of best practices: Demolition and decontamination contractors should have regular meetings to assess progress of the use of best practices in demolition and decontamination operations at radiologically controlled facilities.

This lesson learned document was finalized in March 2014 but publication is on hold as requested by the project site contacts.

Savannah River Site R and P Reactor Disassembly Basin In Situ Decommissioning

The 105-R Disassembly Basin was the first SRS reactor facility to undergo the in situ decommissioning (ISD) process followed by the 105-P Disassembly Basin (Figure 12). The best practice followed at SRS guided the identification and selection of appropriate ISD fill materials to successfully overcome the wide variety of challenges that the large size and structural complexity of these facilities presented. Considerations for grout formulations had to account for flowability, long term stability, set times, heat generation and interactions with materials within the structure. The large size and configuration of the facilities necessitated that grout be pumped from the exterior to the spaces to be filled, which required that the material retain a high degree of flowability to move through piping without clogging while achieving the required leveling properties at the pour site. Set times and curing properties were controlled to meet operational schedules, while not generating sufficient heat (known as heat of hydration) to compromise the properties of the fill material. In addition, the properties of residual materials in the facility necessitate additional requirements for the grout formulations. Where significant quantities of aluminum were present in the facility, common formulations of highly alkaline grouts were not appropriate because of the potential for hydrogen generation with the resultant risks. SRS developed specialized inorganic grout formulations to address this issue.

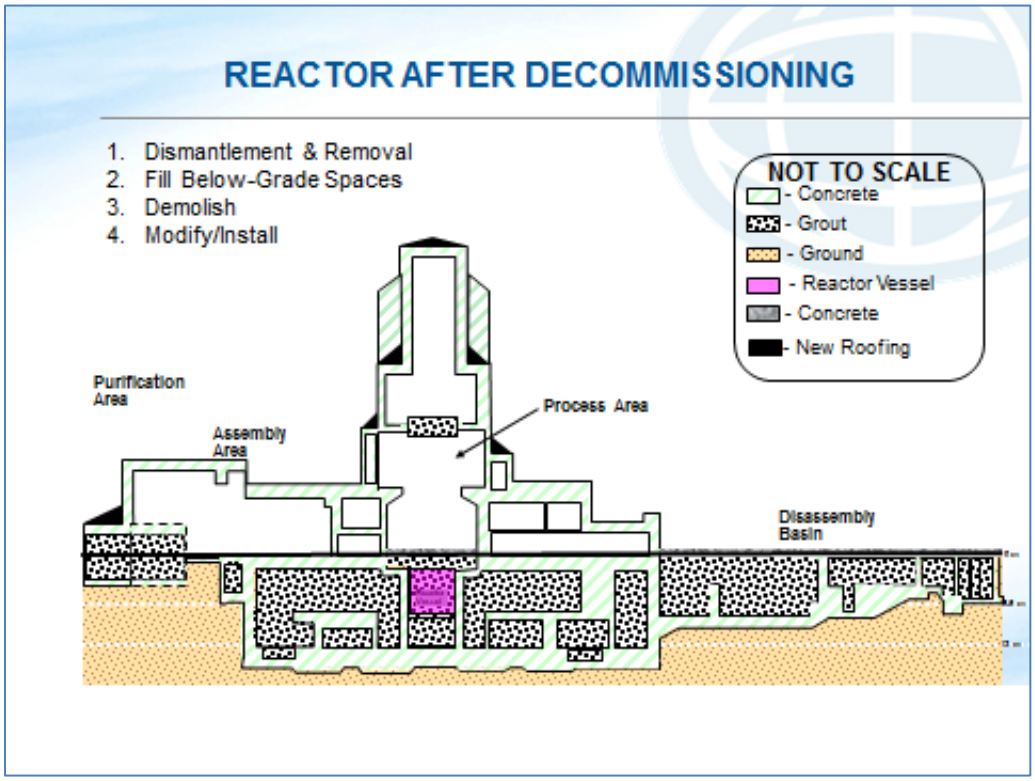


Figure 12. Cross section through SRS 105-P Reactor Building.

Use of Earthen Benches and other Technologies to Support River Structures' Demolition Activities at the Hanford Site

Washington Closure Hanford, as part of the River Corridor Cleanup Project, was contracted to demolish three structures which were located directly in the Columbia River (Figure 13). The project's original work scope included pre-demolition removal of contaminated equipment,

followed by demolition of the structures. However, the final work scope included extensive agency, tribal, and regulator consultation, removal of contaminated equipment, manufacture and replacement of concrete panel sluice gates to isolate the intake structures, removal of contaminated sediment, use of acoustic deterrence to protect fish near the structures, monitoring fish activity and sediment turbidity, installation of earthen benches in front of the river structures to isolate them from the river, placement of clean sand in the structures to control pH during demolition, conventional demolition methods to remove the structures themselves, followed by the restructuring of the shoreline to restore a shallow-water habitat.

The design process for the river structure project went through extensive contractual, regulatory, tribal, and public evaluations. The proximity of the work to the Columbia River made environmental management an integral component in the planning and design process. Developing and maintaining a good working relationship with environmental and regulatory agencies is essential on any project, but especially those located on bodies of water or in culturally sensitive areas.

Figure 13. The Hanford Site River Structures.

Hanford Site 327 Facility Source Term Stabilization and/or Removal Prior to Demolition

The Hanford Site 327 hot cells were designed to provide shielded, ventilated protection for the examination of irradiated fuels and concentrated fission products and played a key role in reactor material and fuel research programs. Consequently, the amount of radioactive material inside the cells and throughout the attached ventilation ducts and waste piping made conventional demolition activities too risky to the employees, the environment, and the public. The final packaged cell shipment weights ranged from 75 to 230 tons. These massive structures required a safe method to lift and transport to the Environmental Restoration Disposal Facility (ERDF). WCH decided on a gantry system to remove 10 of the 11 cells from the building before demolition.

Several facility modifications had to be completed in order to install the temporary gantry system. These modifications included removal of several hundred feet of highly-contaminated ventilation ductwork and piping from the facility basement to allow for the installation of twenty shoring stands each with a 120-ton capacity. These stands were strategically located in the basement under the gantry joint locations to add additional support to the facility's main

level concrete floor.

A large portion of the east wall was removed to permit movement of the hot cells out of the facility. A temporary plastic curtain and temporary HEPA filtered ventilation system were installed to help prevent any contamination spread from inside the building to the environment during final hot cell removal preparations. 300 ft. of gantry rail was installed inside the facility using the facility's overhead crane. An external mobile crane was used to install 400 ft. of gantry rail outside of the building. Four 400-ton capacity hydraulic gantry legs with two 25 ft. header beams were installed onto the rail system. Jacking haunches were fabricated and attached to the cells to lift and rotate the cells for movement out of the facility.

Once outside of the facility, metal boxes were built around each hot cell to prepare them for shipment. The internal voids of some cells and boxes were filled with grout prior to shipment to meet ERDF waste acceptance criteria. Finally, a 12-axle, 96-tire Goldhofer trailer was used to transport the cells to ERDF where a second gantry system was erected to offload the cells. Once offloaded, additional grouting was performed in preparation for final in-place disposal (Figure 14).

Figure 14. The Hanford Site 327 Building during hot cell removal activities and in 2012.

<u>Use of a Remote Tapping Tool at INL to Minimize Worker Exposure and Avoid Future Contamination Accidents</u>

Decontamination and decommissioning (D&D) of facilities at U.S. Department of Energy (DOE) sites often require the draining of piping systems in high radiation areas. In these situations, long-reach or remote tapping tools can be an effective means of keeping radiation exposures or doses as low as reasonably achievable (ALARA). Working with S.A. Technology of Loveland, Colorado, CH2M-WG Idaho, LLC (CWI) personnel developed a long-reach remote tapping tool for attaching a tap-and-drain assembly to a piping system in high radiation areas.

This best practice describes the development and then use of the remote tapping tool at Idaho National Laboratory to address the need for safely tapping piping systems in high radiation areas by increasing the distance from radiation areas and reducing the dose rate to the deactivation and decommissioning worker, improving worker safety and potentially reducing personal protection equipment requirements (Figure 15).

Figure 15. Trench exposing underground piping system(left) and piping system containing contaminated liquids (right).

Workshops, Conferences, and Outreach

Under this subtask, FIU-ARC provided support to the DOE EM-13 D&D program by participating in D&D workshops, conferences and serving as subject matter experts. During FIU Year 4, FIU participated in the Waste Management 2014 Conference held in Phoenix, AZ (March 2-6, 2014) and made preparations to present a technical paper to the American Nuclear Society (ANS) Decommissioning and Remote Systems (D&RS) conference to be held in Reno, NV (June 15 – June 19, 2014).

FIU staff and DOE Fellows participated in the Waste Management 2014 Symposia. Under Task 2 of Project 4, DOE Fellow Mariana Evora presented a student poster on her research work during conference Session 31, Student Poster Competition: The Next Generation – Industry Leaders of Tomorrow (Figure 16). Her research presented was on the literature review performed to gather and evaluate decontamination products available in the market to reduce residual radiological materials from a contaminated facility as well as on a decision model being developed to better guide end users in the selection of these products depending on their specific needs (surface type, decontamination factors and isotopes).

Investigation of Permanent and Removable Coatings for Decontamination of Savannah River Site (SRS) Plutonium Fuel Form Facility

Presenter: DOE Fellow Mariana Evora

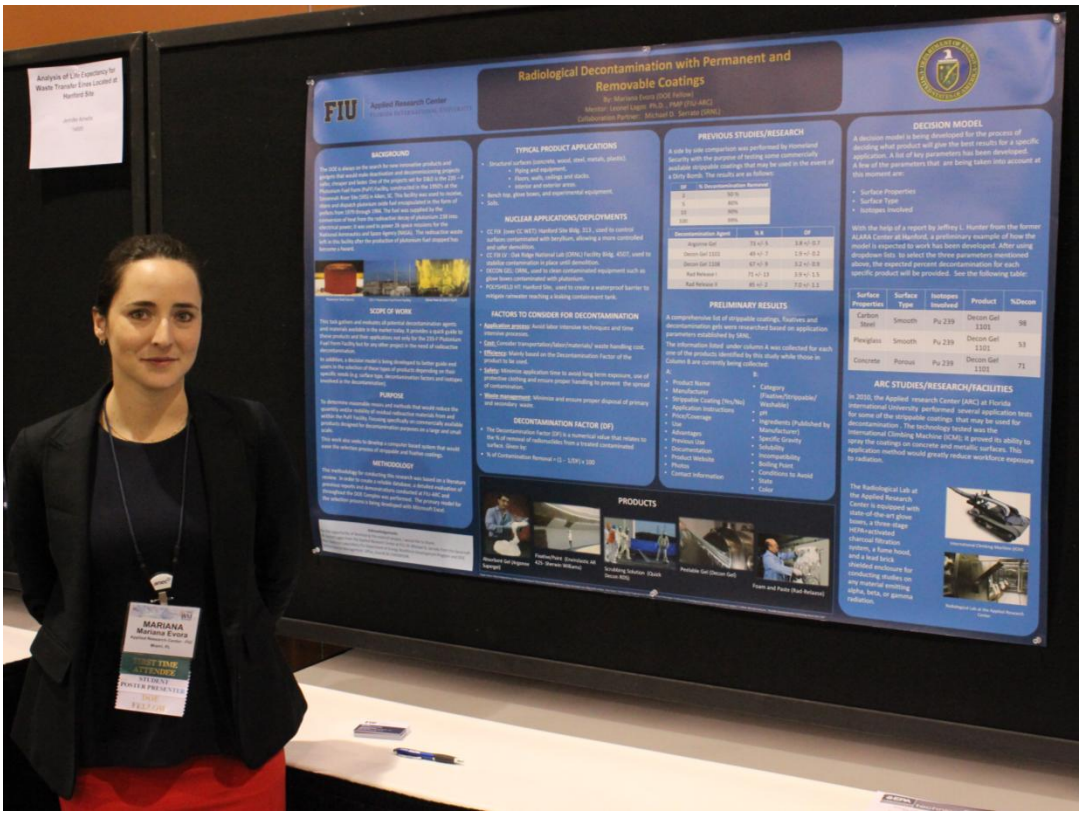


Figure 16. DOE Fellow Mariana Evora presenting her research on the fixatives task at WM14.

FIU submitted a technical paper to the ANS D&RS on the previous research conducted in collaboration with International Climbing Machine for the remote D&D capabilities of the ICM remote platform.

Remote Platform for the Performance of Deactivation and Decommissioning Tasks

Authors: Leonel Lagos, Peggy Shoffner (FIU), Sam Maggio (ICM)
Presenter: Peggy Shoffner

FIU staff also will have the opportunity to co-chair a session on International Decommissioning at the D&RS conference.

TASK 2: CONCLUSIONS

Planning for the D&D of facilities across the DOE complex is a tremendous undertaking, especially considering that a significant number of the facilities contain hazards to human health and the environment: seriously deteriorated structural integrity, very high dose rates, high levels of fixed and removable contamination on/in facility surfaces and equipment, and chemically hazardous materials. Providing support for technology innovation, development, evaluation, and deployment is critical to the safe and efficient completion of facility D&D.

TASK 2: REFERENCES

Florida International University, *Focused Literature Review-Decontamination Agents/Materials for Radiological Surface Decontamination,* Final Report, September 27, 2013.

Florida International University, *Aging Infrastructure at DOE Sites,* Technical Report, May 2, 2014.

