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LARGE SCALE DEMONSTRATION PROJECT AT ARGONNE NATIONAL LABORATORY'S CP-5 REACTOR

Edward C. Wiese and Robert W. Rose
Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL 60439

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Edward C. Wiese
Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL 60439
(630) 252-7983

Robert W. Rose
Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL 60439
(630) 252-8671

ABSTRACT

The world's largest environmental cleanup effort continues to be focused on the Department of Energy (DOE) complex. The significant technical and economic concerns associated with this effort underscore the need for crucial cost-effective technologies and management approaches.

I. INTRODUCTION

The objective of the Large-Scale Demonstration Project (LSDP) was to select and demonstrate potentially beneficial technologies at the Argonne National Laboratory-East (ANL-E) Chicago Pile-5 (CP-5) Research Reactor. The LSDP demonstrated that by using innovative and improved decontamination and decommissioning (D&D) technologies from various sources, significant benefits could be achieved when compared to baseline D&D technologies. Technologies were chosen by a Technology Selection Committee (TSC) which was comprised of representatives from industry, academia, and a national laboratory. The committee evaluated numerous technologies and chose those which met project standards and were applicable for demonstration at CP-5.

II. STRATEGIC ALLIANCE MEMBERS

The members of the Strategic Alliance (SA) consisted of Argonne National Laboratory (ANL), Commonwealth Edison, Duke Engineering and Services (DE&S), Florida International University (FIU), ICF Kaiser, and 3M.

III. PURPOSE

The Strategic Alliance for Environmental Restoration under the direction of DOE-Chicago conducted the LSDP at the CP-5 Research Reactor. Effort was made to qualify technologies for commercialization and subsequent use within the DOE complex and private industry.

The purpose of the CP-5 LSDP was to evaluate and select innovative, "field test ready" D&D technologies, demonstrate those technologies in a large scale demonstration environment, and compare the results against existing commercial technologies with the intent of showing that significant benefits can be achieved through the utilization of enhanced D&D technologies or to verify that specific existing technology practices are the most cost effective.

The CP-5 LSDP demonstrated D&D technologies at the ANL facility to not only benefit on-going CP-5 project D&D activities, but also broader DOE Complex and commercial sector needs. The SA selected, prioritized, demonstrated, and evaluated technologies against established project baselines. Technology performance was documented to qualify the technologies for commercialization and future use within the DOE Complex.

IV. FUNDING

Initial funding for the LSDP was facilitated through a Basic Ordering Agreement between ANL and DE&S. DE&S placed subcontracts with Strategic Alliance members and technology vendors, as appropriate. Long-term funding was facilitated through a Cooperative

Agreement between DOE-Chicago and the Strategic Alliance. DE&S acted as the contract administrator on behalf of the Strategic Alliance.

V. AREAS OF RESPONSIBILITIES

A board of directors was responsible for facilitating corporate commitment and oversight. Membership was comprised of a single representative from each SA participant.

Overall project management and project control activities for the SA were the responsibilities of both DE&S and ANL. DE&S, with SA member support, was responsible for preparing subcontracts with SA members, issuing the project management plan, conducting project review meetings, preparing status reports, technical task plans, and providing overall project direction. ANL was responsible for developing and maintaining the revised schedule and cost baseline for CP-5 D&D and the LSDP project, providing on-site interfacing with CP-5 D&D project personnel and SA support personnel.

DE&S was chosen as the Alliance Administrator and was responsible for providing adequate resources and staffing for the project management of the LSDP.

The Technology Selection Committee (TSC) was responsible for selecting and evaluating technologies demonstrated at the CP-5 facility. This committee was comprised of one representative from each member of the SA. The TSC used the criteria and methodology contained in the "Technology Selection and Demonstration Process: procedure dated January 1996" to evaluate candidate technologies and propose those which had a high probability for demonstration at the CP-5 facility.

The US Army Corps of Engineers (USACE) was assigned the lead responsibility for the collection and analysis of all cost information related to the Innovative Technology Summary Report (ITSR) preparation by Federal Energy Technology Center (FETC). Since this organization was not a member of the SA it was necessary to provide an interface to ensure that the needs of the SA were met. ICF Kaiser was designated as the coordinator for information collection as it related to cross technology comparisons and cost data required by the USACE.

VI. CHICAGO PILE 5 RESEARCH REACTOR

The CP-5 reactor was a heterogeneous, heavy water cooled and moderated, enriched-uranium fueled, thermal neutron reactor designed to provide neutrons for research. CP-5 first achieved criticality in February 1954 and operated for twenty-five years. After eighteen years of cool down, CP-5 contains significant activation and contamination problems representative of a nuclear facility. However, the activation and contamination levels are not so high as to cause undue safety concerns during the inevitable manual operations necessary for full scale demonstrations. The CP-5 facility had many of the essential features of other nuclear facilities in the DOE Complex and could be utilized as a demonstration facility for the future D&D of much larger, more highly contaminated nuclear facilities. A detailed D&D baseline had been developed for the CP-5 D&D project and initial work was completed to remove numerous non-nuclear system components from CP-5. The detailed baseline provided the required information to determine the selection of technology insertion points on the D&D LSDP, and to facilitate the assessment of impacts of applied technologies relative to the existing baseline for extrapolation to future D&D projects.