TASK 3.
D&D KNOWLEDGE MANAGEMENT INFORMATION TOOL

TASK 3: EXECUTIVE SUMMARY

For Task 3, FIU has developed a D&D Knowledge Management Information Tool (D&D KM-IT) to maintain and preserve the D&D knowledge base and to provide a focused web-based tool to assist the DOE D&D community in identifying potential solutions to their problem areas by using the vast resources and knowledge-base tools available through the web. During FIU Year 4, FIU performed several subtasks, including, community outreach and training, application development, system/database/network administration, and data mining.

TASK 3: INTRODUCTION

Planning for the D&D of facilities across the DOE complex is a tremendous undertaking. Capturing the knowledge, experience, and lessons learned from historic D&D activities at DOE sites is imperative to the successful and safe management of future D&D projects. The D&D Knowledge Management and Information Tool is a central initiative to accomplish these goals.

The D&D KM-IT is a web-based system developed to maintain and preserve the D&D knowledge base. The system was developed by FIU-ARC with the support of the D&D community, including DOE-EM (EM-13 & EM-72), the former ALARA centers at Hanford and Savannah River, and with the active collaboration and support of the DOE's Energy Facility Contractors Group (EFCOG). The D&D KM-IT is a D&D community driven system tailored to serve the technical issues faced by the D&D workforce across the DOE Complex. D&D KM-IT can be accessed from web address http://www.dndkm.org.

TASK 3: EXPERIMENTAL

The D&D KM-IT is a web-based knowledge management information tool custom built for the D&D user community by FIU. The objective of the D&D KM-IT is to provide a focused web-based tool to assist the DOE D&D community in identifying potential solutions to their problem areas by using the vast resources and knowledge-base tools available through the web. One such knowledge-base tool includes solutions provided by subject matter specialists who respond to specific questions. The D&D KM-IT archives, in a retrievable module within the system, information collected from the subject matter specialists, thereby building a knowledge repository for future reference. The primary subtasks for FIU Year 4 included community outreach and training, application development, system/database/network administration, and data mining.

TASK 3: RESULTS AND DISCUSSION

Outreach and Training

Significant effort was made towards community outreach in support of the D&D KM-IT system during FIU Year 4. FIU participated in meetings and conferences, hosted a conference exhibitor booth, held two workshops, hosted a videoconference with EM-72 and EM-13, contributed D&D

information to Wikipedia, and disseminated newsletters on D&D KM-IT to registered users, subject matter specialists, and conference attendees.

Conferences

FIU participated in relevant meetings and conferences in support of this project, including the Waste Management Symposium 2014 from March 2 to March 6, 2014, in Phoenix, AZ. FIU completed a draft technical paper on D&D KM-IT and submitted it to the Waste Management Symposium 2014 on November 7, 2013. The paper was accepted for an oral presentation during the conference.

FIU presented D&D KM-IT during an oral presentation entitled, *Knowledge Management Information Tool - 2014*, for Session 11 of the Waste Management Symposium 2014 on March 3, 2014 (Figure 17). This presentation discussed the objectives of knowledge management and demonstrated the modules of the D&D KM-IT. Attendees were encouraged to sign up as a registered user and subject matter specialist in D&D KM-IT.

Knowledge Management Information Tool - 2014

Authors: Himanshu Upadhyay, Leonel Lagos, Walter Quintero, Peggy Shoffner (FIU), John De Gregory (DOE)
Presenter: Himanshu Upadhyay

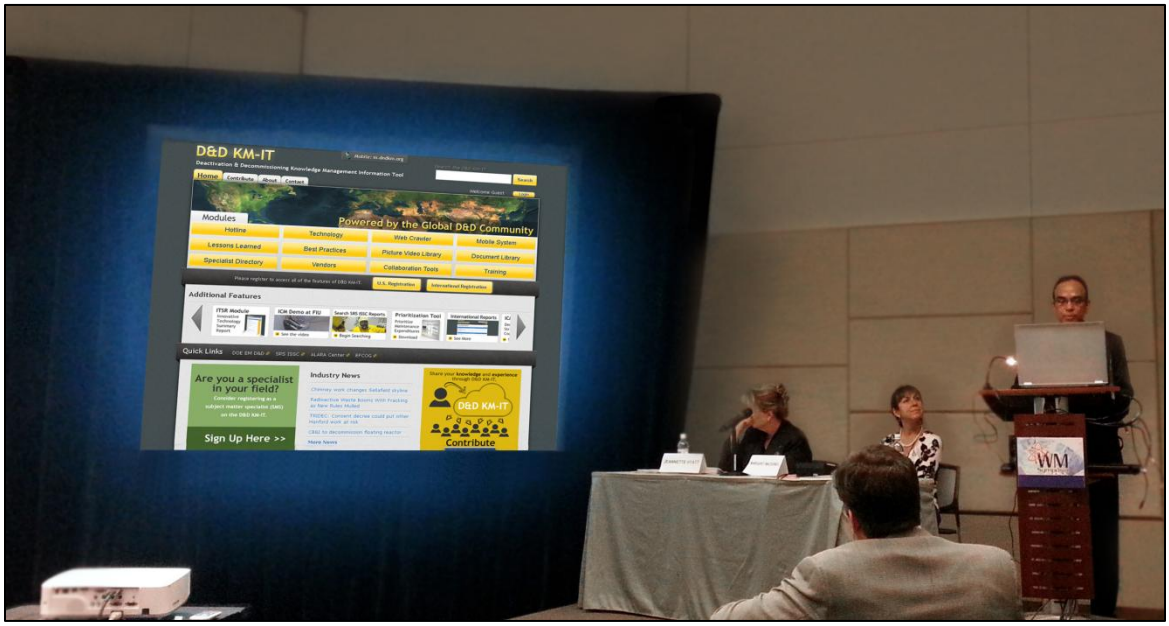


Figure 17. Himanshu Upadhyay presenting D&D KM-IT at Waste Management 2014.

Also during the Waste Management Conference, DOE Fellow Revathy Venkataraman presented her research related to this project task as a student poster during Session 31, Student Poster Competition: The Next Generation – Industry Leaders of Tomorrow (Figure 18). Revathy's presentation was on a the mobile module of D&D KM-IT (m.dndkm.org) which she used as a case study to research and identify the best technology, platform and development process for

mobile applications which can be implemented in the different modules of the D&D KM-IT mobile system.

Performance Evaluation of Mobile Applications with Deactivation & Decommissioning (D&D) Technology Services

Presenter: DOE Fellow Revathy Venkataraman

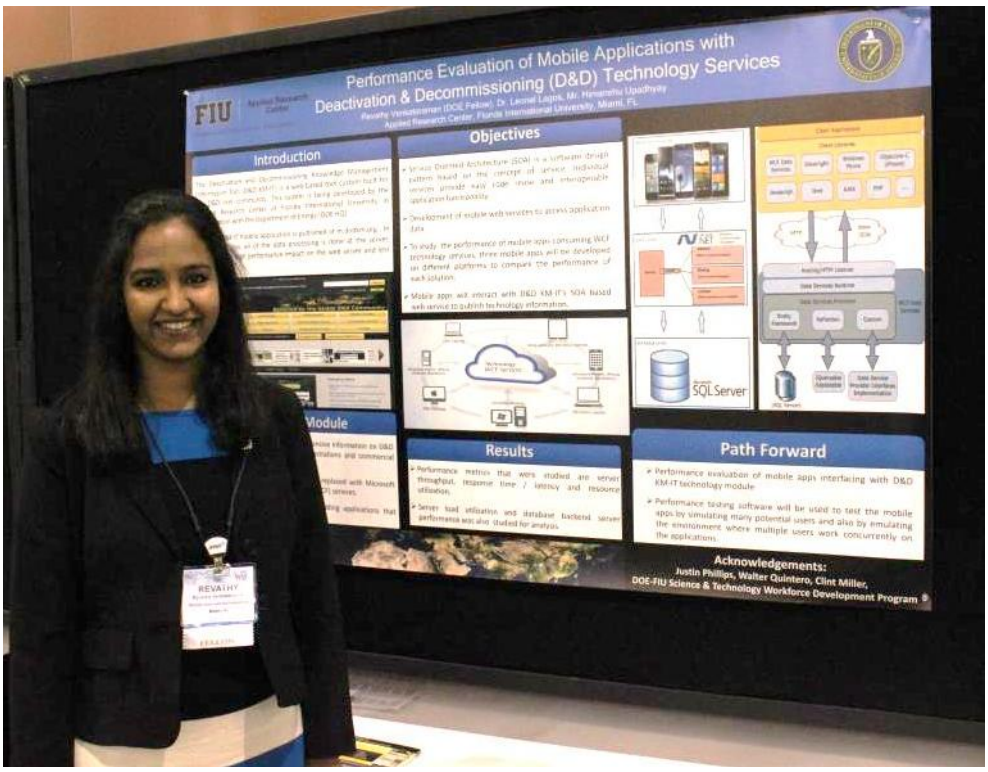


Figure 18. Revathy Venkataraman (DOE Fellow) presenting her research at WM14.

During the workshops and oral presentation of D&D KM-IT, FIU encouraged conference attendees to become active users of the system. Significant interest was shown in the knowledge management of D&D as reflected by the increase in user registrations (87) during the conference, increasing the total number of registered users from 535 to 622. Figure 19 shows ARC staff and a DOE Fellow working the FIU ARC booth at WM14 where conference attendees could get a personalized demonstration of the D&D KM-IT system and register as a new user.

Figure 19. ARC staff with a DOE Fellow at the FIU ARC booth during WM14.

Workshops

FIU conducted two workshops on the D&D KM-IT at the WM14 conference. FIU hosted one workshop at the vendor booth for conference attendees on March 3 and one workshop during the EFCOG DD/FE Working Group meeting on March 4. This second workshop focused on bringing the working group members up to speed on the system and encouraging active participation as registered users and subject matter specialists (SMS) as well as populating the system with their knowledge and experiences. Figure 20 shows the developed agenda for the workshops.

Figure 20. Agenda for D&D KM-IT Workshop.

Newsletters

Also as part of the outreach effort, FIU created targeted newsletters to send electronically to D&D KM-IT registered uses, subject matter specialists, EFCOG D&D Working Group members, and Waste Management Conference attendees. These newsletters informed the recipients of current and newly added features of D&D KM-IT and provided quick links to the system website so that they could immediately try out the enhancements.

On September 13, 2013, FIU sent out a D&D KM-IT newsletter to all registered users of the system (Figure 21). The newsletter announced the availability of the newsletters/reports from the former Hanford and SRS ALARA Centers. Closure of the Hanford ALARA Center and SRS ISSC threatened the accessibility of the knowledge gained during the Centers' operation. By capturing the information updates and activity reports from the Hanford ALARA Center and SRS ISSC before they closed, the D&D KM-IT preserves this valuable knowledge, makes it easily searchable for specific information, and disseminates the data as needed to the D&D community.

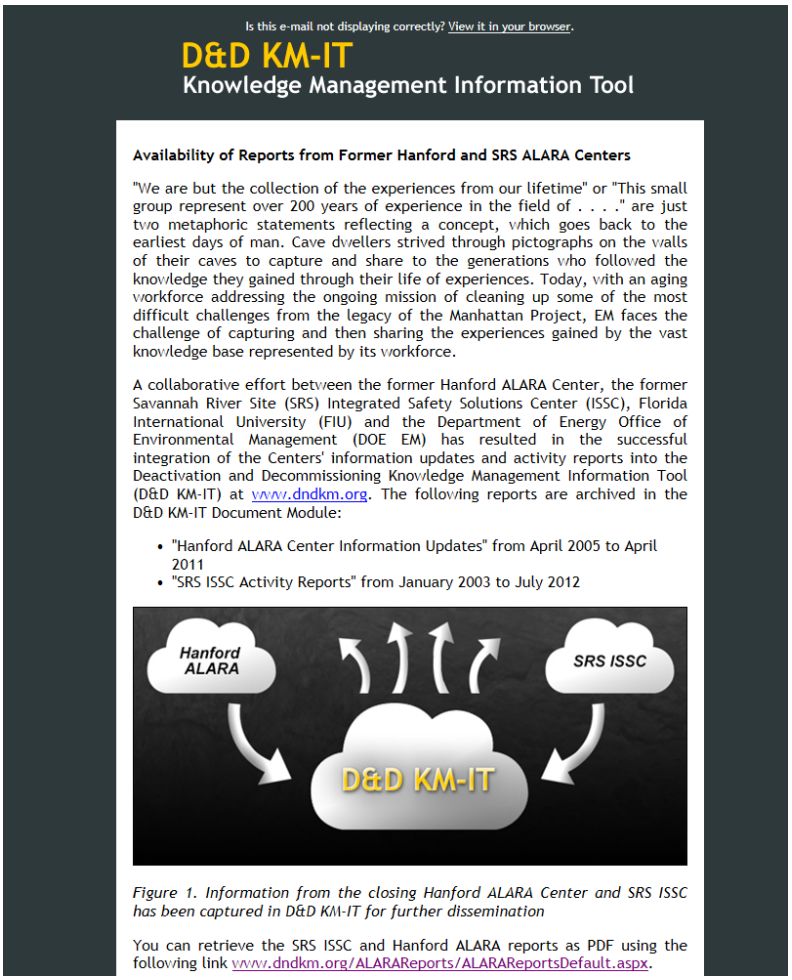


Figure 21. Newsletter for D&D KM-IT announcing availability of the newsletters from the former ALARA Centers at Hanford and SRS.

FIU developed two additional D&D KM-IT newsletters and sent them to DOE for review on September 18, 2013. The first one was on their participation in the American Nuclear Society (ANS) Utility Working Conference and Vendor Technology Expo and focused on the addition of new subject matter specialists (SMS) from the conference to the D&D KM-IT SMS module (Figure 22). The second newsletter highlighted the recent changes to the D&D KM-IT website look and functionality. FIU revised these two newsletters based on comments received from the DOE review.

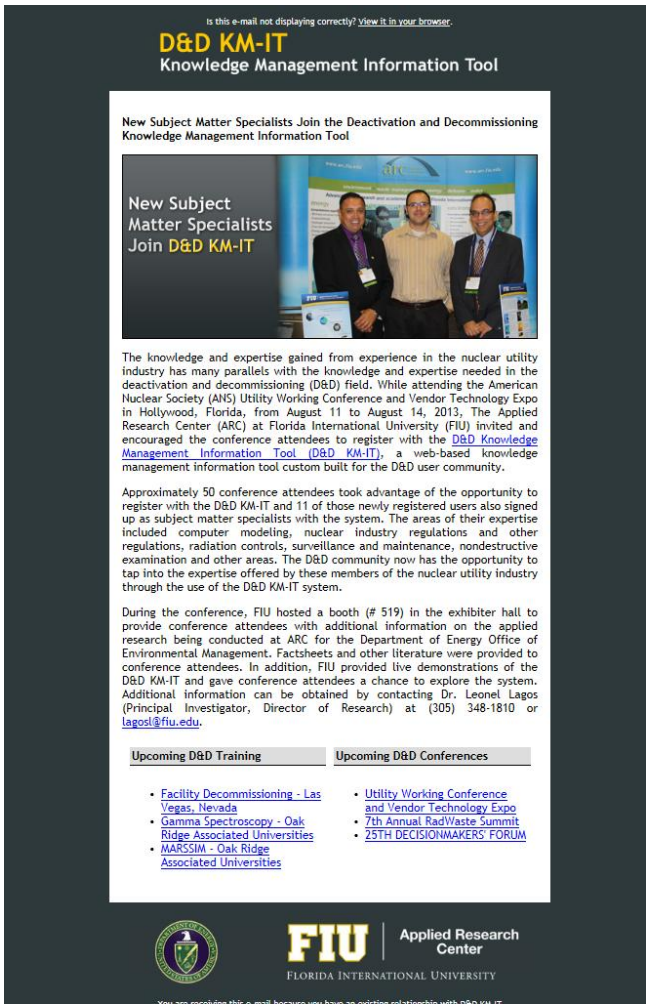


Figure 22. Newsletter for D&D KM-IT marketing at the ANS conference.

On November 4, 2013, FIU sent out a D&D KM-IT newsletter to all registered users of the system (Figure 23). The newsletter announced the two new D&D best practices that have been added to the D&D Knowledge Management Information Tool (www.dndkm.org) and the EFCOG website (www.efcog.org):

1. Structural Code Guidance for Decontamination and Decommissioning Activities at DOE Facilities
2. Electrical Code Guidance for Decontamination and Decommissioning Activities at DOE Facilities

The guidance in these documents has been implemented at the Idaho National Laboratory over the past 6 years and has yielded hundreds of thousands of dollars in cost savings and reduced the installation of the infrastructure and temporary power by months. There have been no adverse safety effects as a result of following this guidance. In fact, the hazards to the worker have been reduced because of reduced excavation and cement work by running conduit above ground and/or on "jersey bounce" barriers.

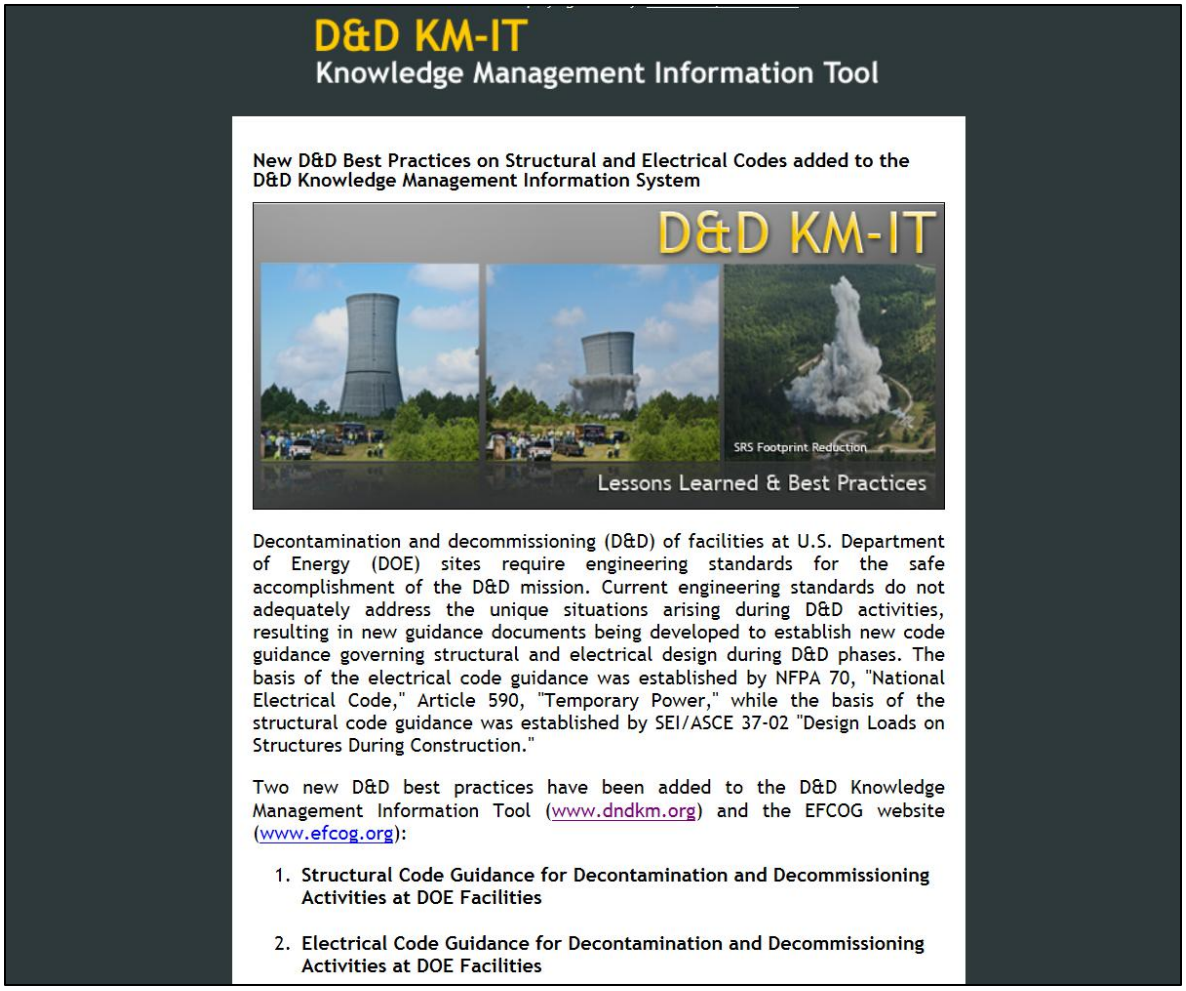


Figure 23. Newsletter from D&D KM-IT announcing new best practices.

Prior to WM14, FIU developed a newsletter and sent it out to the list of conference attendees to announce FIU's participation in the Waste Management 2014 Conference and the times and places they can view and participate in information for the D&D KM-IT system, including the FIU vendor booth, D&D KM-IT workshops, and an oral presentation (Figure 24).

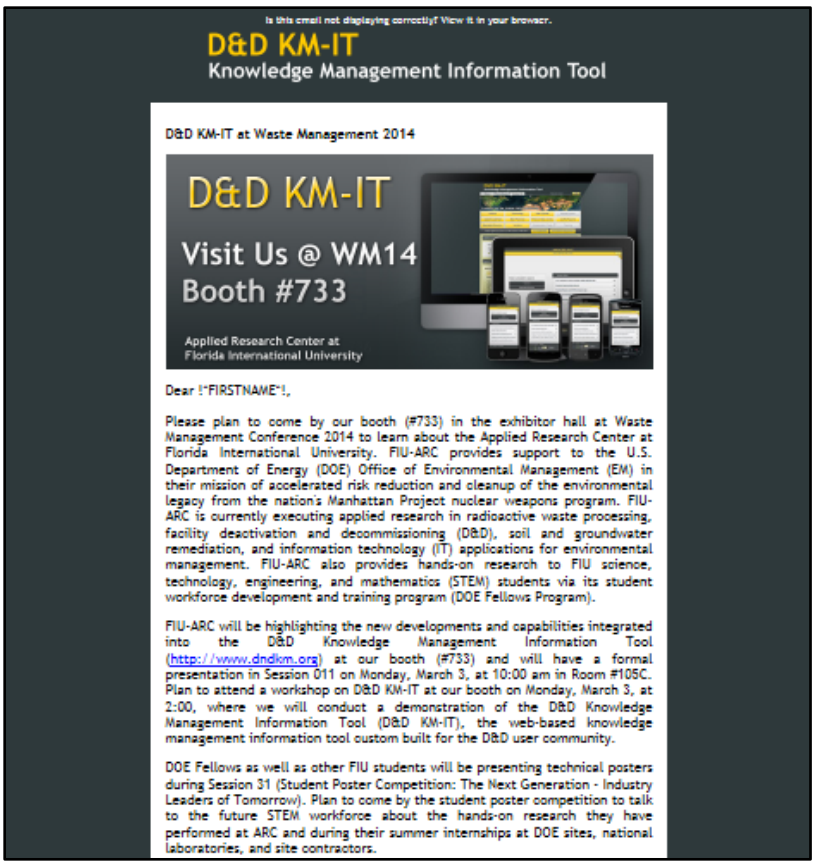


Figure 24. Newsletter on D&D KM-IT at Waste Management 2014.

After the conference, FIU developed a brief "Thank you" notice and sent it out to the new users who registered on D&D KM-IT during the Waste Management 2014 conference (Figure 25) to thank them for their interest and encourage them to continue using and contributing to the system.

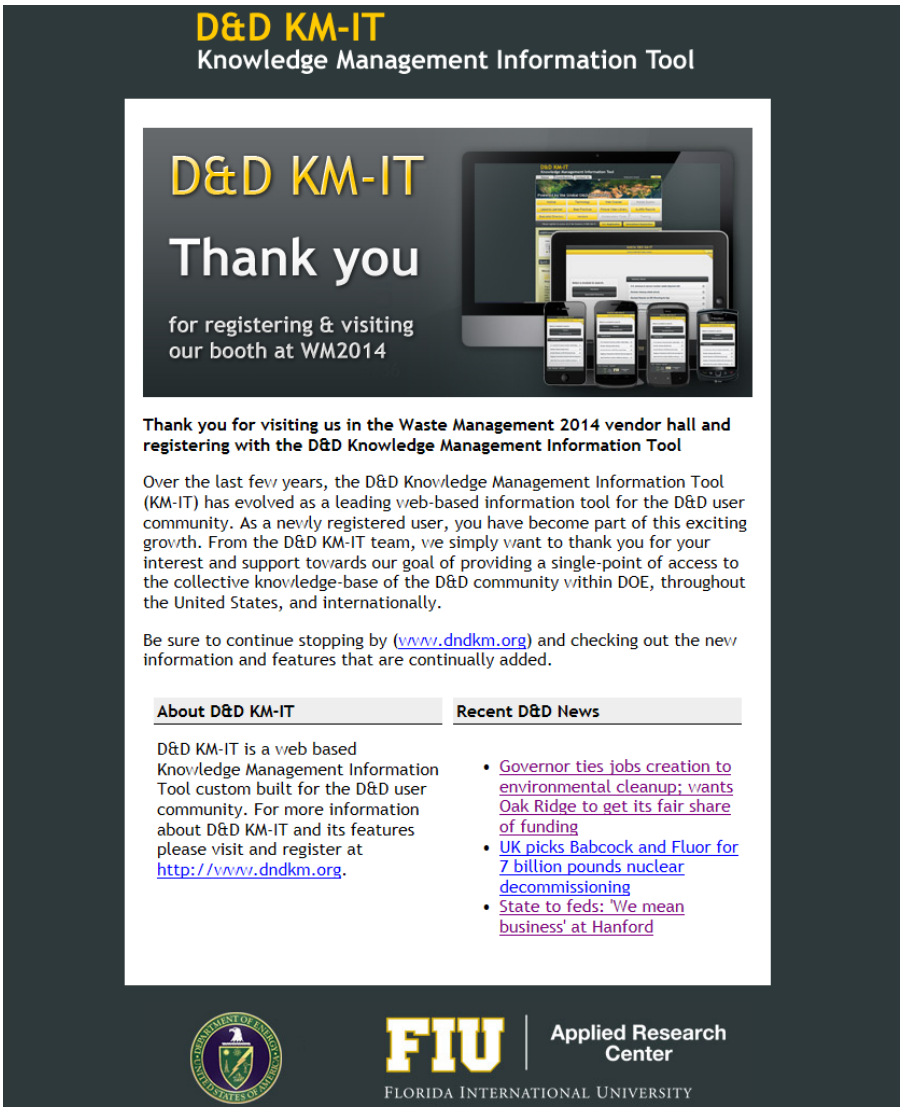


Figure 25. Thank you notice to new D&D KM-IT users.