VII. LARGE SCALE TECHNOLOGY DEMONSTRATIONS

Demonstrations were conducted in four areas; characterization, decontamination, dismantlement, and worker health & safety. The demonstrations evaluated the technology with respect to the baseline in the areas of effectiveness and quality of results; speed and responsiveness; safety; mobilization and demobilization; support requirements; ergonomics; waste generation; readiness status; and cost.

The characterization demonstrations evaluated pipe and surface characterization type technologies. The pipe characterization demonstrations compared methods for characterization of embedded piping to the baseline technology of excavating, dismantling, and surveying. Surface characterization techniques were compared with manual characterization using hand-held instruments with manual recording of data and the need to send samples off-site for analysis.

The decontamination technologies evaluated coating removal and concrete cleaning methods as well as liquid decontamination. Coating removal technologies were compared with the baseline of scabbling while liquid decontamination was compared with shipping the water in tanks to an on-site evaporator facility for treatment,

and the use of mobile treatment filtration and selective ion exchange treatment to remove cesium and cobalt.

The dismantlement technologies demonstrated improved tools and robotics. Improved tools compared the technology with the unimproved model and robotics compared the baseline of manual entry and tool handling to perform the required task.

Worker health & safety demonstrations compared the personal protective equipment of coveralls made with innovative materials to the baseline coverall created of Tyvek® material. Analysis of the coveralls examined the suits ability to protect the worker, donning and doffing ease, the fit of the suit, and waste generation. Workers commented on the suits in the areas of comfort, feel against the skin, heat generation, perspiration rate, and durability of the suit.

VIII. CONCLUSION

The CP-5 LSDP demonstrated D&D technologies at the ANL facility to not only benefit on-going CP-5 project D&D activities, but also broader DOE Complex and commercial sector needs. The LSDP was created to integrate technology demonstrations with management approaches to support the on going EM-40 funded D&D of CP-5. DOE-Chicago managed this demonstration under the Strategic Alliance. This alliance selected, prioritized, demonstrated, and evaluated technologies against established project baselines. Technology performance was documented to qualify the technologies for commercialization.

Each technology demonstrated had a one-page Demonstration Fact Sheet prepared on the technology and the results of the demonstration. These fact sheets provided a brief summary of the technology and demonstration results. A detailed Innovative Technology Summary Report (ITSR) was prepared on each demonstration which provided details on the technology, the demonstration performance and applications, cost, regulatory policies, and lessons learned. The Fact Sheets and ITSRs were sent to a DOE targeted mailing distribution.

Upon completion of the LSDP, twenty-two technologies had been demonstrated in four different areas. The characterization demonstrations were divided into two parts, pipe and surface characterizations. The pipe characterization demonstrations showcased two technologies. Both technologies performed better than the baseline technology in the areas of effectiveness, safety, cost, and ease of use. Both technologies surveyed the entire length of pipe without removing the pipe from the installed position which the baseline technology could not perform. Both technologies are being considered for future D&D work at ANL-E.

The second part of the characterization demonstrations showcased four surface characterization technologies. All four technologies had visual data displays, minimized personnel exposures, and were easy to operate. Three of the technologies provided automatic data collection with visual data displays. Two of the technologies were less than the baseline cost and two were currently higher than the baseline cost. As the equipment is further developed, the higher costs should come more in-line with the baseline costs.

The decontamination technologies were divided into two areas; concrete coating removal and liquid decontamination. The first area, concrete coating removal, compared seven technologies with the baseline technology. Results of the demonstration were inconclusive for two of the technologies and no further analysis was completed for them. Three of the technologies were less expensive and two were more expensive than the baseline technology. Four of the technologies reduced airborne activity during operations making it safer for the operators than the baseline technology. All five of the technologies were easy to use and reduced operator fatigue. Two of the technologies are being considered for future D&D work at ANL-E.

The second area of decontamination, liquid decontamination, compared one technology to the baseline technology. The new technology was less expensive than the baseline, easier to install and operate, and requires less operator attention. The new technology was a prototype scale model and is still being developed for future use.

The dismantlement technologies concentrated on two areas, improved tools and robotics. The improved tools area demonstrated one new technology and compared it to the baseline tool. The improved tool was faster and more responsive than the baseline. Reliability was equal to the baseline tool. The improved tool reduces the operator skill level required for equivalent operation.

The second area of dismantlement, robotics, compared three technologies to the baseline technology. Worker safety is greatly increased by the robotics due to fewer personnel incursions into the contaminated work

area. One of the technologies was much faster than the baseline and the other two technologies were faster for some tasks and slower for other tasks. One of the technologies is commercially available and was much less expensive than the baseline technology. The other two technologies were prototype machines and direct cost comparisons were not available.

The fourth area of demonstrations, Worker Health and Safety, compared two innovative protective clothing technologies to the baseline technology. The two innovative materials were equally effective in protecting the workers and both were relatively comfortable and easy to use. The two innovative materials were strong and did not tear easily when snagged. The two innovative material technologies had sealed seams that made them waterproof which was an improvement over the baseline technology, but both were more expensive. The higher costs may be off-set under certain work conditions. Both technologies are commercially available.

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