Help Videos

FIU finished the development of the help videos for D&D KM-IT and provided the links to DOE on January 31, 2014, completing project milestone 2013-P4-M3.2. Figure 26 shows the videos available on the Best Practices Help Page. There are 11 new help videos, including:

- 2 Best Practice Videos - Search and Upload
- 1 D&D Dictionary Video
- 3 Technology Videos - Search, Advance Search, Advance Search Part 2
- 1 Lesson Learned Video - Upload
- 1 Picture/Video Library Video - Upload
- 1 Mobile Video – Overview of Mobile Feature
- 1 Web Crawler Video - Introduction
- 1 Collaboration Tools Video – Introduction

This brings the total number of help videos on D&D KM-IT to 26, including:

- 3 Hotline Videos
- 4 Technology Videos
- 3 Lessons Learned Videos
- 3 Best Practices Videos
- 3 Picture & Video Library
- 2 Specialist Directory Videos
- 2 Vendor Videos
- 3 Training Videos
- 1 Mobile Videos
- 1 Web Crawler Videos
- 1 Collaboration Tools Videos

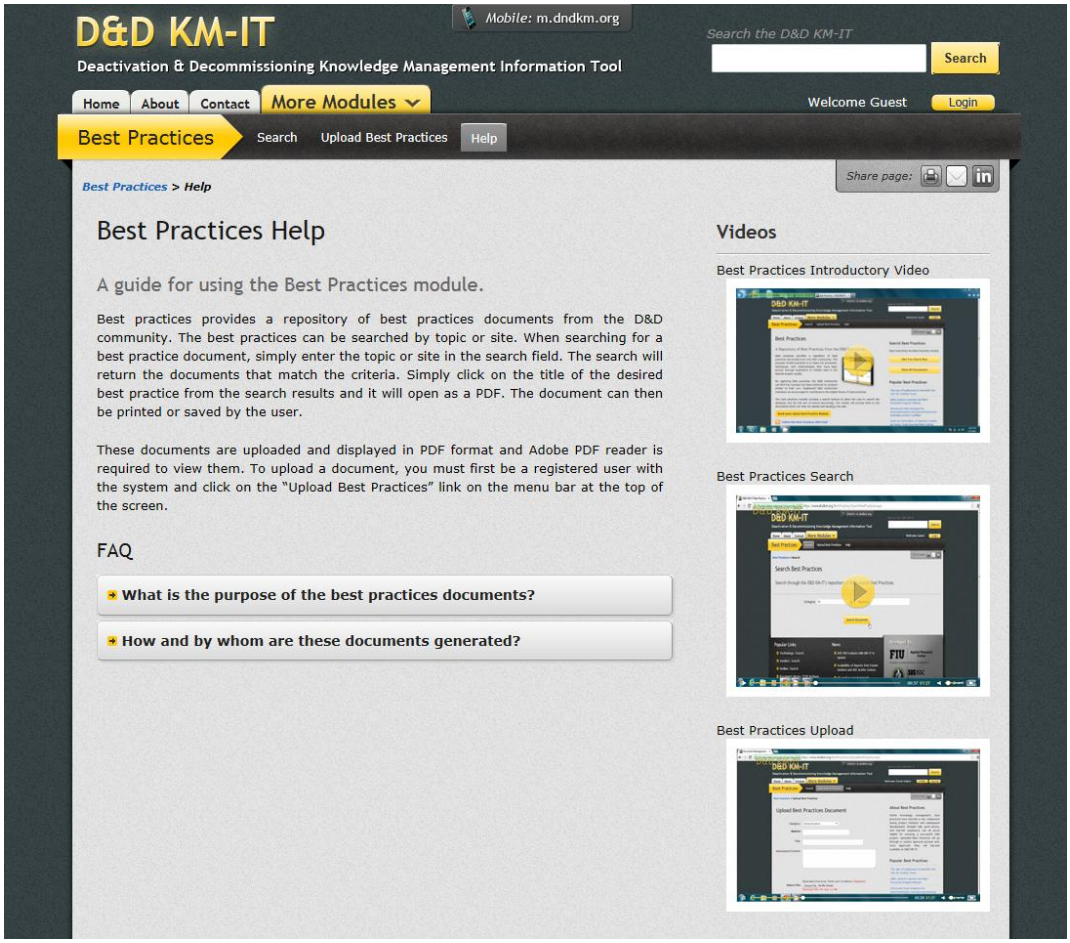


Figure 26. Help Videos for the Best Practices Module at D&D KM-IT.

Wikipedia

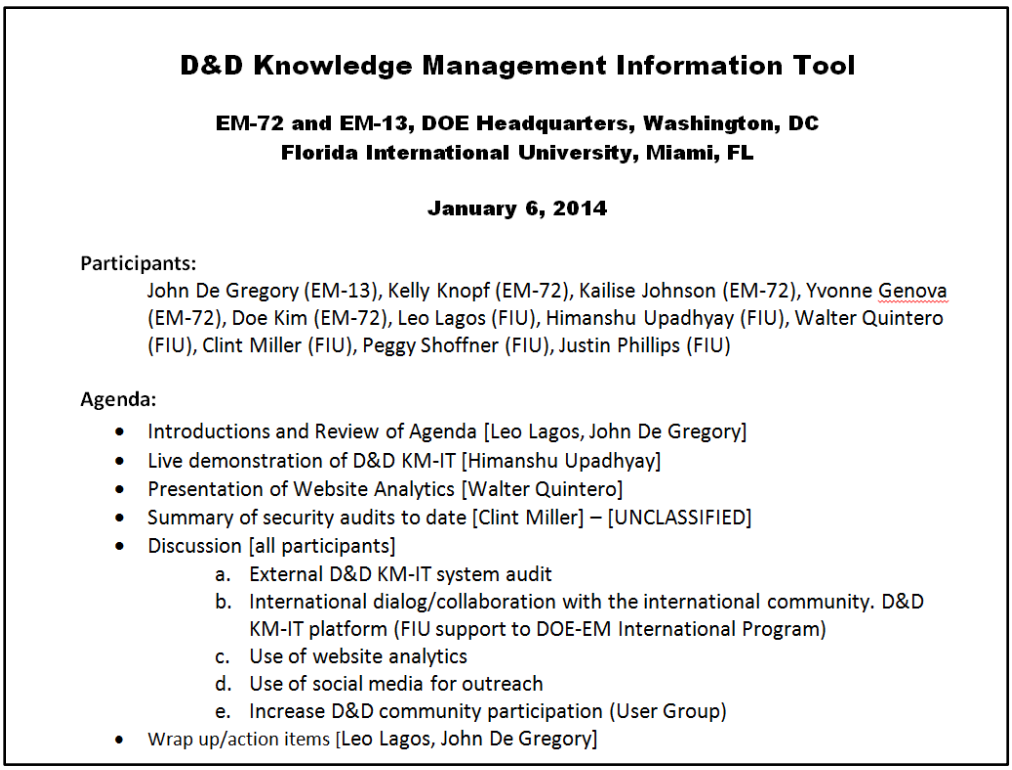
D&D knowledge management through contributions in Wikipedia was a part of the outreach and training (D&D community support) subtask. FIU completed the related milestone, 2013-P4-M3.6, and sent a draft summary report to DOE on May 9, 2014. The general D&D knowledge which has been gained through this project offers an opportunity to expand access to a broad

audience via Wikipedia, which has a significant presence on the web, thereby offering greater opportunities for collaboration on D&D knowledge. ARC researched and targeted D&D information on Wikipedia where D&D KM-IT could provide additional relevant information while citing the source of the original information on D&D KM-IT. The information sources focused on for this initial effort were the EFCOG lessons learned and best practices that have been developed in collaboration between FIU and EFCOG and published on D&D KM-IT.

During the completion of this task, four Wikipedia articles were edited with information from an EFCOG best practice or lessons learned document. For each of these articles, relevant and significant text was added to the body of the article and a reference to the information source (EFCOG lesson learned or best practice on D&D KM-IT) was included in the article's list of references. The edited Wikipedia articles included: 1) Area 25 (Nevada National Security Site) with information from the lesson learned titled, "Accelerated Demolition of the Reactor Maintenance Assembly, and Disassembly Facility and the Pluto Disassembly Facility;" 2) Building Implosion with information from the following two best practices: "The Use of Explosives to Demolish the 185-3K Cooling Tower at SRS" and "Explosive Demolition of Buildings 337, 337B and 309 Stack at the Hanford's 300 Area;" 3) National Electrical Code with information from the best practice titled, "Electrical Code Guidance for Decontamination and Decommissioning Activities at DOE Facilities;" and 4) Heavy Water Components Test Reactor with information from the lesson learned titled "Unanticipated High Dose during the Removal of Wire Flux Monitor Cabling form the HWCTR Reactor Vessel."

Videoconference with EM-72 and EM-13

FIU conducted a videoconference with EM-13 and EM-72 on January 6, 2014. The list of participants and agenda discussed is included as Figure 27. In addition to a demonstration of the D&D KM-IT system, FIU presented the efforts on collecting and analyzing the website analytics as well as the cyber security of the system. The meeting discussions were very productive and FIU, along with DOE EM-13, will continue these interactions with EM-72 to solicit their input and feedback on the D&D KM-IT.



D&D Knowledge Management Information Tool

EM-72 and EM-13, DOE Headquarters, Washington, DC
Florida International University, Miami, FL

January 6, 2014

Participants:

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Agenda:

- Introductions and Review of Agenda [Leo Lagos, John De Gregory]
- Live demonstration of D&D KM-IT [Himanshu Upadhyay]
- Presentation of Website Analytics [Walter Quintero]
- Summary of security audits to date [Clint Miller] – [UNCLASSIFIED]
- Discussion [all participants]
    a. External D&D KM-IT system audit
    b. International dialog/collaboration with the international community. D&D KM-IT platform (FIU support to DOE-EM International Program)
    c. Use of website analytics
    d. Use of social media for outreach
    e. Increase D&D community participation (User Group)
- Wrap up/action items [Leo Lagos, John De Gregory]

Figure 27. FIU Meeting Agenda with EM-72 and EM-13.

Application Development

During FIU Year 4, FIU continued the development of the D&D KM-IT application and maintained the system for the D&D community at http://www.dndkm.org.

Application optimization

One type of application optimization that FIU performed in FIU Year 4 was a search engine optimization process for the D&D KM-IT web application. Search engine optimization (SEO) is the process of improving the visibility of a website or a web page in the search results provided by internet search engines (e.g., Google, Bing). In general, more users will visit sites that appear high or frequently on the search engine results page. SEO targets different kinds of searches, including image search, local search, video search, academic search, news search and industry-specific vertical search engines.

FIU has also been collecting and using web analytics to analyze the use of the D&D KM-IT website and implement website improvements.

The information gathered from the web analytics software is valuable since it provides insight on site visitor behavior and is helpful to anticipate users' interests and needs. Web analytics has allowed D&D KM-IT to respond to its users' needs by making the information they seek easier for them to access. The ultimate aim is to mature a system that will contain all the necessary information for the D&D KM-IT community and allow the users of the system to consume the information as efficiently as possible across all module and platforms.

A summary of the 2013 web analytic data is shown in Figure 28. Quarterly D&D KM-IT Performance Analysis Reports were completed and submitted to DOE on October 29, 2013; February 3, 2014; and May 7, 2014.

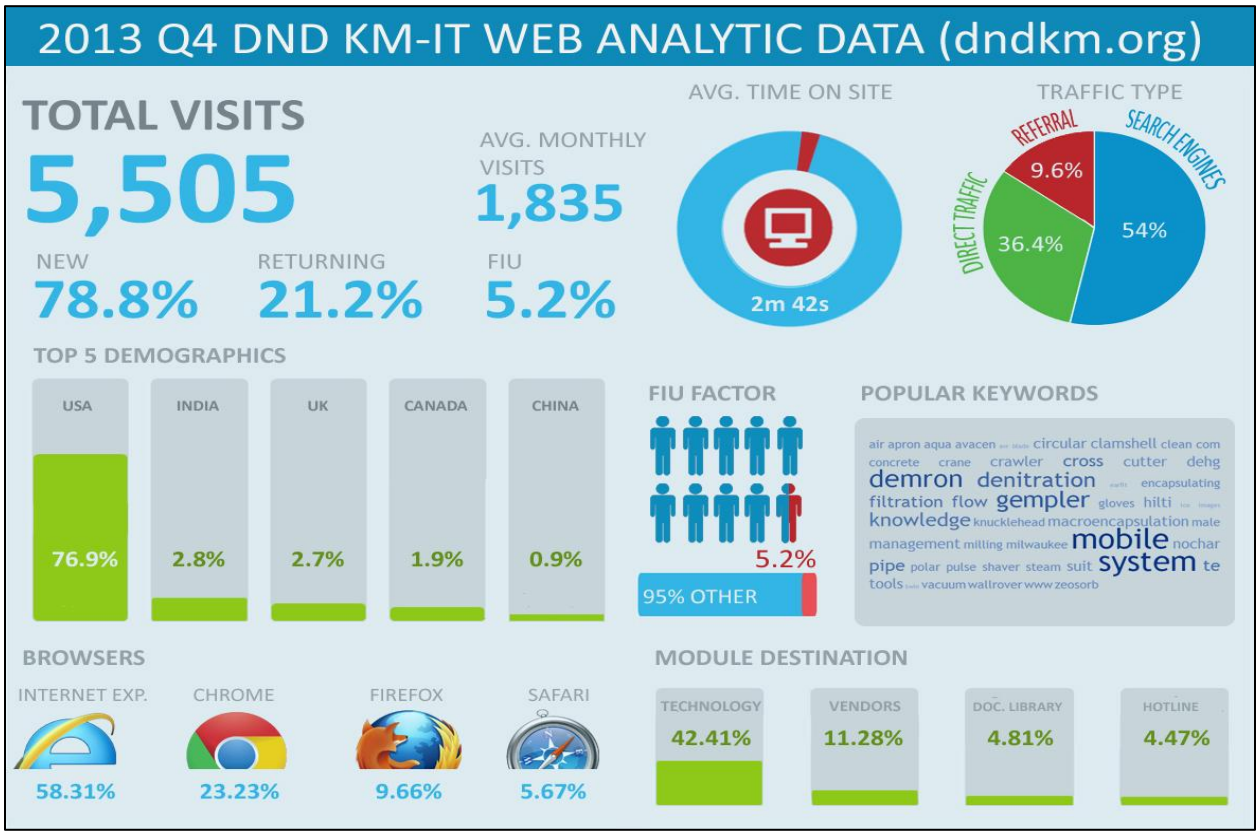

Figure 28. D&D KM-IT Web Analytic Data for 2013.

The summary report of web analytics for the 3nd quarter (July to September) was drafted and sent to DOE for review and comment on October 29, 2013. Figure 29 shows a keyword tag cloud representation of the top 40 keyword query impressions on the D&D KM-IT website for the period of July to September 2013. It provides a good visualization of the data: the tag cloud separates phrases into single words and displays the "weight" of each word according to the frequency the keyword was used. Figure 30 summarizes the web analytic data for the same time period as an Infographic.

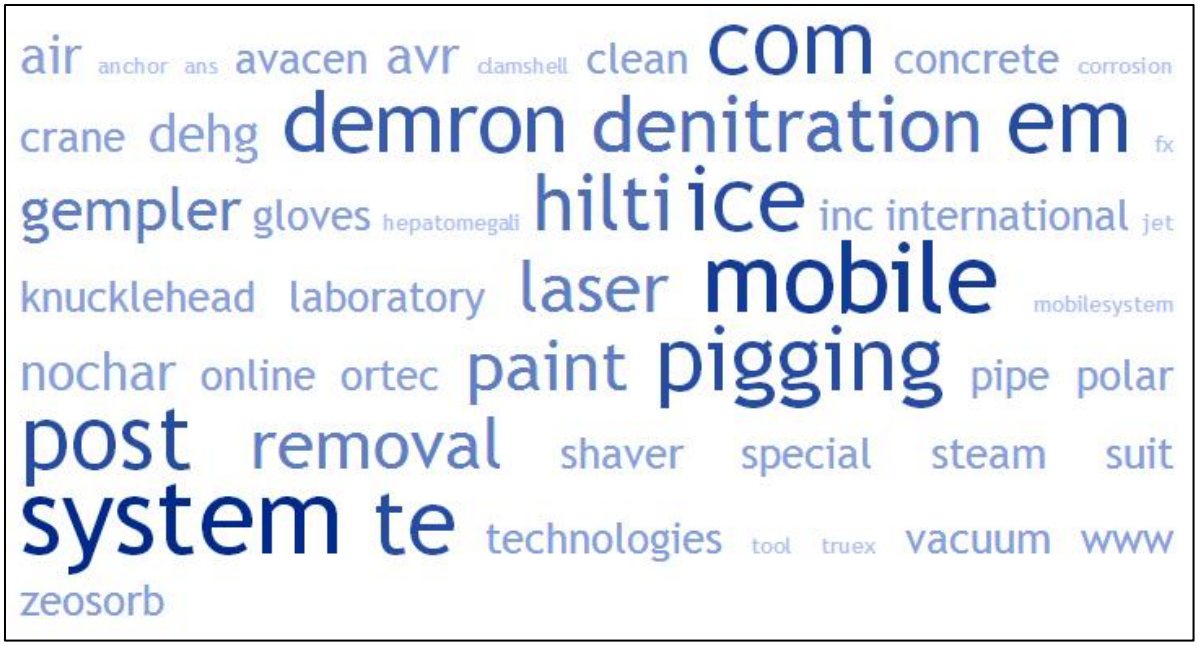

Figure 29. Keyword tag cloud representation of top 40 query impressions.

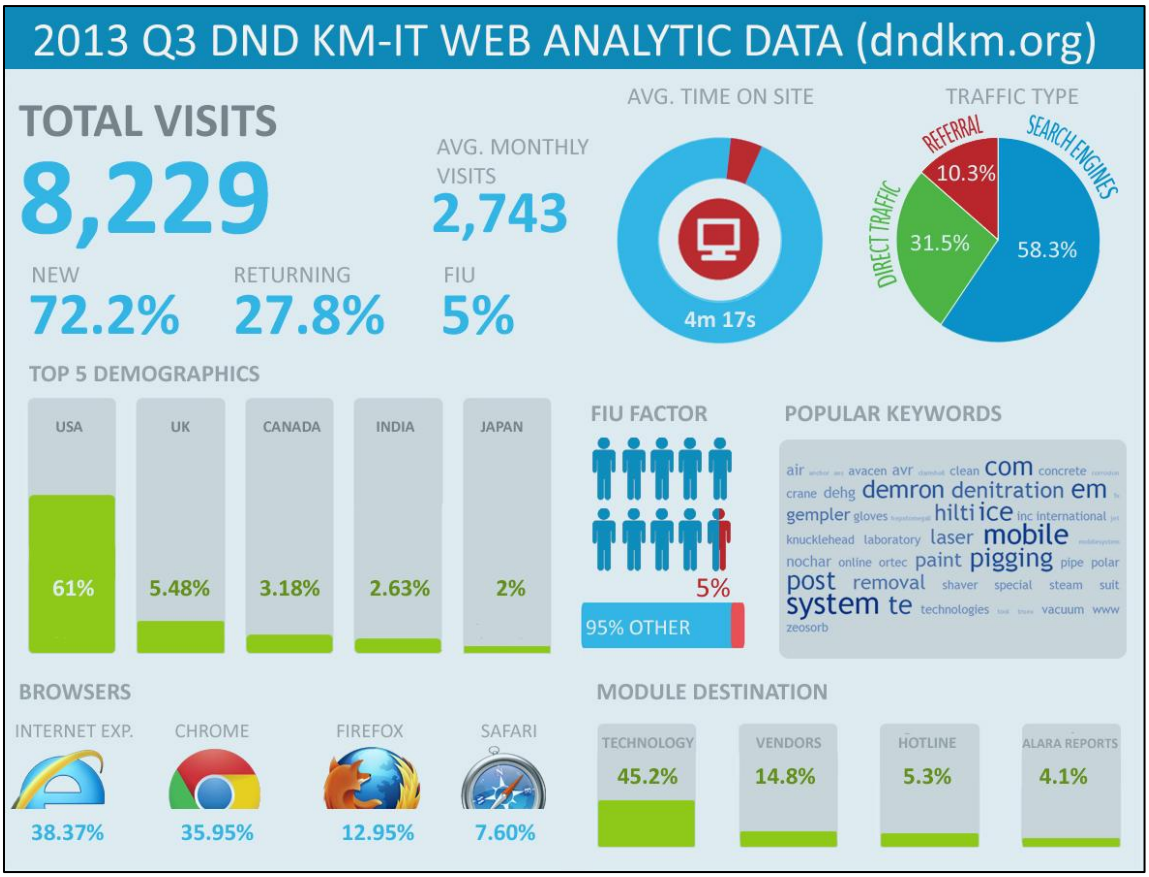

Figure 30. Infographic for 2013 Q3 Based on Web Analytic Data.

FIU completed the development of the D&D KM-IT Website Analytics Performance Report for the fourth quarter of calendar year 2013 (October to December 2013) and sent it to DOE on February 3, 2014. Figure 31 shows an infographic for this time period. This period reflected a seasonal decrease in usership of the website, similar to what was experienced during this period last year.

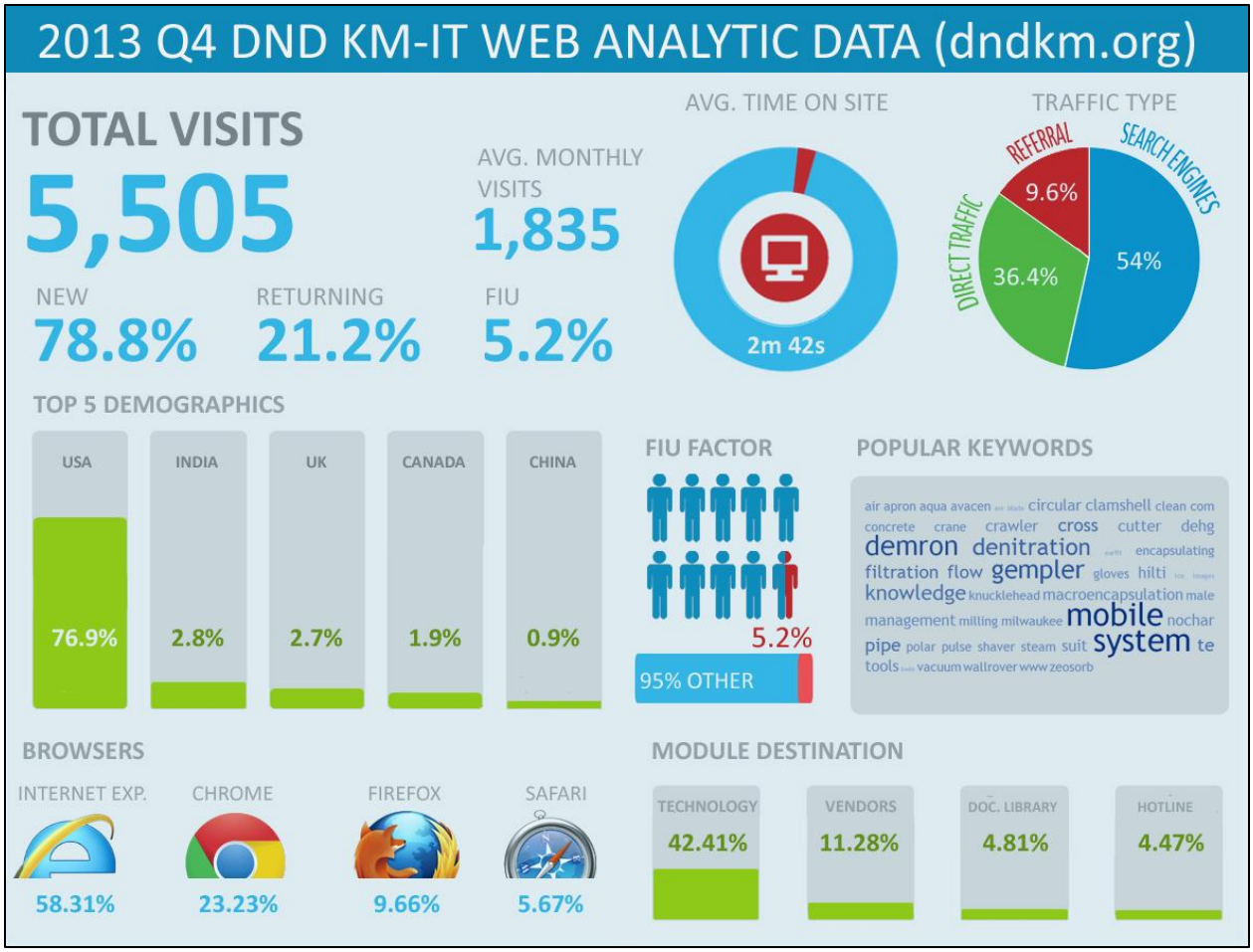

Figure 31. Infographic based on Web Analytic Data for D&D KM-IT for Oct-Dec 2013.

FIU completed the development of the D&D KM-IT Website Analytics Performance Report for the first quarter of calendar year 2014 (January to February 2014) and sent it to DOE on May 7, 2014. Figure 32 shows an infographic for this time period. An interesting observation during this period is the 14.03% drop in traffic by visitors using Internet Explorer (IE), from 58.31% last quarter to 44.07% this quarter. The browsers gaining ground are Chrome with an 8.12% increase followed by Firefox (4.54%) and Safari (1.67%). Recently, many security firms and even the banking sector have been warning their users against using the IE due to some vulnerabilities recently discovered that could allow an attacker to hijack a user's online session after the PC was infected with malware. This warning may be the reason we saw the 14.03% drop in IE visits to the D&D KM-IT.

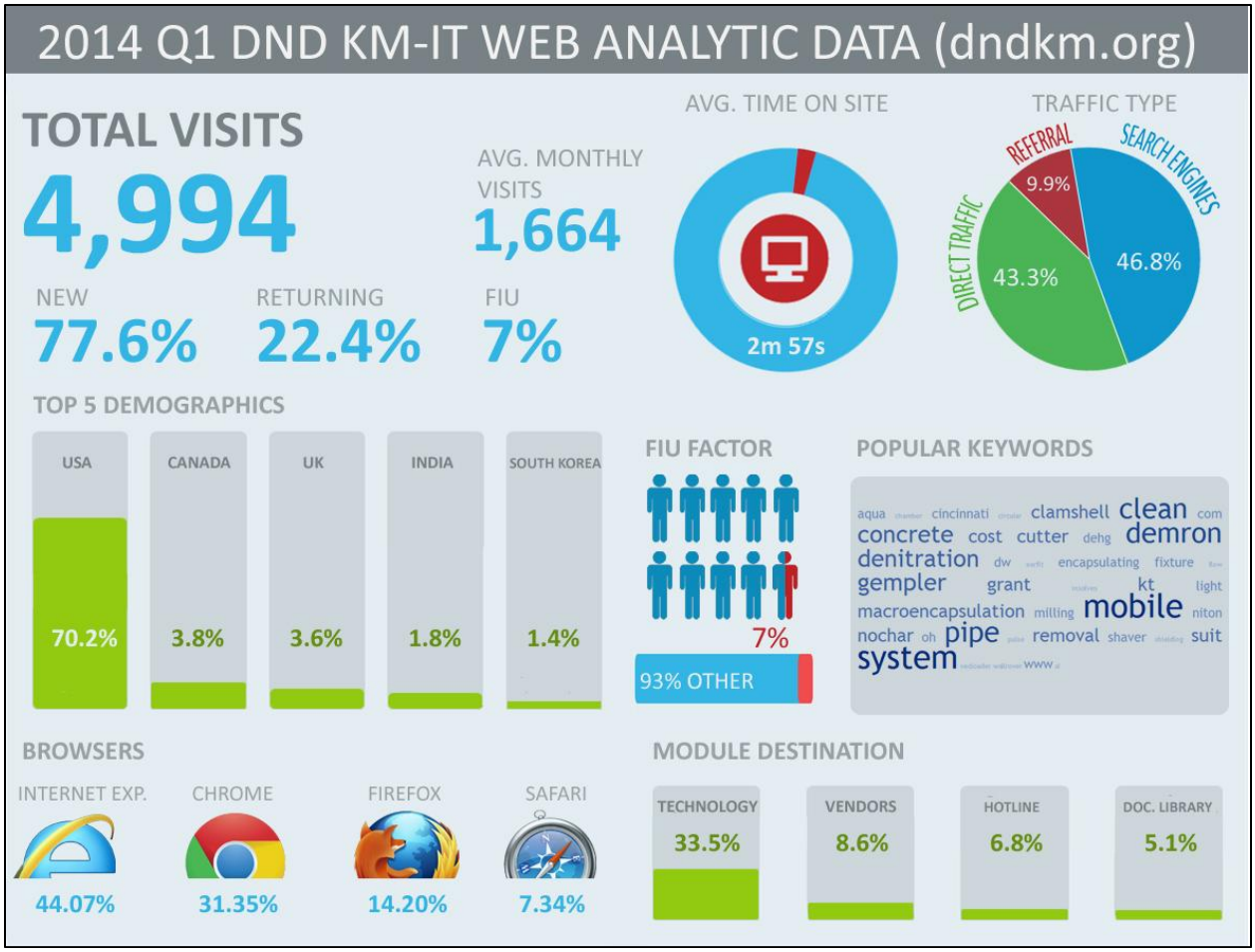

Figure 32. Infographic based on Web Analytic Data for D&D KM-IT for January-March 2014.

Community Content Contribution

FIU completed the development and deployment of the community contribution module for D&D KM-IT on March 28, 2014, completing project milestone 2013-P4-M3.4. To further community awareness to knowledge management, a community contribution module was added to the KM-IT in the hopes of fostering greater community contribution in the area of D&D. The community contribution module is linked from the home page of the KM-IT. The content displayed is short, precise and quickly readable highlights about how to begin contributing to the information contained in each module. This lists all the features of KM-IT with short descriptions and links to available help videos to inform the user on uploading or adding content to the KM-IT's various modules. This new feature will provide users with more readily accessible information on how they can participate in the knowledge management goals of the D&D KM-IT. Figure 33 shows a screenshot of the new module.

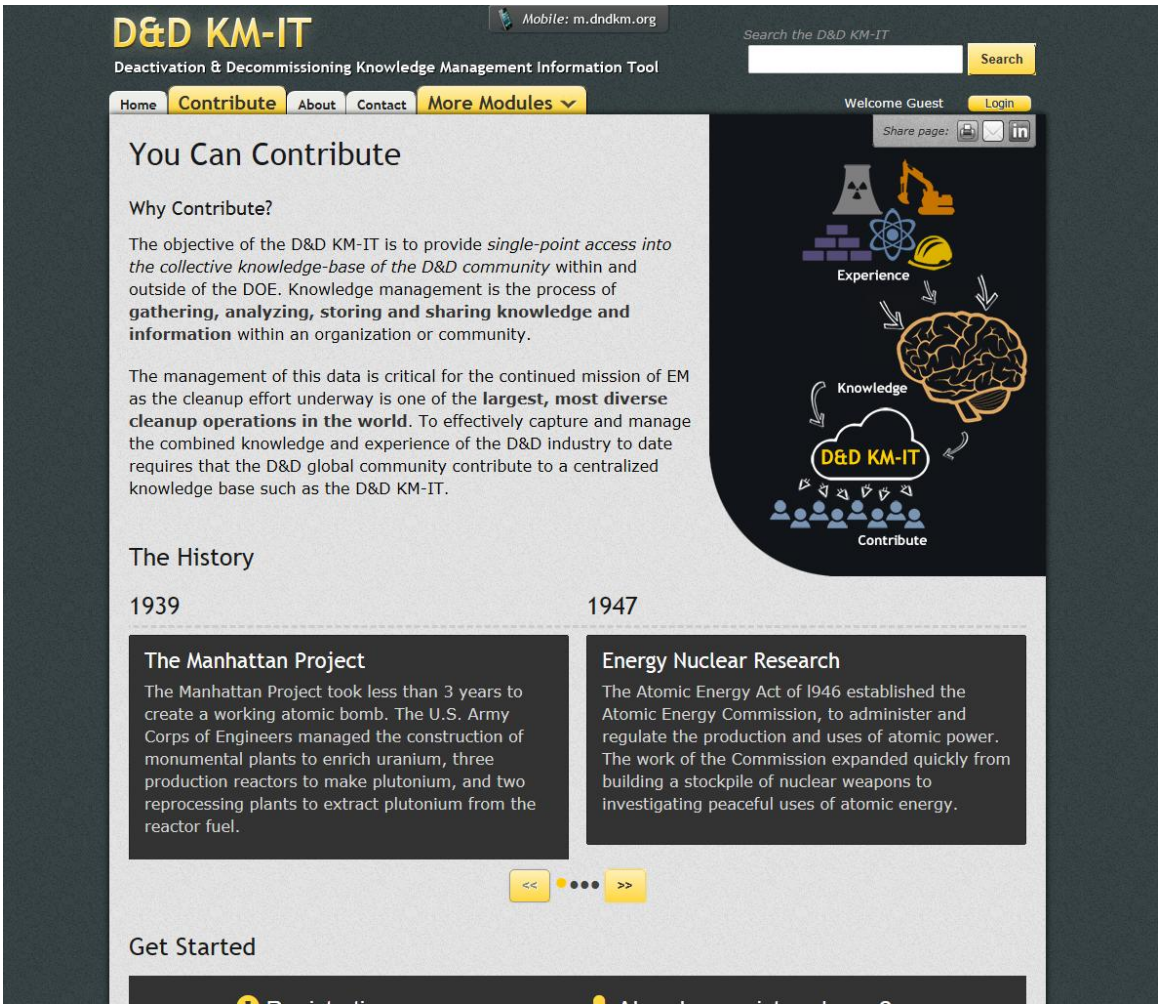

Figure 33. Community contribution module on D&D KM-IT.

Popular Content Module

FIU completed the development and deployment of the popular content module for D&D KM-IT on April 25, 2014, completing project milestone 2013-P4-M3.5. The popular content feature has been implemented on the D&D KM-IT homepage where the section "Popular Destinations" displays 3 columns with D&D Technologies, Popular Pages and Popular Problems & Solutions (Figure 34).

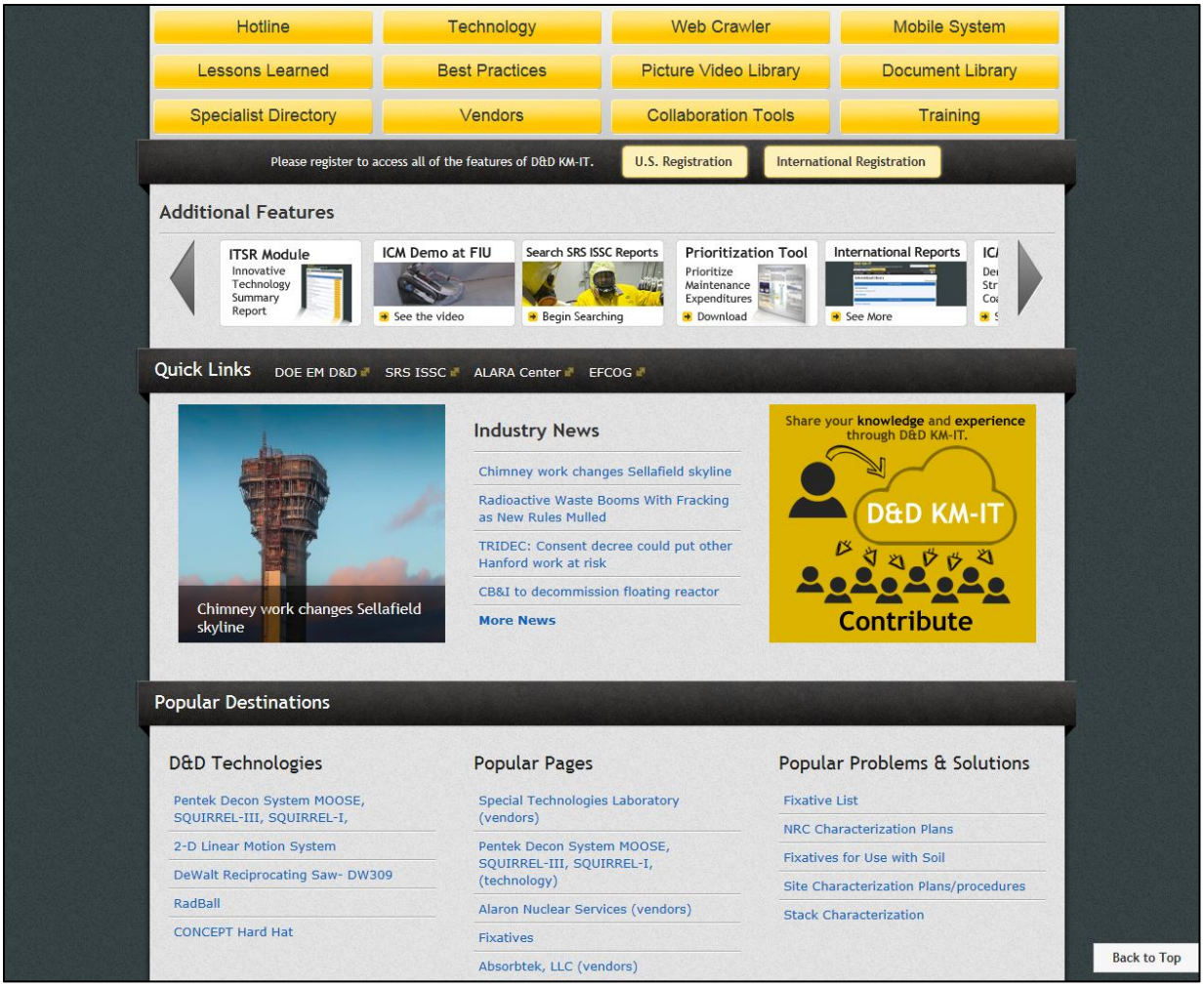

Figure 34. Screenshot of D&D KM-IT homepage showing new popular content feature.

Popular content is also displayed on the landing pages for the following modules: Hotline, Technology, Lesson Learned, Best Practices, Document Library, Specialist Directory Profile and Vendor. Figure 35 shows a screenshot of the Document Library with the popular content displayed. FIU developed a light weight and efficient internal tracking algorithm for the purpose of displaying popular & related content to the user for Technology, Hotline, and Vendor. The algorithm tracks the page views of each page in real-time and updates the database with the page information (name, URL, module and count). The algorithm categorizes visited and searched pages according to the parent module. This allows for the isolation of the pages in order to return the appropriate popular pages for each module.

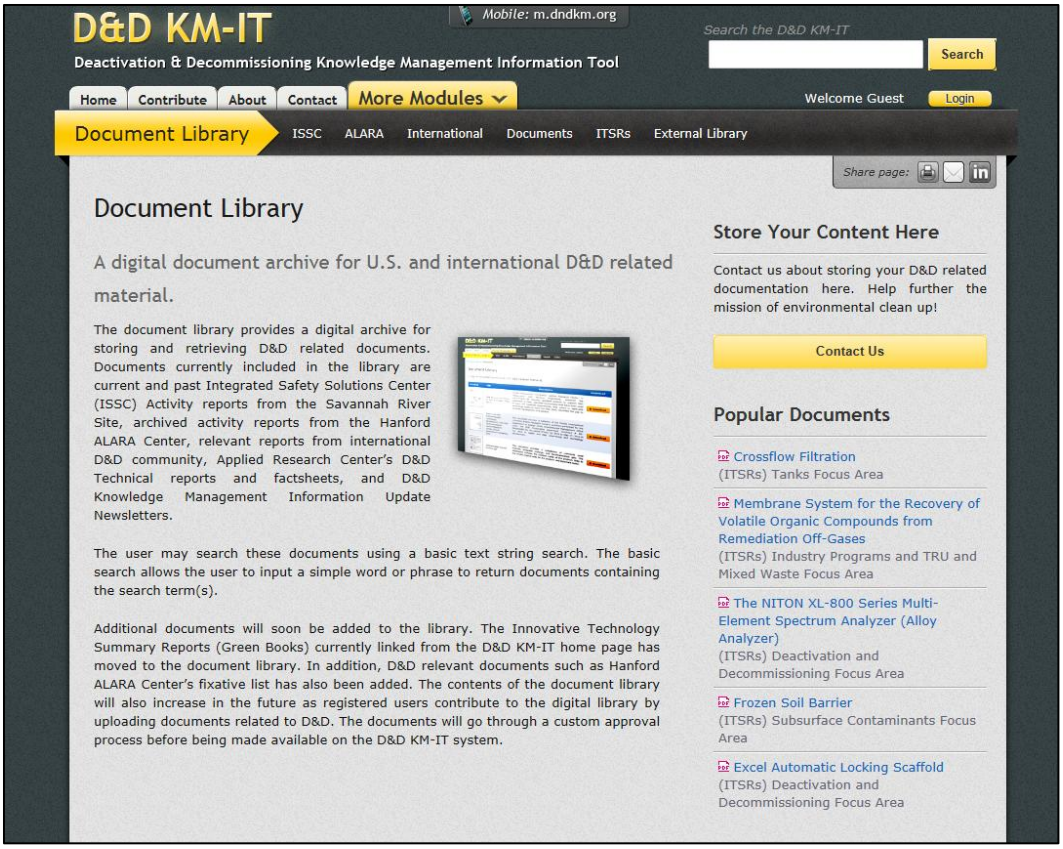

Figure 35. D&D KM-IT Document Library with popular documents displayed.

To display the popular content, a User Control was developed to render the information from the database based on the custom parameters. The result is a list of popular pages for the requested module, keywords or site wide pages. User Control displays the name of the page with the appropriate URL link in each module. A manual approach for popular content is used based on Google Analytics for PDF documents on the site where the tracking algorithm could not be implemented (i.e. Lessons Learned, Best Practices and Document Library).

The Popular Content feature will improve internal linking on D&D KM-IT. It will allows users to find related and popular content easier. As a result, it will help with retaining users on the site which ultimately could be reflected in the analytic report with increased page views, pages visited per session and average time on site.

Hotline Lite Module

FIU completed the development and deployment of the hotline lite mobile application (project milestone 2013-P4-M3.3) and sent it to DOE on February 28, 2014. The mobile system component provides access to important D&D KM-IT features through wireless devices, including iPhone (3.1 and above), iPad, Blackberry (6.0 and above), Android (2.1 and above), and Windows (7 and above) smart devices (Figure 36).

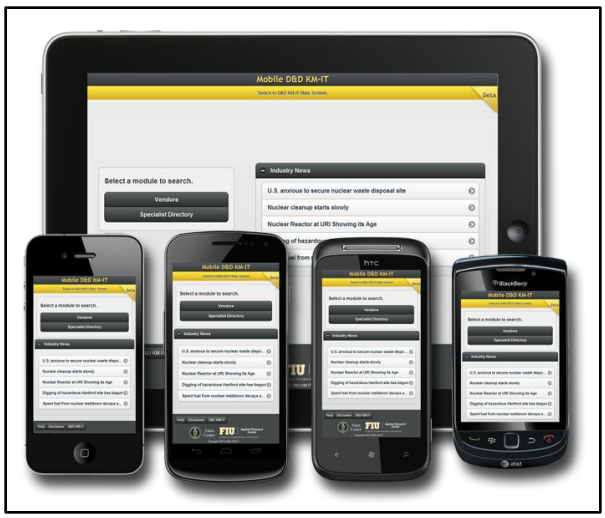

Figure 36. Wireless devices that can be used to access D&D KM-IT mobile.

External Library

FIU created a new feature on D&D KM-IT based on user feedback. An "External Library" webpage has been added to the system to direct users to external D&D web resources available (Figure 37). Based on input from system users, the links that have been added to date include:

- Department of Energy – Office of Health, Safety, And Security enforcement documents
- DOE Lessons Learned Database
- Nuclear Regulatory Commission (NRC) library

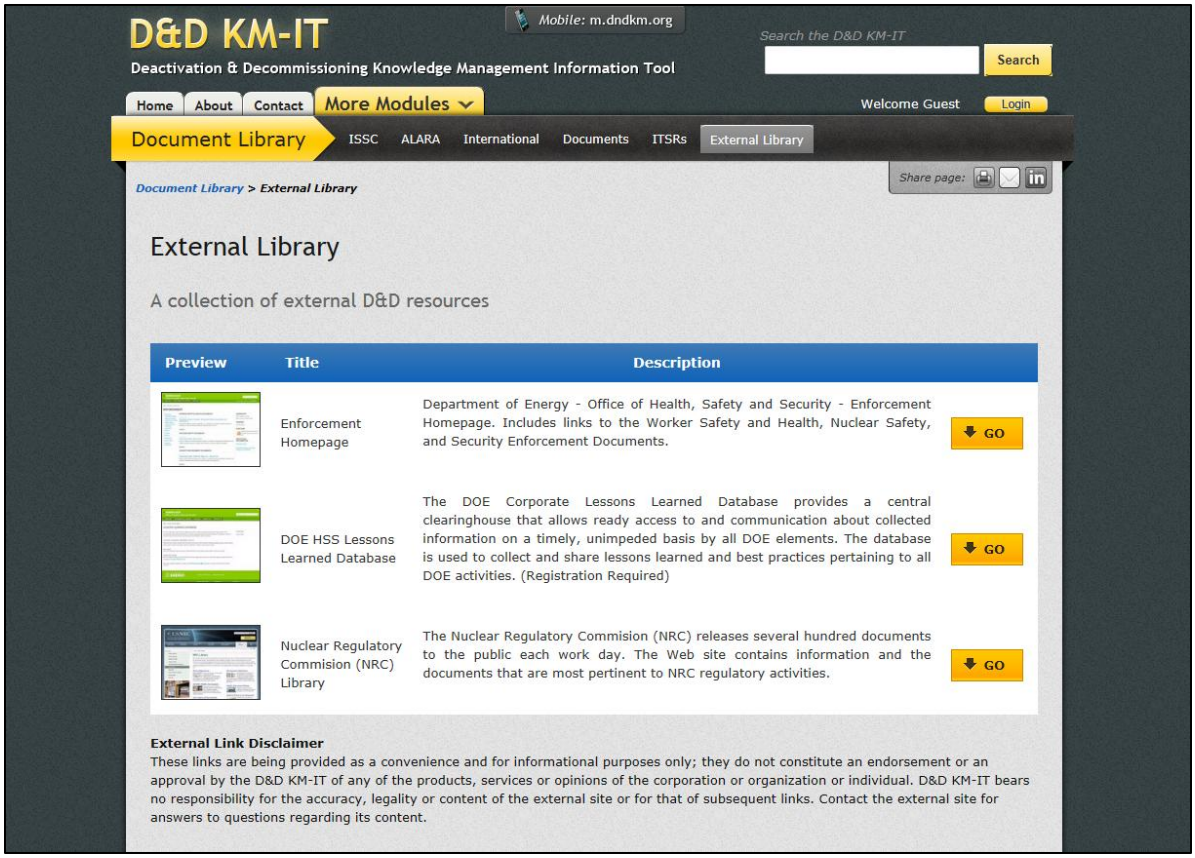

Figure 37 External library webpage is a new feature on D&D KM-IT.

Administration

System, database, and network administration are ongoing activities that FIU undertakes to maintain servers and applications to ensure a consistent high level of performance. FIU continued these efforts during this reporting period. System administration included the day-to-day maintenance and administration of the D&D KM-IT servers. Major tasks involved load balancing, active directory accounts, security patches, operating system updates, system optimization, server monitoring, and emergency problem resolution. Database administration included database backup, optimization, performance tuning, system security, controlling and monitoring user access to the database, and maintaining the database cluster. Finally, the network administration involved monitoring the network and server traffic, installing and maintaining the network hardware/software, assigning addresses to computers and devices on the network, troubleshooting network activities and performance tuning.

Data Mining

EFCOG Lessons Learned and Best Practices

One data mining task for FIU Year 4 focused on capturing the manager experience through the EFCOG points-of-contact. FIU worked with EFCOG to identify lessons learned and best practices from across the DOE complex, engaged FIU staff and DOE Fellows by working with site managers to document their experiences, facilitated a review and approval process by DOE and EFCOG, and disseminated the final documents to the DOE community by publishing them

on the EFCOG website (www.efcog.org) and the D&D Knowledge Management Information Tool (www.dndkm.org). This subtask is discussed in detail under Task 2.

Vendors and Technologies

DOE Fellows and FIU graduate students performed data management activities in order to add current and relevant data to the D&D KM-IT System. Their efforts included identifying and adding additional D&D vendors and technologies from industry journals and conference publications. The students also completed adding technologies to the technology module from the archived SRS ISSC newsletters. As of May 17, 2014, the Vendor module included a total of 664 vendors, an increase of 76 (13%) in the last year, and the Technology module included a total of 696 technologies, an increase of 108 (18%) in the last year.

Legacy Technology Videos

DOE Fellows also performed worked to convert videos showing legacy D&D technologies from VHS tapes received from DOE EM to a digital format. The videos were viewed and edited to provide brief clips that can be loaded on the Picture/Video module of D&D KM-IT for viewing and use by the D&D community. A link to view the edited videos was sent to DOE on January 31, 2014. FIU developed descriptions for 21 of the 25 videos; the remaining four videos are undergoing troubleshooting. FIU is also including links from the video descriptions to other relevant resources within D&D KM-IT (e.g., ITSRs).

TASK 3: CONCLUSIONS

Planning for the D&D of facilities across the DOE complex is a tremendous undertaking, especially considering that a significant number of the facilities contain hazards to human health and the environment: seriously deteriorated structural integrity, very high dose rates, high levels of fixed and removable contamination on/in facility surfaces and equipment, and chemically hazardous materials. Capturing the knowledge, experience, and lessons learned from historic D&D activities at DOE sites is imperative to the successful and safe management of future D&D projects. The D&D Knowledge Management and Information Tool is a central initiative to accomplish these goals.

TASK 3: REFERENCES

D&D Knowledge Management Information Tool (D&D KM-IT), www.dndkm.org, Applied Research Center, Florida International University.

Florida International University, *D&D Knowledge Management through Contributions in Wikipedia*, Summary Report, May 9, 2014.

Phillips, J., *Leveraging Wikipedia and Wiki-Based Technologies – Significance to D&D Knowledge Management*, Rev. 1.2, White Paper, Applied Research Center, Florida International University, November 2011.

Quintero, W., *Web Analytics Narrative Report for D&D KM-IT: Third Quarter 2013 (July 1 to Sept 30, 2013)*, Applied Research Center, Florida International University, October 2013.

Quintero, W., *Web Analytics Narrative Report for D&D KM-IT: Fourth Quarter 2013 (Oct 1 to Dec 31, 2013)*, Applied Research Center, Florida International University, February 2014.

Quintero, W., *Web Analytics Narrative Report for D&D KM-IT: First Quarter 2014 (Jan 1 to March 31, 2014)*, Applied Research Center, Florida International University, May 2014.

Upadhyay, H., L. Lagos, W. Quintero, P. Shoffner, J. De Gregory. *Knowledge Management Information Tool - 2014*, Waste Management 2014 Conference, Phoenix, AZ, March 2014.

TASK 4. CENTRALIZED KNOWLEDGE BASE SYSTEM AND FIU-DOE RESEARCH WEBSITE

TASK 4: EXECUTIVE SUMMARY

This task consisted of the development of two tools for easy retrieval of the research work FIU performs for DOE EM. The first was a simple interface developed to illustrate the connection between all the independent applications or systems developed for DOE EM under different projects. The second was a DOE Research website to capture and make available all the resulting research, reports, publications developed under the Cooperative Agreement.

TASK 4: INTRODUCTION

This was a new task under Project 4 for FIU Year 4. The centralized knowledge base system and FIU-DOE research website serve to capture and make easily available the work that FIU performs for DOE under the FIU-DOE Cooperative Agreement. These virtual tools function as a point-of-access for easy retrieval by the users.

TASK 4: EXPERIMENTAL

The objective of this task was to centralize the virtual systems that FIU uses to capture and make available the work they perform for DOE under the FIU-DOE Cooperative Agreement. Under this task, FIU created two centralized virtual systems: 1) a centralized system to connect all the knowledge management base work under the FIU-DOE Cooperative Agreement, and 2) the DOE Research website to capture and make available all the resulting research, reports, publications developed under the Cooperative Agreement.

TASK 4: RESULTS AND DISCUSSION

FIU completed the design of a single web page for linking all the IT applications developed for EM. The link was sent to DOE for review on November 27, 2013 (milestone 2013-P4-M4.1). This simple interface was developed to illustrate the connection between all the independent applications or systems developed for DOE EM under different projects (Figure 38).

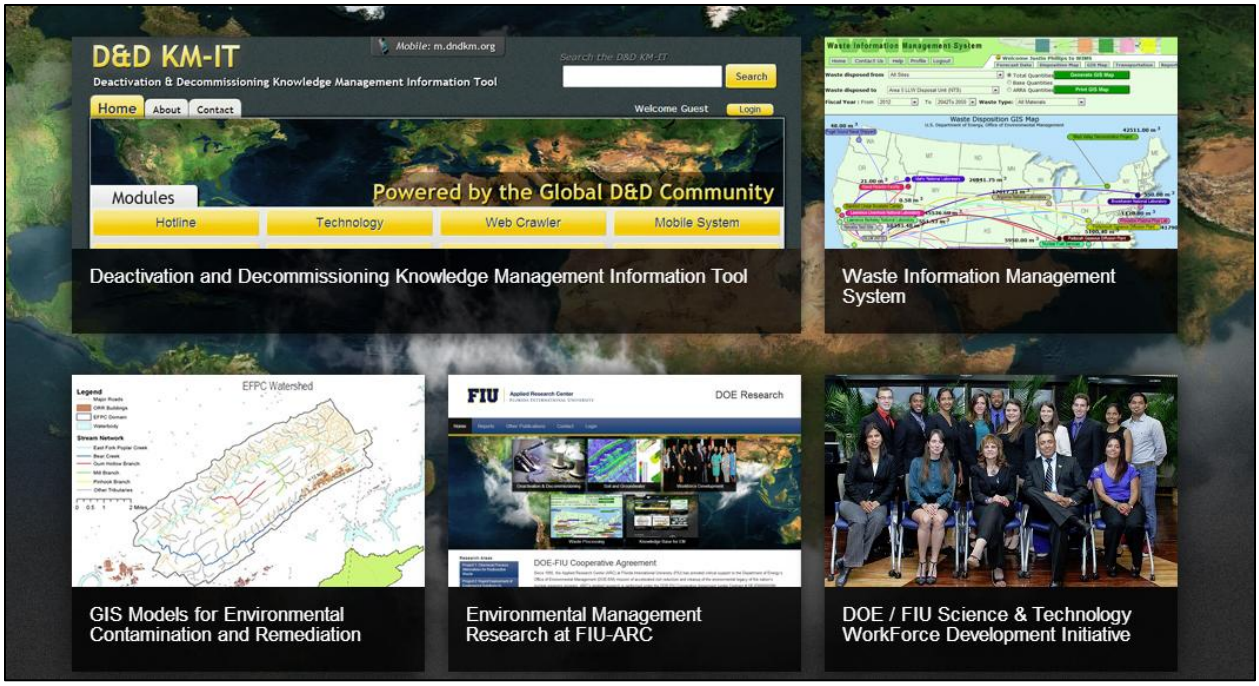

Figure 38. Centralized Knowledge Base Interface.

FIU also developed and deployed the DOE Research website (www.doeresearch.fiu.edu) to provide a centralized location for the research information developed under the Cooperative Agreement (milestone 2013-P4-M4.2). Figure 39 shows a screenshot of the DOE Research webpage. The DOE Research website is available at www.doeresearch.fiu.edu and includes technical reports, quarterly progress reports, end of year reports, presentations, journal articles, conference papers, and more. The DOE Research webpage is updated on a continual basis with the most recent research documents. The DOE Research webpage was used to host the presentations for the FIU Mid-Year Review meetings which were held during the week of February 24, for convenient download by the meeting participants. The posters and presentations that were presented at Waste Management 2014 by ARC staff, students, and DOE Fellows were also posted to the DOE Research website.

Figure 39. DOE-FIU Cooperative Agreement Research Webpage.

TASK 5. CYBER SECURITY COMPLIANCE AND DEPLOYMENT OF ENVIRONMENTAL CONTAMINATION AND REMEDIATION MODELS

TASK 5: EXECUTIVE SUMMARY

Under this new task for FIU Year 4, FIU published and deployed one environmental contamination and remediation model, developed under Project 3, through a secured platform.

TASK 5: INTRODUCTION

During FY2008-2012, FIU developed integrated flow and transport models of East Fork Poplar Creak (EFPC), Upper EFPC (Y-12 NSC) and White Oak Creek (WOC) watersheds for Oak Ridge, TN. In addition, a variable density model which was developed by site contractors for the Moab Site was used by FIU to provide simulations of several scenarios related to creating a hydraulic barrier between the mine tailings stored at the site and ecologically sensitive areas of the Colorado River. These models currently reside on servers and personal computers at the Applied Research Center at FIU in Miami. This task published and deployed one of these models on a secured platform to improve access to the models by project stakeholders.

TASK 5: EXPERIMENTAL

In this task, FIU publish and deploy an environmental contamination and remediation model over the web using ArcGIS (Geographic Information System) platform and framework for stakeholders. The GIS servers, applications and databases to host these models were deployed in the secure infrastructure facility developed for D&D KM-IT at FIU.

IT team worked with subject matter experts at ARC to develop a Geo database for hydrological modeling work being performed at DOE EM sites, providing access to data generated from simulation of contaminants. This information was published over the web using ArcGIS platform. ArcGIS system was deployed in a secured infrastructure at FIU for stake holders to view the model over the web and take advantage of research work performed at ARC.

TASK 5: RESULTS AND DISCUSSION

FIU began this task by researching the requirements related to deploying an environmental contamination and remediation model from a server/personal computer onto the secured platform. FIU also worked on the preliminary design for the web interface for this feature (Figure 40).

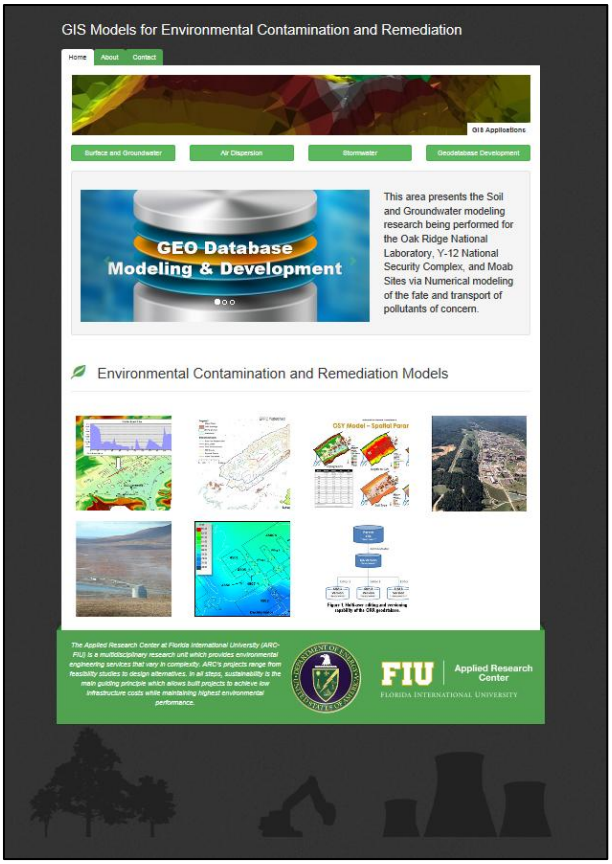

Figure 40. Web interface for the environmental contamination and remediation model.

FIU upgraded the ArcGIS software to the latest version and migrated the geodatabase to a secure server in order to implement some of the security protocols being investigated. FIU also investigated the programming/scripting necessary for customization of the web viewers for visualization of project data and to determine how to implement the necessary security protocols.

FIU completed the deployment of an environmental contamination and remediation model from a server/personal computer onto the secured platform. The completed milestone, 2013-P4-M5.1, was sent via link to the website (http://131.94.112.150) to DOE for review/testing on May 16, 2014.

The current system capabilities include:

- Ability to share GIS models through websites accessible from desktop computer and mobile devices.
- Common GIS functionality such as zoom, hiding of layers, selecting of layers for field analysis, etc.
- Ability to pan, zoom by rectangle and arbitrarily zoom around the map.
- Ability to show raster data overlaid on the map.
- Print functionality.

A website was created that displays an interactive map that users can view (Figure 41). The website uses ESRI's JavaScript API to create a map object from the web service created and using the map information.

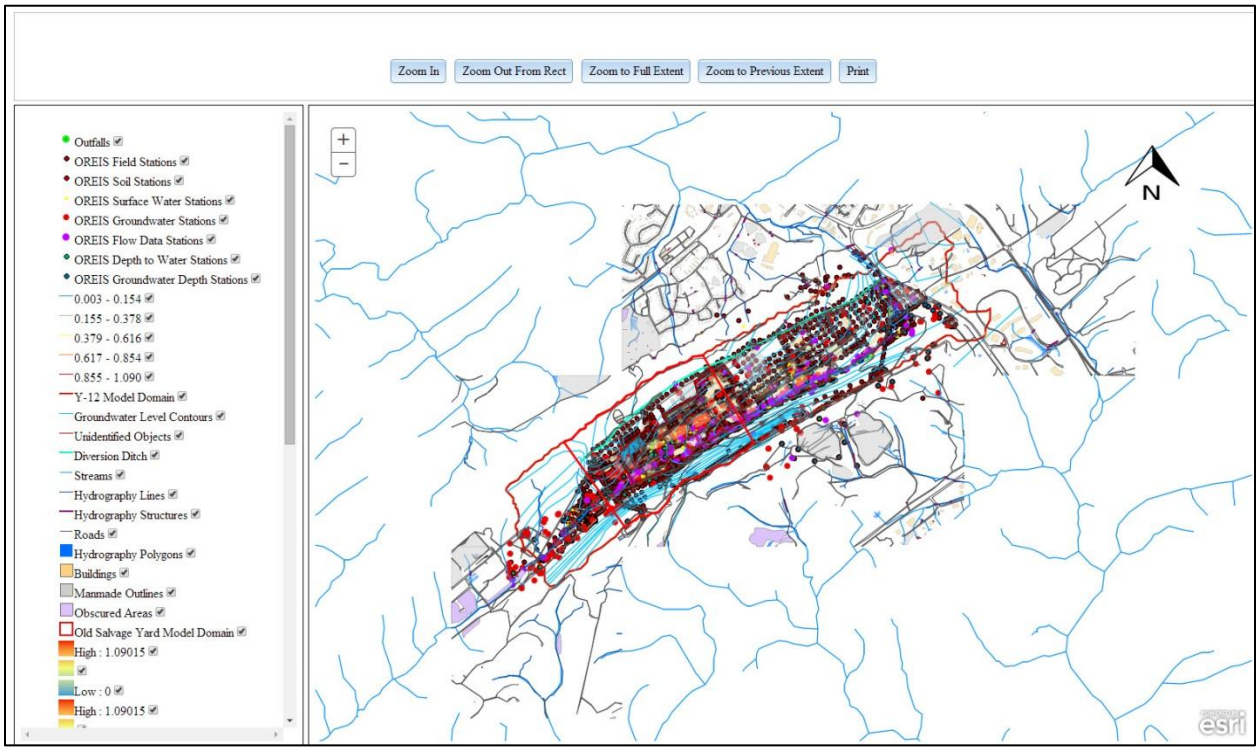

Figure 41. Interactive GIS map.

A map legend was also created to inform the user what the different geometries on the map represent. This functionality also uses JavaScript to retrieve the different map layer information from the web service and manipulates the web page to visually display this information to the user. Another feature added to the website is the ability to toggle different map layers on and off using checkboxes in the legend. Large maps can be crowded with many different layers and points of data, therefore the layer toggle feature allows the user to view meaningful layers of information and omit irrelevant data crowding the map. Zooming and panning are also features implemented on the map allowing users to move and pan to any location within the map object.

OVERALL PROJECT CONCLUSIONS

WIMS continues to successfully accomplish the goals and objectives set forth by DOE for this project. WIMS has replaced the historic process of each DOE site gathering, organizing, and reporting their waste forecast information utilizing different database and display technologies. In addition, WIMS meets DOE's objective to have the complex-wide waste forecast information available to all stakeholders and the public in one easy-to-navigate system. The enhancements to WIMS made over the last year include annual updated data sets.

The D&D support work for this period of performance included the research of contamination control products for the SRS 235F facility, research of aging infrastructure across the DOE complex, as well as D&D support to EFCOG through the development of D&D lessons learned and best practices. These activities provide DOE with the information necessary to complete D&D safely and effectively for facilities which contain hazards that prevent the use of safe manual techniques; enhance safety while reducing risk to workers, the public, and the environment; reduce the future cost, schedule, and risk for similar work through a thorough understanding of existing technologies and technical approaches from past D&D projects, and provide the tools necessary to successfully complete difficult D&D tasks that can then be applied complex-wide to similar DOE facilities.

Planning for the D&D of facilities across the DOE complex is a tremendous undertaking. Capturing the knowledge, experience, and lessons learned from historic D&D activities at DOE sites is imperative to the successful and safe management of future D&D projects. The DOE D&D Support task and the D&D KM-IT are two central initiatives to accomplish these goals and FIU has made significant contributions towards developing these tools. The D&D KM-IT system was developed by FIU in collaboration with DOE (EM20), EFCOG, and the former ALARA Center at Hanford and former ISSC at Savannah River. The D&D KM-IT system is ultimately a tool for and by the D&D community. Its success will be dependent on the participation and cooperation of those for whom it was designed. FIU will continue to work closely with DOE, EFCOG, and the D&D community to ensure that the KM-IT system meets their needs for accurate and timely D&D information.

While the centralized knowledge base provided a simple interface to illustrate the connection between all the independent applications or systems developed for DOE EM under different projects, the DOE Research Website provides a centralized location for all the research information developed under the Cooperative Agreement (DOE Research Website) in order for stakeholders to conveniently and efficiently retrieve research documents developed by FIU for EM. In addition, the benefits of publishing and deploying environmental contamination and remediation models include making the remediation models more easily assessable to the stakeholders and providing a secure platform from which to deploy the models over the web.

APPENDIX

The following reports are available at the DOE Research website for the Cooperative Agreement between the U.S. Department of Energy Office of Environmental Management and the Applied Research Center at Florida International University: http://doeresearch.fiu.edu

1. Florida International University, *Focused Literature Review – Decontamination Agents/Materials for Radiological Surface Decontamination*, Technical Report, September 2013.
2. Florida International University, *Aging Infrastructure at DOE Sites*, Technical Report, May 2014.
3. Florida International University, *D&D Knowledge Management through Contributions in Wikipedia*, Summary Report, May 9, 2014.
4. Quintero, W., *Web Analytics Narrative Report for D&D KM-IT: Third Quarter 2013 (July 1 to Sept 30, 2013)*, Applied Research Center, Florida International University, October 2013.
5. Quintero, W., *Web Analytics Narrative Report for D&D KM-IT: Fourth Quarter 2013 (Oct 1 to Dec 31, 2013)*, Applied Research Center, Florida International University, February 2014.
6. Quintero, W., *Web Analytics Narrative Report for D&D KM-IT: First Quarter 2014 (Jan 1 to March 31, 2014)*, Applied Research Center, Florida International University, May 2014.
7. Florida International University, *Project Technical Plan*, Project 4: Waste and D&D Engineering and Technology Development, October 2013.

The following best practices were finalized during FIU Year 4 and the first one is available for download from the D&D Knowledge Management Information Tool website: https://www.dndkm.org/BestPractices/SearchBestPractices.aspx?Query=All. Publication of the second one is on hold, pending project site contact agreement to publish.

1. Closure of the Reactor Maintenance, Assembly, and Disassembly Facility and the Pluto Disassembly Facility at the Nevada National Security Site
2. Radiological Contamination Event During Demolition of the Separations Process Research Unit (SPRU) Building H2